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Master Thesis

Factors Influencing the Adoption of Demand Responsive Transit Service (DRTS) and a Discussion on Willingness to Pay - A Case Study of Taitung City and Luye Township in Taiwan

影響需求反應式運輸服務(DRTS)接受度之因素及願 付價格探討-以台東市及鹿野鄉為例

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ABSTRACT

Demand Responsive Transit Service (DRTS) is a concept that differs from traditional mass transit systems. It is characterized by greater flexibility in scheduling and routes to meet the diverse needs of the public better. DRTS is considered a solution to address deficiencies in public transportation services. This study analyzes data obtained from an aging rural area in Taitung County, Taiwan. The goal is to identify the key service factors that residents in this area would prioritize and the willingness to pay. Contrary to existing literature, this study reveals that residents in the research area show a higher emphasis on accessibility and boarding convenience. Additionally, the unemployed population shows a greater concern for DRTS services. The findings indicate a consensus in the region for an accessible and barrier-free DRTS service.

This study also investigates the reasonable fare for future DRTS in Luye Township, Taitung County. The results indicate that most people are willing to pay a higher fare than the current bus service to enjoy more convenient services. Additionally, respondents are willing to pay the highest additional costs for DRTS if the bus type changes to small-sized buses and reduces walking time to the bus stations.

Keywords: DRTS, OLOGIT, Transport policy, Rural transportation management, Willingness to pay

摘要

需求反應式運輸服務(DRTS)是一種不同於傳統公共交通系統的概念。 此種新型態大眾運輸服務不論是在班次安排上或路線安排上,皆具有比傳 統大眾運輸更大的靈活性,以更好地满足公眾出行的多樣化需求。根據文 獻回顧結果可以發現,DRTS 被許多專家學者視為解決偏鄉公共交通服務 不足的一種解決方案。本研究之主要研究範圍為台東縣鹿野鄉,並使用紙 本問卷為主、線上問卷為輔的調查方式分析當地居民及生活圈包含鹿野鄉 之民眾對於DRTS 服務因素的重視程度及願付價格,研究目的是探討該地 區居民優先考慮的關鍵服務因素以及支付意願。

經問卷數據分析,當地民眾對於 DRTS 服務因素重視程度的結果與現 有文獻相反,先前的研究表明旅客重視的服務因素主要為與時間相關之服 務因素,而本研究發現,此研究區域的居民重視之服務因素為可及性和上 下車便利性。此外,失業者、第一產業從業人員以及持有機車駕照的旅客 對 DRTS 服務表現出高度的關注。研究結果顯示,該地區因目前公路客運 服務範圍涵蓋率不足的問題,使當地民眾對於可及性更高並且提供身心障 礙者及戶服務的 DRTS 抱有高度期待。

本研究亦調查了台東縣鹿野鄉未來 DRTS 的合理票價。結果表明,大 多數人願意支付比現有巴士服務更高的票價,以享受更便捷的服務。此外, 受訪者表示,如果巴士類型更改為小型巴士並縮短步行至巴士站的時間, 他們願意支付最高的額外費用。

關鍵字:需求反應式運輸服務、有序羅吉特模型、運輸政策、偏鄉交通、 願付價格

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CHAPTER 1 INTRODUCTION

1.1 Research Background and Motivation

In recent years, the government has tried to create a green, high-quality, and sustainable public transportation system in Taiwan. Due to geographical and industrial development factors, certain remote regions in Taiwan have a dispersed population settlement pattern, posing challenges to efficient public transportation operations. This situation has resulted in an inability to meet the travel needs of the population in these remote areas. To enhance the accessibility of public transportation in rural regions, the Highway Bureau, and Ministry of Transportation and Communications (MOTC) have actively initiated the Demand Responsive Transit Service (DRTS) project since 2016. This project is a policy initiative aimed at enhancing the quality of public transportation services. It seeks to promote efficient and diverse subsidy schemes to improve connectivity by shuttling passengers to various transfer stations. The goal is to enhance the convenience of transfers and ensure that residents in remote areas can also access public transportation services. Currently, DRTS routes have been established in remote areas of 21 cities nationwide to enhance public transportation coverage in rural regions continually.

By 2025, Taiwan will become a super-aged society, meaning that one fifth of the population will be aged 65 or above. As a result, providing convenient public transportation for the elderly and people with limited mobility has become an urgent issue. As Taiwan's population structure shifts towards an aging society, ensuring convenient access to public transportation for elders and mobilityimpaired individuals has become increasingly important. For instance, Southern east of Taiwan, Taitung County, the Taitung City, and Luye Township have significant populations holding disability certificates and elderly residents. According to the statistics from the Ministry of Health and Welfare's Disability Statistics Division for the fourth quarter of 2023, Taitung City has a population of 7,453 individuals with disability certificates, accounting for 7.13% of the total city population. Similarly, Luye Township has 655 individuals with disability certificates, making up around 9.04% of the township's total population. According to the population statistics from the Taitung County Household Registration Office in January 2024, there are 18,841 elderly individuals (aged 65 and above) in Taitung City, constituting 18% of the city's population. Additionally, based on the Guanshan Household Registration Office statistics, Luye Township has 1,730 elderly individuals, representing 24% of the township's population. The following are pie charts depicting the population distribution in Taitung City and Luye Township, based on statistics from the National Population Database, categorized into three age groups: 0-14 years, 15-64 years, and 65 years and above.



Source: National Population Database



Figure 1-1 Age distribution of the population in Taitung City



Figure 1-2 Age distribution of the population in Luye Township

Given the statistical data, both Taitung City and Luye Township have a considerable proportion of individuals with disabilities and elderly residents. These inhabitants typically require assistance when going outdoors and have higher medical needs. Consequently, providing a comprehensive public transportation services to facilitate medical-related requirements has become of utmost importance.

Based on the provided data above, Luye Township has a significant population of elders and individuals who hold disability certificates and require medical care, but without DRTS services available. For residents with medical needs and treatments, accessibility to these facilities is crucial. They may encounter substantial transportation difficulties due to the absence of specialized transport services tailored to their demands. This situation could pose significant challenges to the health and quality of life of the residents in the region.

1.1.1 The Current Status of DRTS in Taitung County

Table 1-2 shows the administrative regions in Taitung County where DRTS services, including "Happiness Bus" and "Happiness Taxi," are currently operating. The "Happiness Bus" is a flexible rural transportation solution to address issues such as narrow roads, sparse population, and lack of bus services in certain remote areas. It is planned, applied for, operated, and managed by township and city hall, which act as the role of passenger transport operators. The concept of "Happiness Taxis" involves taxi companies operating certain bus routes, with the flexibility to add driving routes as needed. The operation follows

fixed schedules and routes, supplemented by flexible reservation services.

Operational Mode	Happiness Bus	Happiness Taxi
Vehicle type	9 or 18-seater bus	Taxi
Route	Fixed	Flexible
Frequency	Fixed schedules	Fixed schedules and Reservation
Reservation system	Available	Available
Operator	Township and city hall	Taxi operators

Table 1-1 Comparison of the happiness bus and happiness taxi



Administrative Region	DRTS Service	Number of Routes
Taitung City	Happiness Taxi	1
Chenggong Township	Happiness Taxi	1
Daren Township	Happiness Bus	9
Donghe Township	Happiness Bus	3
Jinfeng Township	Happiness Bus	4
Changbin Township	Happiness Bus	4
Chishang Township	Happiness Bus	3
Dawu Township	Happiness Bus	3
Haiduan Township	Happiness Bus	3
Lanyu Township	Happiness Bus	2
Guanshan Township	Happiness Bus	3
Yanping Township	Happiness Taxi	4
Beinan Township	Happiness Bus	1
Taimali Township	Happiness Bus	1
Luye Township	No DRTS Service	0
Green Island Township	No DRTS Service	0

Table 1-2 DRTS service in Taitung County

Based on the information in Table 1-2, Taitung County has a total of 16 townships and cities. Among them, only Luye Township, Taimali Township, and Green Island Township have no DRTS services.

Source: Highway Bureau, and Ministry of Transportation and Communications



Figure 1-3 The administrative regions without DRTS service

The upcoming DRTS service will operate under two distinct modes: one for the public who can board at bus stops, and the other for residents with less disabled mobility who require door-to-door service. This program is set to commence soon, and this initiative aims to compare the differences in mode choice among the public before and after the implementation of this DRTS service.

1.2 Research Objectives

This study aims to investigate the key determinants of DRTS importance and to understand the willingness to pay for using DRTS. Therefore, the objectives of this research are as follows:

1. Assessing Key Service Factors: Investigating the primary factors

influencing individual choices to use DRTS services, such as service coverage, vehicle types, operating hours, etc., to understand which elements are crucial in attracting users and enhancing their satisfaction.

2. Analyzing Willingness to Pay: Understanding how much passengers are willing to pay for DRTS service is beneficial for determining appropriate fare prices, enhancing passenger satisfaction, and comprehending the different levels of price sensitivity among various types of passengers.

3. Providing Policy and Planning Recommendations: Based on the analysis of demand factors and willingness to pay, offering suggestions to the government and service providers for enhancing DRTS services and establishing reasonable fare structures. This aims to meet the transportation needs of rural residents, promote public transportation development, and ensure effective mobility solutions.

1.3 Research Area and Limitations

1. The research area of this study is focused on Luye Township, Taitung County, where there is currently no operation of DRTS. The aim is to investigate the factors that residents in rural areas prioritize when it intent to implement DRTS. The research area of this study is illustrated in Figure 1-4, the red line represents the current main bus route, while the orange circles indicate the future operating area of the DRTS. In Taitung City, the coverage area is primarily within a radius of 2 kilometers from the Taitung Bus Station. In Luye Township, it mainly covers the western part of the Beinan River. The one-way journey driving from Taitung City to Luye Township takes approximately 40-50 minutes, which illustrates the urge demand for DRTS.

2. The limitation of this study is the homogeneity in the population structure within the selected research area. The age distribution of the population in this region may not be evenly balanced, which could constrain the generalizability of the research findings, especially regarding their applicability to the middle-aged population.



Figure 1-4 The primary research area of this study

1.4 Research Process and Flow Chart

The research flow chart of this study is illustrated in Figure 1-5. Firstly, the research motivation, objectives, and scope are defined. A literature review is conducted to comprehend the essential DRTS factors and willingness to pay among the public. Subsequently, a questionnaire survey is carried out targeting residents of Taitung City and Luye Township. This survey aims to compile passengers' most crucial service factors and determine their willingness to pay for the service. The study is divided into two phases: in the first phase, the stated preference (SP) survey is applied to understand the significant factors affecting passengers' willingness to use the service and their satisfaction. In the second phase, an appropriate pricing method will be employed to determine the willingness to pay of residents in Taitung City and Luye Township for using DRTS.





Figure 1-5 Research flowchart

CHAPTER 2 LITERATURE REVIEW

This chapter is divided into four sections. Firstly, it reviews the literature concerning the success or failure of DRTS cases including its background, development, and key factors. Following that, people of various age groups and the variables used in previous literature surveys explored the service factors valued. Finally, a literature review on studies related to willingness to pay is summarized.

2.1 Introduction to DRTS Services

2.1.1 Origin and Development of DRTS

DRTS is not a recent innovation confined to the twenty-first century; its proto-type can be traced back much earlier. Scholarly research on DRTS has been conducted for several decades. Initially, the focus of the research was on how to communicate travel needs to local public transportation providers via telephone (Guenther, 1971; Gustafson *et al.*, 1973; Roos *et al.*, 1971). The inaugural documented experiment took place in 1916, specifically in Atlantic City. This initial DRTS initiative involved a jitney service that catered to the public, operating along a predetermined route while picking up and dropping off passengers based on their needs (Coutinho *et al.*, 2020). At that time, this concept, primarily driven by passenger demand, was referred to as DRTS. As early as the 1960s, the UK introduced flexible public transport experimental routes, telephone reservation services, and the operation of community cars and buses to improve rural transportation (Jack, 1961). Flexi-route, dial-a-ride, and

community car and bus schemes have been introduced since the 1960s (Nutley, 1988).

Imhof and Blättler (2023) indicated public transportation operators in sparsely populated areas encounter challenges due to low service frequency and unattractive service availability. Due to rural depopulation and uneven distribution, public transportation faces the challenge of increased transportation costs per passenger due to insufficient demand (O'Shaughnessy *et al.*, 2011). Bar-Yosef *et al.* (2013) believe that rural public transportation may face a vicious cycle of reduced service due to low demand. While residents of rural and urban areas should have equal mobility rights, the cost of providing mobility services in rural areas is significantly higher (Ehlert *et al.*, 2019; Pucher & Renne, 2005; Shergold & Parkhurst, 2012).

To address these problems, the DRTS concept has garnered interest from operators and researchers. DRTS aim to enhance rural transportation by providing higher accessibility compared to traditional fixed-route bus services. They offer flexibility and responsiveness to passengers' needs, allowing customized routes and schedules based on demand. This adaptability overcomes the limitations of fixed-route services in sparsely populated regions. Therefore, DRTS is often used to address the public transportation challenges brought about by population decline (Takeuchi *et al.*, 2003). Sörensen *et al.* (2021) argued that rural areas face the challenges of decline and aging. Public transportation operators in these regions are faced with the predicament of increased transportation costs per passenger due to reduced demand. To meet the residents'

mobility needs, the DRTS concept has been introduced in rural areas. DRTS is commonly proposed as a solution to address issues arising from aging populations or decreasing population trends. Given its higher flexibility, DRTS can contribute to reducing private car usage in rural areas and enhancing the willingness to travel among individuals with limited mobility or elderly citizens.

2.1.2 Challenges in DRTS Operation

According to the research by Currie and Fournier (2020) operating DRTS is not an easy task, indicates that operating DRTS is highly prone to failure and it often relies on government subsidies to sustain operations (Schwarzlose et al., 2014; Wang et al., 2015; White, 2015). Around 50% of businesses have operational lifetimes of less than 7 years, which among of them, 40% have lifetimes of less than 3 years, and approximately a quarter experience failure within 2 years. Wang et al. (2023) presented potential reasons for both the success and failure of DRTS: one of the issues is that, unlike public transportation services, DRTS systems often provide high-quality transportation tailored to passengers with similar travel needs. This leads to higher operating costs. If these systems cannot maintain a sufficient level of passenger volume, it can result in a survival challenge for DRTS systems. The authors believe that both unsuccessful instances and successful systems demonstrate that the feasibility of DRTS services varies across different types of human settlements. In previous studies, three key factors have been identified as significantly impacting the willingness to use and the number of passengers in DRTS. These factors are area-related attributes (geographical location, population density),

service characteristics (operating hours, service area coverage, and vehicle types), and individual/household characteristics (Davison *et al.*, 2012; Wang *et al.*, 2013; Wang *et al.*, 2021).

Inturri *et al.* (2021) mentioned that DRTS has been proposed as a potential solution to address this gap in public transportation and analyze when it is most appropriate to use DRTS services to reduce the rate of DRTS failure. The authors used an Agent-Based Modeling (ABM) approach for simulation and compared it with taxi services. The research findings revealed how significant efficiency is for transportation services, which is influenced by the level of demand and the size of the vehicle fleet. When the demand is low, taxi services outperform DRTS services in terms of efficiency. However, in cases of high demand, DRTS services demonstrate higher efficiency. Furthermore, the efficiency of DRTS services is closely related to fleet size and the number of seats. Increasing the number of vehicles can reduce the overall cost of service and improve passenger satisfaction. Lastly, the choice of route selection strategy also impacts service performance.

In summary, the study suggests that factors such as demand volume, fleet size, the number of seats in a vehicle, and route selection strategy have a substantial impact on service efficiency. These findings contribute to the better formulation of transportation policies and decisions in various urban and demand contexts.



Source: Taxi vs. demand responsive shared transport systems: An agent-based simulation approach

Figure 2-1 DRTS vehicle and taxi dynamics

2.2 Key Determinants for DRTS Service

Avermann and Schlüter (2019) conducted a study on DRTS in Südniedersachsen, Germany, utilized an ordered logit model (OLOGIT) to examine factors influencing satisfaction with the DRTS. The OLOGIT model evaluates how independent variables impact a dependent variable with multiple ordered categories. The investigation included factors like waiting time, ease of entry (boarding convenience, service availability, reservation ease), age, car ownership, and other guests. Findings indicated that longer waiting times are linked to lower satisfaction. Improved ease of entry showed a strong positive correlation with higher satisfaction. Older respondents tended to be more satisfied. However, car ownership had a negative impact on satisfaction, particularly among car owners. Alonso-González *et al.* (2020) also found that the value of time and the punctuality of the service schedule have consistently been a determining factor in whether people are willing to use DRTS, in addition, transfers and longer travel times are also believed to have a negative impact on users, making them reluctant to accept DRTS (Te Morsche *et al.*, 2019).

A similar study was conducted by Morton *et al.* (2016), which investigated public perceptions of service quality in public transport in Scotland. This study similarly aimed to assess the impact of various factors on passenger satisfaction, bus users expressing their perceived satisfaction using a five-point Likert scale. The investigated service quality in the study includes convenience (being on time, frequency, reliability), cabin environment (cleanliness, comfort, safety), and ease of use (transfer convenience, information openness, fare affordability). The research indicates male respondents have relatively higher expectations for the cabin environment (comfort and cleanliness), while females prioritize safety aspects. In terms of personal economic status, retired respondents exhibit higher satisfaction levels with service quality compared to homemakers. Across overall personal income, higher-income respondents express lower satisfaction regarding the convenience of bus usage. Concerning Educational level, individuals with a university degree are less satisfied with the convenience of bus usage.

While the mentioned studies surveyed diverse age groups and

socioeconomic backgrounds, Kersting *et al.* (2021b) specifically investigated potential differences in satisfaction with DRTS between elderly and non-elderly passengers, in central Germany. The survey items encompassed travel purpose, age, occupation, car ownership, and waiting time. Additionally, passengers' overall satisfaction with EcoBus was assessed using a Likert scale. The satisfaction analysis reveals positive attitudes towards the DRTS across all age groups. This could be due to the service's high comfort and quality, addressing concerns important to the elderly like accessibility and door-to-door convenience. Jittrapirom *et al.* (2019) conducted a comprehensive study focusing on the key factors influencing the significance of DRTS among elderly passengers. The outcomes of this study revealed elderly individuals placed the highest importance on the proximity of their homes to the nearest DRTS station. Additionally, they highly valued aspects such as the attitude of service providers, waiting times, and the reliability of the service.

Schasché *et al.* (2022) conducted a systematic literature review on DRTS, investigating the factors influencing user acceptance of DRTS. The authors believe that the influencing factors can be categorized into individual factors and service-related factors. After analyzing 44 research papers related to DRTS, the authors concluded that individual factors could influence the acceptance of DRTS. For instance, lower income correlates with higher demand for public transport and DRTS. People with higher incomes usually consider travel time to be more important. Moreover, lower car ownership is associated with higher acceptance of DRTS. Among service-related factors, waiting time, travel time,

and travel costs significantly impact passengers' overall satisfaction and acceptance of DRTS.

2.3 Public Transportation Fare Elasticity

According to Guzman *et al.* (2021), research on price elasticity has proven highly effective in predicting changes in passenger volume, revenue, and policy planning associated with variations in fares or transportation service supply. Additionally, in developing countries, compared to developed nations, there are often more challenges related to public transportation supply. Simple fare interventions might not be sufficient to increase ridership significantly. Therefore, interventions might be more required in terms of public transportation supply and integration. Differentiated pricing should also be designed for peak and offpeak hours, with subsidies during off-peak hours potentially shifting some trips away from peak hours. Similar findings are supported by the research of Sianturi et al. (2022), which reveals that the elasticity of demand concerning fare is not very high. However, demand elasticity varies across different periods within a day. Passengers tend to have higher elasticity during off-peak hours, while during morning or afternoon peak hours, elasticity is relatively lower. Due to the relatively low elasticity of demand regarding fares Tscharaktschiew and Hirte (2012), adjusting fares alone might not effectively attract more passengers to public transportation. Therefore, raising peak-hour fares and enhancing public transportation integration should be considered to increase convenience and incentivize people to switch from private vehicles to public transportation.

The above two studies only focused on the fare elasticity of individual

transportation modes. However, Wardman (2022) considered the elasticity of different modes of transportation, travel purposes, distances, and both short-term and long-term factors. Regarding fares, there are significant differences in elasticity between cars and railways, especially for leisure trips by car, where fare changes may have a larger impact on demand. Changes in fares have a smaller impact on railway passengers, reflecting differences in market characteristics and user behavior between different transportation modes. Furthermore, the cross-elasticity between different fare categories within railways is lower, meaning that changes in fares of one fare type have a limited impact on the demand for other fare types. This may suggest a certain degree of price stability among different fare types, and fare changes have a limited effect on the demand for other fare types. Additionally, in long-term studies, it was observed that the price elasticity of different transportation modes did not show a clear trend or variation over time. This result may imply that the sensitivity of transportation demand to prices remains relatively stable over the long term and is not significantly influenced by time.

Similarly, Ho (2020) considered various modes of transportation, trip lengths, different times of the day, and weekends versus weekdays were considered. The results showed that the demand for public transportation was not very sensitive to price changes. Regarding trip distance, it was observed that as travel distance increased, the sensitivity of public transportation demand to price also increased. When considering weekend travel compared to weekdays, the elasticity values were lower across all distance categories. The author suggested that the determinant of elasticity levels is the availability of alternative modes of transportation. People who have more choices in terms of alternative transportation modes and travel times tend to be more sensitive to price changes.

The study by Kholodov et al. (2021) considered different socioeconomic statuses (such as car ownership and income) and modes of public transportation (subway, train, and bus) while deriving specific price elasticity values. They also considered regional variations in residential areas. The study found that individuals who frequently use a particular mode of transportation were more sensitive to fare changes. Additionally, users' sensitivity to fares increased as the travel distance grew longer. Among different public transportation modes, subway users exhibited the lowest sensitivity to fare changes, while passengers commuting by train showed the highest sensitivity. Groups with lower socioeconomic factors, including lower income, lower socioeconomic indices, and lower car ownership rates, displayed lower sensitivity to fares than those with higher socioeconomic factors. The elasticity estimates in this study reflected short-term changes in travel behavior, with an expectation that long-term fare elasticity would be higher. The research suggested that implementing a uniform fare scheme could reduce geographical disparities in public transportation travel. However, when considering the implementation of such a scheme, it is essential to consider the geographical characteristics of the region, the level of public transportation service, and the policy planning of the local government.

2.4 Public Transportation Willingness to Pay

Public authorities worldwide heavily subsidize public transportation to

offset the gap between fare revenue and operating costs (Tscharaktschiew & Hirte, 2012). Public transportation subsidies bridge the gap between operating costs and revenue (Bly *et al.*, 1980). According to Parry and Small (2009), The subsidy range for bus operating costs is between 57% and 89%. From this, it can be inferred that the government largely subsidizes public transportation operating costs, and the willingness to pay for public transportation is relatively low, resulting in a gap between fare revenue and actual operating costs.

According to Brough *et al.* (2022), the overall willingness to pay for public transportation users is relatively low. Several cities, including Seattle, Boston, Los Angeles, Salt Lake City, and Denver, are even considering free-of-charge for some low-income individuals (Hess, 2020). Additionally, the willingness to pay is also influenced by factors related to public transportation services, for example, accessibility, which is primarily measured by walking distance (Delbosc & Currie, 2011). There is an increasing amount of literature exploring the relationship between accessibility and willingness to pay(Liu & Kwan, 2020).

The actual public transportation fares that people are willing to pay depending on the country, region, and mode of transportation. Ho *et al.* (2018) found that the average willingness to pay for unlimited access to public transportation per day in Sydney, Australia is 5.90 Australian dollars (3.9 USD). Feneri *et al.* (2022) investigated the monthly willingness to pay for unlimited access to public transportation in Zurich, Switzerland. According to the survey results, residents' willingness to pay for public transportation is approximately 120.2 Swiss francs (121 USD). Gilibert *et al.* (2020) investigated a trial operation of DRTS conducted in Barcelona, Spain, where the willingness to pay of the local population for this service was collected. According to the survey, the local residents' willingness to pay was approximately 3.50 euros (3.77 USD). Nyga *et al.* (2020) conducted in Lower Saxony, Germany, focusing on a local DRTS service (Eco Bus), where a willingness to pay survey was conducted. The results revealed that the local population's willingness to pay was 4.21 euros (4.54 USD).

2.5 Summary

After the reviews above, the compilation of critical factors influencing DRTS are presented in Table 2-1. Based on the previous literature, we can observe that the variables used can be broadly categorized into the following groups: Household Characteristics (Vehicle Ownership, Number of Cohabitants), Travel Characteristics (Trip Purpose, Waiting Time, Comfort, Accessibility), and Socioeconomic Characteristics (Age, Gender, Working Conditions, Educational level, Income). According to the literature review, waiting time is a significant influencing variable. This study will investigate the three key factors among the target population to delve deeper into the demand and usage patterns of DRTS services among the public.

The study also examined fare elasticity and willingness to pay. Fare elasticity research plays a crucial role in predicting passenger volume and revenue. However, more than simple fare adjustments may be required to attract more passengers. Additionally, fare elasticity varies during different periods. Therefore, to increase public transportation usage, considering raising fares during peak hours and expanding public transportation options becomes
necessary. These research findings provide relevant recommendations regarding

fare policies and transportation planning.

		Considered Variables	lered Variables		
Literature	Methodology	Household Characteristics	Travel Characteristics	Socioeconomic Characteristics	
Avermann and Schlüter (2019)	Ordinal Logistic Regression Analysis (OLOGIT)	*Vehicle Ownership	*Waiting Time *Boarding Convenience *Service Availability *Reservation Convenience	*Age	
Morton <i>et</i> <i>al</i> . (2016)	Exploratory Factor Analysis (EFA) Confirmatory Factor Analysis (CFA) Regression Analysis	副로	*Cabin Environment *On-Time Performance *Frequency *Transfer Convenience *Fare *Reliability	* Age *Gender * Working Conditions *Educational level *Income	
Kersting <i>et al.</i> (2021)	Pearson Correlation Analysis Monte Carlo Approach	*Vehicle Ownership	*Trip Purpose *Waiting Time *Comfort *Accessibility	* Age * Working Conditions	
Jittrapirom <i>et al.</i> (2019)	Expert Interviews Face-to-face Survey Online Survey	*Number of Cohabitants	*Trip Purpose *Convenience *Cleanliness *Information Accuracy *Reservation Convenience *Waiting Time *Driver's Attitude	* Age *Gender * Working Conditions	
Schasché <i>et al.</i> (2022)	Literature Review Method	*Vehicle Ownership	*Waiting Time *Travel Time *Travel Cost	*Income	

Table 2-1	Factors	influencing	DRTS
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(Source: compiled by this study)

CHAPTER 3 METHODOLOGY

This study aims to gather information through a questionnaire survey to understand the DRTS factors that resident of Taitung City and Luye Township value, as well as their willingness to pay.

3.1 Ordered Logit Model

In terms of questionnaire data collection, this study employs the Likert fivepoint scale, where respondents are asked to select from a scale of five levels ranking from "not important at all" to "very important," in order to investigate the factors related to DRTS that passengers prioritize. The Likert scale is a commonly used rating format designed to gauge participants' level of agreement with a particular issue or statement (Cheng *et al.*, 2021). According to Likert (1932), the final result is typically obtained by summing or averaging each item's scores.

The main reason for using the Likert scale in conjunction with the Ordered Logit Model is that the Likert scale can capture the ordered nature of respondents' preferences for different options. At the same time, the Ordered Logit Model is suitable for analyzing ordered categorical dependent variables, allowing for more accurate analysis and interpretation of respondents' ordered preferences for DRTS factors. The ordered logit model evolved from the binary logistic regression model (Long & Freese, 2006). The development of the ordered logit model was driven by the need to address the modeling requirements of ordered categorical dependent variables. Traditional binary logistic regression models

were not well-suited to handle situations with a clear and meaningful order among the dependent variable categories. Therefore, the ordered logit model was introduced to better capture this ordered nature of the data, providing more accurate representation of real-world research scenarios. This model has found widespread application in various fields where ordered categorical variables are common. The general form of the ordered logit model is as follows:

$$logit[P(Y \le i|X)] = \ln\left[\frac{P(Y \le i|X)}{1 - P(Y \le i|X)}\right]$$
(1)

This mathematical function is used to predict the probability that the dependent variable Y takes on a value less than or equal to i, given the independent variable X. The independent variables X represent different considered variables, such as household characteristics (vehicle ownership), travel characteristics (waiting time, travel time, travel cost, comfort, frequency, boarding convenience, reservation convenience, accessibility, transfer convenience), and socioeconomic characteristics (age, gender, Educational level, job occupations, income). The dependent variable Y represents the evaluation or importance that individuals attribute to DRTS service factors. In this study, it is represented using ordered categories, such as from "not important at all" to "very important." While *i* represents different levels of evaluation, ranging from "not important at all" (i = 1) to "very important" (i = n). Therefore, the objective of the model is to investigate the probability of individuals selecting each level of evaluation under different independent variable conditions.

An alternative expression to represent the general form of the ordered logit

model as follows:

$$logit[P(Y \le i|X)] = \beta_{0i} + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_m X_m$$
(2)

 β_{0i} represents the intercept parameter for each ordered category, with each *i* corresponding to an ordered category of the dependent variable *Y*. β_1 , β_2 , ..., β_m are regression coefficients, with each coefficient corresponding to an independent variable $(X_1, X_2, ..., X_m)$. When the respective independent variable increases by one unit, these coefficients represent the change in the log odds of belonging to the specific ordered category *i* or lower. In other words, the regression coefficients indicate the impact of independent variables on different ordered categories.

When conducting ordered logit model, it is typically necessary to consider the following key conditions:

1. Dependent Variable: The dependent variable should be ordered and have a clear level or ordinal relationship. This means that there is an inherent order among different levels of the dependent variable, such as "dissatisfied," "somewhat satisfied," and "satisfied."

2. Independent Variables: Studies usually involve one or more independent variables, which can be quantitative or qualitative.

3. Independence of Observations: It is assumed that observations are independent of each other, meaning that one observation's outcome does not influence another's. This assumption is typically reasonable in data collection and analysis. 4. Absence of Multicollinearity: Independent variables should not exhibit high correlations with each other to maintain model stability.

5. Parallelism Test: The slopes (or log odds) between different levels of the dependent variable in the model should be parallel. This implies that the effect of independent variables on different levels of the dependent variable should be consistent.

These conditions provide the basic framework for conducting ordered multinomial logistic regression analysis. However, specific circumstances may vary depending on the nature of the study and the data. In practical research, it is essential to validate and meet these conditions based on the specific context.

3.2 Payment Card (PC) Approach

According to Breidert *et al.* (2006), willingness to pay (WTP) refers to the maximum price that consumers are willing to pay for a particular good or service, reflecting the value of that good or service to the consumers. In general, as the quantity of the purchased goods increases, the willingness to pay usually decreases, and this phenomenon can be observed on the demand curve, and this concept is associated with consumer surplus. Typically, for most goods or services, their prices are determined through transactions in the open market. However, in some cases, especially for non-market goods such as tourism resources and environmental resources, their value cannot be directly determined by market prices. Therefore, it is necessary to use some non-market valuation methods to estimate the willingness to pay price, expressed in terms of the

monetary amount people are willing to pay.

Bateman *et al.* (1995) argued that the core concept of the Contingent Valuation Method (CVM) is to assess the social value of an environmental policy or project through questionnaire surveys, especially when these values cannot be determined through market prices. This method is particularly suitable for research on willingness to pay. The contingent valuation method has four pricing methods, including:

1. Open-ended bidding method: the open-ended bidding method is used in contingent valuation studies to assess individuals' willingness to pay for goods or services that lack market prices. It involves asking respondents to specify how much they are willing to pay for a particular item without predefined options. While it allows free expression of willingness to pay, the diverse responses often require further analysis to extract meaningful insights.

2. Sequential bids method: this pricing method is typically used to simulate or explore potential real-world transactions rather than actual market transactions. In this approach, researchers usually set a price range and initiate with an initial price for respondents. Subsequently, respondents are asked if they are willing to accept that price. If they agree to pay, the price increases; if they decline to pay, the price decreases, until the researcher can no longer raise the respondent's willingness to pay. This method aims to determine the maximum price a respondent is willing to pay. However, this method also has shortcomings, such as requiring a significant amount of time, the way questions are presented and the range of prices set may influence respondents' answers. 3. PC approach: the PC approach is a commonly used pricing method in contingent valuation studies to estimate individuals' willingness to pay for goods or services. Researchers prepare payment cards based on referenced information, with each card displaying different price options under varying circumstances. Each card features a different price, and respondents can select one card, with the price marked on it representing their willingness to pay the highest amount for the respective good or service. This approach is particularly useful when assessing non-market goods or services for which market prices do not exist.

4. Close-ended bidding method: close-ended bidding is a method used to assess respondents' willingness to pay for a particular product or service. In this approach, surveyors predefine multiple sets of different payment amounts on the questionnaire and randomly select one set to present to the respondents. Respondents are then asked whether they are willing to accept the presented price without the need to consider specific price figures. However, this method comes with several defects, participants are required to choose from predetermined price options, which limits the range of prices. This can lead to a limited range of prices, and participants' responses may tend to converge, potentially resulting in bias in the outcomes. This method may not fully reflect real-market scenarios. Additionally, because the options are pre-designed, participants' choices may not reflect their true preferences.

The PC approach was developed by (Mitchell & Carson, 1981). This approach offers several advantages when surveying individuals' willingness to pay. Firstly, it is characterized by its ease of understanding and operation, requiring no complex calculations or decision-making. Additionally, the approach presents respondents with multiple payment options, ranging from low to high amounts. This enables respondents to make comparisons among these options to determine the amount they are most willing to pay. Respondents can choose the amount they are willing to pay in a manner like a real shopping scenario. Furthermore, the PC approach is particularly suitable for assessing the value of non-market goods or services that typically lack market prices for reference.

Donaldson *et al.* (1997) found that comparing the PC approach with the Open-ended (OE) method, respondents are more inclined to answer payment card questions. Additionally, using the PC approach results in more consistent mean and median values, as well as a stronger correlation between willingness to pay and the ability to pay. These findings suggested that the PC approach may be more advantageous in assessing respondents' willingness to pay for specific goods or services in certain situations. Furthermore, due to the advantages of the PC approach, it is widely applied in the fields of transportation planning, environmental economics (natural resource valuation), natural disaster risk management measures, healthcare, and willingness to pay studies related to educational services.

In summary, this study selected the payment card approach as the pricing method for several reasons. Firstly, it is very easy to understand and user-friendly, allowing survey participants to easily engage in the survey. Secondly, it offers multiple pricing options, enabling respondents to choose the amount that best aligns with their willingness to pay. This reflects real-world scenarios where individuals often need to compare various choices. Additionally, the PC approach has a proven track record of successful application in various fields. Importantly, given that DRTS services typically lack market price references, this method is particularly well-suited for assessing the value of non-market goods or services, providing valuable insights into respondents' willingness to pay.

3.3 Model Estimation and Testing

The basic concept of Maximum Likelihood Estimation (MLE) involves considering all possible combinations, assessing the likelihood of the model generating the observed data, comparing different parameter combinations, and ultimately finding the model that best explains the observed data. This process aims to identify the most suitable model parameters. This process can be carried out using the log-likelihood function, with the formula as follows:

$$\hat{P} = \frac{\Sigma_{i=1}^{n} x_{i}}{n} \tag{3}$$

 \widehat{P} : the sample mean.

n: the number of observations in the sample.

 x_i : each individual observation.

 Σ : summation across all *i*, implying the summation of all individual observations.

When assessing the fitness for the Ordered Logit Model, the Likelihood-

Ratio Index is a commonly used indicator. The formula is listed as follows:

$$\rho^2 = 1 - LL^* / LL(0) \tag{4}$$

 ρ^2 : the Likelihood-Ratio Index.

LL^{*}: the log-likelihood function value at the point of model convergence.

LL(0): the log-likelihood function value for the null model.

The value of ρ^2 is between 0 and 1, with a higher value indicating better explanatory power and higher goodness of fit for the model. If the likelihood ratio index reaches 0.4, it signifies that the model's explanatory capacity has achieved a considerable degree (凌瑞賢, 2004).

3.4 Questionnaire Design

This questionnaire is designed to gain insights into public opinions regarding DRTS service. The questionnaire is divided into three main sections. The first section focuses on demographic and socioeconomic characteristics. The second section assesses the importance of various service factors. The third section investigates the willingness to pay for specific aspects of the service. Below, explanations are provided for each section of the questionnaire. Please refer to the appendix for the detailed questionnaire content.

1. The first section of this questionnaire is the personal socioeconomic variables for the respondents include age, gender, Educational level, job occupations, income (per month), and vehicle ownership. The complete list of questions can be found in Table 3-1.

Variables	Question types	Question descriptions
Age	Multiple choice question	Options unit year: Under 18 × 19-25 × 26-35 × 36-45 × 46-55 × 56-64 × 65-70 × 71-80 × 81-90 × Above 91
Gender	Multiple choice question	Options: Male Female
Educational level	Multiple choice question	Options: No-educational · Elementary school or below · Junior high · Senior high · College · Graduate school or above
Place of residence	Multiple choice question	Options: Taitung County · Beinan Township · Luye Township · Yanping Township · Guanshan Township · Chishang Township · Other
Job occupation	Multiple choice question	Options: Student, Military/Public servant, Healthcare worker, Service industry, Secondary industry, Finance/Insurance industry, Secondary industry, First industry, Self-employed, Unemployed, Homemaker, Other
Income (per month)	Multiple choice question	Options: No income, Below 20,000 NTD, 20,000-40,000 NTD, 40,000-60,000 NTD, 60,000-80,000 NTD, 80,000-100,000 NTD, Above 100,000 NTD
Car and motorcycle licenses ownership	Multiple choice question	Options: Car and motorcycle licenses ownership 、 Only possesses a car license 、 Only possesses a motorcycle license 、 Do not have a car or motorcycle license
Vehicle ownership	Short answer question	Enter the number of cars and motorcycles in your household.
Frequency of using public transportation (per week)	Multiple choice question	Options: Less than once a week \ 1-3 times per week \ 4-6 times per week \ 7-9 times per week \ More than10 times per week

Table 3-1	Socioeconomic	variables
	Socioccononic	variables

2. The second section of this questionnaire aims to assess respondents' views on the importance of various service factors in DRTS. Using a Likert five-point scale, respondents rate the importance of these service factors on a scale of 1 to 5, where 1 represents "not important at all" and 5 represents "very important." The purpose of this section is to understand the preferences and expectations of the respondents regarding DRTS and to design and provide services that align with these preferences. The complete list of questions can be found in Table 3-2.

Variables	Question Descriptions	
Importance of waiting time	DRTS waiting time importance score (1 to 5 points)	
Importance of travel time	DRTS travel time importance score (1 to 5 points)	
Importance of travel cost	DRTS travel cost importance score (1 to 5 points)	
Importance of comfort	DRTS comfort importance score (1 to 5 points)	
Importance of frequency	DRTS frequency importance score (1 to 5 points)	
Importance of boarding convenience	DRTS boarding convenience importance score (1 to 5 points)	
Importance of reservation convenience	DRTS reservation convenience importance score (1 to 5 points)	
Importance of accessibility	DRTS accessibility importance score (1 to 5 points)	
Importance of transfer convenience	DRTS transfer convenience importance score (1 to 5 points)	

Table 3-2 DRTS service variables

3. The third section of this questionnaire is the willingness to pay scenario design, which aims to access various service improvements in the context of DRTS. Assuming that respondents are in a current commuting situation where the shortest peak-hour bus frequency is 15 minutes, the nearest bus stop from their home requires a walk of more than 10 minutes, and other transportation options, such as taxis, are also scarce and expensive. In this scenario, if there were DRTS that could meet the respondents' travel needs, what price are they willing to pay?

According to the literature review, DRTS often faces financial losses leading to operational failures. In order to enhance the quality of rural public transportation services, increase operational revenue, and reduce losses, this section of the questionnaire covers different scenarios related to waiting time, travel cost, comfort, and accessibility. Respondents can choose from various price options or state that they are unwilling to pay extra fee.

- (1) Waiting time and willingness to pay: in this section, respondents will be asked how much extra they are willing to pay if the waiting time is reduced. Currently, the peak-hour bus service from Taitung City to Luye Township operates every 15 minutes. Assuming that in the future, the DRTS service reduces the waiting time to 5 minutes or 10 minutes, respondents will be asked how much additional cost they are willing to pay in each scenario.
- (2) Travel cost and willingness to pay: respondents will be asked about the reasonable fare for the DRTS service from Taitung City to Luye

Township, with an approximate travel time of 40-50 minutes. Currently, the bus fare is set at 84 TWD, starting at 85 TWD, and incrementing by 5 TWD for each level. Respondents will choose from the provided options the price they consider reasonable.

- (3) Comfort and willingness to pay: this section is aimed to know respondents' willingness to pay for improved comfort. Currently, the bus service from Taitung City to Luye Township is provided by a 40-seater bus. If in the future, the DRTS service switches to a medium-sized bus (18 seats) or a small-sized bus (9 seats), how much extra fee would people be willing to pay for a more comfortable service.
- (4) Accessibility and willingness to pay: in this part, respondents will be asked about their willingness to pay, to reduce the walking time to the DRTS stations. This study assumes that currently, there are fewer bus stops, and people walk an average of over 10 minutes to the station. In the future, if the DRTS service can provide more stops, reducing the walking time to 3 minutes or 5 minutes, respondents will be asked how much extra fee they are willing to pay.

CHAPTER 4 QUESTIONNAIRE SURVEY ANALYSIS

This chapter will mainly explain the basic information collected from Taitung City and Luye Township residents, the regression analysis results, and willingness to pay. A detailed discussion of the data analysis will be presented in Chapter 6. Therefore, this chapter consists of four main aspects: (1) questionnaire survey (2) basic statistical analysis results (3) investigation of the importance of DRTS service factors, and (4) investigation of willingness to pay. The detailed content is as follows.

4.1 Questionnaire Survey

The main purpose of this questionnaire is to investigate the public's viewpoint on the importance of DRTS service factors and their willingness to pay. The target population is travelers within Taitung County, and respondents include residents of Luye Township, Taitung County residents with travel needs to Luye Township, and tourists.

Considering that the population surveyed in this questionnaire includes unspecified individuals, comprising residents within Taitung County as well as visitors from outside the county, the characteristics of the population are diverse and not easily collected. Sampling based on these characteristics would be extremely challenging in practical implementation. Therefore, this study did not adopt a sampling design but instead collaborated with various agencies in Taitung County. Random surveys were then conducted locally among people with different socioeconomic backgrounds. Considering the high proportion of elderly residents in Luye Township, a paper-based questionnaire was primarily used, supplemented by an online survey. To increase the number of valid responses, this study employed a one-on-one face-to-face interview approach by visiting Taitung County and meeting with respondents. Additionally, Eastern Top Transportation Company, Luye Township Office, and the Elderly Association were commissioned to assist in distributing the surveys. The survey was conducted from October 15 to October 17, 2023, and from January 15 to January 17, 2024. A total of 368 surveys were distributed, and after excluding 6 invalid responses, 362 valid surveys were collected.

The study initially conducted an SP survey on both paper-based and online questionnaires. The questionnaire comprised three sections:

1. Analyze the basic information of the questionnaire.

2. Investigation of the importance of DRTS service factors.

3. A willingness-to-pay survey.

The analysis utilized SPSS statistical software. The following sections provide detailed explanations of the results for each part of the questionnaire.

4.2 Socioeconomic Analysis

The basic information section of the research questionnaire includes nine parts: 'gender,' 'age,' 'Educational level,' 'place of residence,' 'job occupations,' 'monthly income,' ' Car and motorcycle licenses ownership,' 'number of cars/motorcycles owned at home,' and 'frequency of using public transportation per week.' The following will provide detailed explanations for each socioeconomic variable.

(1) Gender

The ratio of male respondents is 49.2% and the ratio of female respondents is 50.8%. The distribution of male and female participants is roughly equal, each accounting for approximately half of the total.

Gender	Sample Number	Percent	Cumulative Percent
Male	178	49.2	49.2
Female	184	50.8	100.0
Total	362	100.0	

Table 4-1 Gender distribution

(2) Age

Based on the analysis results, it is observed that the population aged below 65 accounts for 81.2%, while those aged 65 and above constitute 19.8%. According to the collected age statistics in this study, the surveyed population in Taitung City aged 65 and above is 18%, and in Luye Township is 24%. These findings align with the local age distribution. Additionally, 18% of the population is Under 18. This can be attributed to the significant presence of students in Luye Township, who are a major group weekly commuting between Taitung City and Luye Township. Therefore, this study conducted surveys targeting students from Taitung High School and those using the Eastern Top Transportation Bus for commuting between Luye Township and Taitung City.

Age	Sample Number	Percent	Cumulative Percent
Under 18	65	18.0	18.0
19-25	24	6.6	24.6
26-35	44	12.2	36.7
36-45	67	18.5	55.2
46-55	46	12.7	68.0
56-64	48	13.3	81.2
65-70	31	8.6	89.8
71-80	28	7.7	97.5
81-90	8	2.2	99.7
Above 91		0.3	100.0
Total	362	100.0	

Table 4-2 Age distribution

(3) Educational level

According to the results of educational level frequency distribution, most respondents have completed or are currently attending Senior high, constituting 47.5%, followed by those who have completed or are currently attending university education, accounting for 27.6%.

Educational loval	Sample	Doroont	Cumulative
Educational level	Number	Percent	Percent
Non-educational	9	2.5	2.5
Elementary school or below	27	7.5	9.9
Junior high	36	9.9	19.9
Senior high	172	47.5	67.4
College	100	27.6	95.0
Graduate school or above	18	5.0	100.0
Total	362	100.0	

Table 4-3 Educational level distribution

(4) Place of residence

According to the data analysis results, it is evident that 65.2% of the respondents were collected from Luye Township, aligning with the assumed research scope of this study. Furthermore, 26% of the respondents were from Taitung City. Additionally, residents from outside Luye Township, who could engage in activities or tourism in Luye Township, are also included as the target audience of this study. Among these respondents, 3 respondents live in Taimali, 4 respondents live in Taichung City, and 1 lives in Pingtung.

Place of residence	Sample Number	Percent	Cumulative Percent
Taitung County	94	26.0	26.0
Beinan Township	9	2.5	28.5
Luye Township	236	65.2	93.6
Yanping Township	10	2.8	96.4
Guanshan Township	3	0.8	97.2
Chishang Township	2	0.6	97.8
Other	8	2.2	100.0
Total	362	100.0	

Table 4-4 Place of residence distribution

Table 4-5 Place of residence (other)

Place of residence (other)	Sample Number	Percent	Cumulative Percent		
太麻里	3	0.8	98.6		
台中市	4	1.1	99.7		
屏東	B	0.3	100.0		
Total	362	100.0			
(5) Job occupation					

The job occupations of respondents, 22.1% are students, 15.2% are military and public servants, 14.6% are in the service industry, 13.5% are in the first industry, and 12.7% are homemakers.

Job occupation	Sample Number	Percent	Cumulative Percent
Student	80	22.1	22.1
Military/Public servant	55	15.2	37.3
Healthcare worker	11	3.0	40.3
Service industry	53	14.6	55.0
Technology industry	4	1.1	56.1
Finance/Insurance industry	5	1.4	57.5
Secondary industry	12	3.3	60.8
First industry	49	13.5	74.3
Self-employed	22	6.1	80.4
Unemployed	6	1.7	82.0
Homemaker	46	12.7	94.8
Other	19	5.2	100.0
Total	362	100.0	

Table 4-6 Job occupation distribution

Table 4-7 Job occupation (other)

Job occupation (other)	Sample Number	Percent	Cumulative Percent
水電工程		0.3	96.7
未上班		0.3	97.0
未填答	1	0.3	97.2
未填寫	1	0.3	97.5
村長	1	0.3	97.8
退休	4	1.1	98.9
照服員	1	0.3	99.2
廚工	1	0.3	99.4
鄰時工	1	0.3	99.7
臨時人員	1	0.3	100.0
Total	362	100.0	

(6) Monthly income

In terms of the monthly income of the respondents, 38.7% reported having no income, while 27.6% indicated a monthly income ranging from 20,000 to 40,000 NTD.

Monthly income	Sample Number	Percent	Cumulative Percent
No income	140	38.7	38.7
Below 20,000 NTD	51	14.1	52.8
20,000-40,000 NTD	100	27.6	80.4
40,000-60,000 NTD	47	13.0	93.4
60,000-80,000 NTD	19	5.2	98.6
80,000-100,000 NTD	4	1.1	99.7
Above 100,000 NTD	Barn	0.3	100.0
Total	362	100.0	

Table 4-8 Monthly income distribution

(7) Car and motorcycle licenses ownership

Most respondents, accounting for 63.3%, possess both car and motorcycle licenses, while 24.3% of respondents do not hold licenses for either cars or motorcycles.

Licenses ownership	Sample	Percent	Cumulative Percent
	Number		
Car and motorcycle licenses ownership	229	63.3	63.3
Only possesses a car license	14	3.9	67.1
Only possesses a motorcycle license	31	8.6	75.7
Do not have a car or motorcycle license	88	24.3	100.0
Total	362	100.0	

Table 4-9 Car and motorcycle licenses ownership distribution

(8) Number of cars/motorcycles ownership

According to the number of car ownership, the majority, at 47.5%, have one car, followed by 23.8% having two cars.

The result about the number of motorcycle ownership has the same distribution. 45.3% of the respondents have one motorcycle, and 24.6% have two motorcycles.

Number of car ownership	Sample Number	Percent	Cumulative Percent
0	70	19.3	19.3
1	172	47.5	66.9
2	86	23.8	90.6
3	21	5.8	96.4
4	6	1.7	98.1
5	2	0.6	98.6
6	3	0.8	99.4
7	1	0.3	99.7
9	1	0.3	100.0
Total	362	100.0	

Table 4-10 Number of car ownership distribution

Number of motorcycle ownership	Sample	Percent	Cumulative Percent
	Number		
0	40	11.0	11.0
1	164	45.3	56.4
2	89	24.6	80.9
3	46	12.7	93.6
4	18	5.0	98.6
5	4	1.1	99.7
6	1	0.3	100.0
Total	362	100.0	

Table 4-11 Number of motorcycle ownership distribution

(9) Frequency of using public transportation per week

From the collected data, it is evident that over 80% of the population does not have the habit of using public transportation, with only 8.8% of respondents using public transportation 1-3 times per week. During the survey, many respondents mentioned that the reason for not using public transportation frequently is the inconvenience of local public transportation services. As a result, they rely on private vehicles. This underscores the necessity of providing convenient DRTS services in the area.

Frequency of using public transportation	Sample	Percent	Cumulative Percent
	Number		
Less than once a week	295	81.5	81.5
1-3 times per week	32	8.8	90.3
4-6 times per week	19	5.2	95.6
7-9 times per week	6	1.7	97.2
More than10 times per week	10	2.8	100.0
Total	362	100.0	

 Table 4-12 Frequency of using public transportation per week

4.3 Investigation of The Importance of DRTS Service Factors

In this section, the study will analyze the importance of nine DRTS service factors to the public based on the collected questionnaire data. Section 4.3.1 analyzes the average scores of the 9 DRTS service variables based on the questionnaire data to understand which variables are most valued by respondents and which ones are relatively less important to them. Section 4.3.2 will use regression analysis to investigate the associations between various socioeconomic variables and the importance attributed by individuals to DRTS service factors.

4.3.1 Analysis of DRTS Service Factors

Through the questionnaire analysis, this study found that in the DRTS service, accessibility (route coverage) received the highest rating among respondents, followed by boarding convenience and transfer convenience. In contrast to previous literature, the results of this study indicate that waiting time, travel time, and travel costs are not the most prioritized DRTS service factors

considered among respondents in this region.

The reason could be the presence of 24% of seniors over 65 and 9.4% of respondents holding disability certificates in Luye Township. According to the data analysis of the questionnaire in this study, over 70% of respondents aged 65 and above have a monthly income below 20,000 NTD. This data suggests that the elderly respondents in the area may not disregard fare factors due to generous economic conditions. Rather, it is more likely that compared to fares, more people prioritize a public transportation service that meets their travel needs, and elderly individuals require more convenient transportation services compared to other age groups. Due to considerations of their physical conditions, these special passengers place a high expectation on the boarding convenience. In contrast, the variable with the lowest average score is travel cost. During the survey, it was observed that most respondents are dissatisfied with the current public transportation convenience and frequency, thus anticipating convenient DRTS services in the future. This also explains why respondents were more lenient in their ratings concerning travel costs.

DRTS service factors	N	Minimum	Maximum	Mean	Std. Deviation
Importance of waiting time	362	1	5	4.18	0.824
Importance of travel time	362	1	5	4.14	0.818
Importance of travel cost	362	1	5	4.04	0.869
Importance of comfort	362	1	5	4.19	0.790
Importance of frequency	362	1	5	4.28	0.764
Importance of boarding	362	1	5	4.34	0.758
convenience					
Importance of reservation	362	1	5	4.25	0.799
convenience					
Importance of accessibility	362	1	5	4.35	0.755
Importance of transfer	362	1	5	4.31	0.759
convenience					
Valid N (listwise)	362				

Table 4-13 Importance of DRTS service factors



Figure 4-1 Average of DRTS service factor importance bar chart

4.3.2 Regression Analysis

This section applies regression analysis to explore how socioeconomic variables influence the importance assigned to DRTS service factors. By examining different socioeconomic indicators, to understand their connections with various aspects of DRTS services. Through regression analysis, can reveal potential relationships between socioeconomic variables and the importance attributed to DRTS service factors, offering significant insights to improve the effectiveness of public transportation services.

1. Importance of waiting time

The regression analysis results provide a summary of the significance between socioeconomic variables and the importance of waiting time for DRTS. In terms of age, significant differences were observed in the perceived importance of waiting time among different age groups, including those aged below 18, 19-25, 26-35, 36-45, 46-55, 56-64, 65-70, and 71-80 (p-value of 0.000***). In terms of occupation, healthcare workers (p-value of 0.036**) and individuals in the finance/Insurance industry (p-value of 0.029**) demonstrate a higher level of concern for the waiting time of DRTS. In addition, individuals possessing only a motorcycle license exhibited a significant difference in the importance attributed to waiting time compared to other groups (p-value of 0.045**).

Moreover, monthly income (p-value of 0.998) and motorcycle ownership (p-value of 0.998) do not affect the importance placed on waiting time by the respondents at all.

Socioconomia variables	Questionneire items	Waiting time
Socioeconomic variables	Questionnaire items	(p-value)
Gandar	Male	0.757
Gender	Female	-
	Under 18	0.000***
	19-25	0.000***
	26-35	0.000***
	36-45	0.000***
4	46-55	0.000***
Age	56-64	0.000***
	65-70	0.000***
	71-80	0.000***
	81-90	-
	Above 91	-
	Non-educational	0.246
	Elementary school or below	0.439
Educational laval	Junior high	0.283
Educational level	Senior high	0.411
	College	0.528
	Graduate school or above	-
	Taitung County	0.489
	Beinan Township	0.796
	Luye Township	0.601
Place of residence	Yanping Township	0.997
	Guanshan Township	0.874
	Chishang Township	0.667
	Other	-
	Student	0.997
Job occupation	Military/Public servant	0.301
	Healthcare worker	0.036**

Table 4-14 Regression analysis of socioeconomic variables and waiting time (continue)

C	Socioconomia variables Questionnaire items	
Socioeconomic variables	Questionnaire items	(p-value)
	Service industry	
	Technology industry	0.996
	Finance/Insurance industry	0.029**
	Secondary industry	0.134
	First industry	0.341
	Self-employed	0.274
	Unemployed	0.273
	Homemaker	0.557
	Other	-
	No income	0.998
	Below 20,000 NTD	0.998
	20,000-40,000 NTD	0.998
Monthly income	40,000-60,000 NTD	0.998
	60,000-80,000 NTD	0.998
	80,000-100,000 NTD	0.998
	Above 100,000 NTD	-
	Possession of car and motorcycle licenses	0.502
Car and motorcycle license	Only possesses a car license	0.921
ownership	Only possesses a motorcycle license	0.045**
	Do not have a car or motorcycle license	-
		0.871
	(1)ニモニシー	0.981
	2	0.96
	3	0.775
Car ownership	4	0.465
	5	0.452
	6	0.702
	7	0.502
	9	-
	0	0.998
	1	0.998
Motorcycle ownership	2	0.998
wiotoreyere ownership	3	0.998
	4	0.998
	5	0.998

Table 4-14 Regression analysis of socioeconomic variables and waiting time (continue)

Socioeconomic variables	Questionnaire items	Waiting time
	Questionnaire items	(p-value)
	6	-
Frequency of using public transportation per week	Less than once a week	0.855
	1-3 times per week	0.959
	4-6 times per week	0.955
	7-9 times per week	0.677
	More than10 times per week	-

Table 4-14 Regression analysis of socioeconomic variables and waiting time (continue)

***p<0.01, **p<0.05, *p<0.1

2. Importance of travel time

From these data, it can be observed that individuals engaged in the first industry (p-value of 0.036**) and those who are unemployed (p-value of 0.04**) place significant importance on travel time. Income level also emerges as a crucial socioeconomic variable influencing travel time, with all income levels showing high statistical significance (p-value of 0.000***). Lastly, individuals with only a motorcycle license exhibit a very high statistical significance (p-value of 0.003***). This suggests that individuals with only a motorcycle license are particularly concerned about or significantly affected by waiting times in public transportation.

Socioeconomic variables	Questionnaire items	Travel time (p-value)
	Male	0.382
Gender	Female	-
	Under 18	0.852
	19-25	0.57
	26-35	0.326
	36-45	0.395
	46-55	0.532
Age	56-64	0.238
	65-70	0.573
	71-80	0.482
	81-90	0.987
	Above 91	-
	Non-educational	0.457
	Elementary school or below	0.595
	Junior high	0.474
Educational level	Senior high	0.641
	College	0.452
	Graduate school or above	-
	Taitung County	0.309
	Beinan Township	0.484
Place of residence	Luye Township	0.344
	Yanping Township	0.538
	Guanshan Township	0.183

Table 4-15 Regression analysis of socioeconomic variables and travel time (continue)

Socioeconomic variables	Questionnaire items	Travel time (p-value)
	Chishang Township	0.447
	Other	-
	Student	0.783
	Military/Public servant	0.402
	Healthcare worker	0.082*
	Service industry	0.212
	Technology industry	0.809
	Finance/Insurance industry	0.314
Job occupation	Secondary industry	0.152
	First industry	0.036**
	Self-employed	0.538
	Unemployed	0.04**
	Homemaker	0.514
	Other	-
	No income	0.000***
	Below 20,000 NTD	0.000***
	20,000-40,000 NTD	0.000***
Monthly income	40,000-60,000 NTD	0.000***
	60,000-80,000 NTD	0.000***
	80,000-100,000 NTD	-
	Above 100,000 NTD	-
	Possession of car and motorcycle licenses	0.067*
Car and motorcycle licenses	Only possesses a car license	0.831
ownersnip	Only possesses a motorcycle license	0.003***

Table 4-15 Regression analysis of socioeconomic variables and travel time (continue)

Socioeconomic variables	Questionnaire items	Travel time (p-value)
	Do not have a car or motorcycle license	-
	0	0.475
	1	0.549
	2	0.443
	3	0.687
Car ownership	4	0.957
	5	0.221
	6	0.056*
	7	0.179
	9	-
		0.082*
		0.168
	2	0.222
Motorcycle ownership		0.256
		0.079*
	5	0.14
	6	-
	Less than once a week	0.889
	1-3 times per week	0.838
Frequency of using public transportation per week	4-6 times per week	0.586
transportation per week	7-9 times per week	0.942
	More than10 times per week	-

Table 4-15 Regression analysis of socioeconomic variables and travel time (continue)

***p<0.01, **p<0.05, *p<0.1

3. Importance of travel cost

Among different age groups, individuals aged between 26 and 64 show a significant preference for travel cost (p<0.05), and individuals aged 65 and above exhibit less emphasis on public transportation fares. Furthermore, respondents with no income up to those earning 60,000-80,000 NTD consider travel cost as a crucial factor (p-value of 0.000^{***}). Regarding driving licenses, individuals possessing both car and motorcycle licenses care about travel cost (p-value of 0.018^{**}). Those holding a motorcycle license demonstrate an extremely high regard for travel cost (p-value of 0.000^{***}). Respondents with only a car license (p-value of 0.118) do not show a significant concern for travel costs, which can be attributed to their better economic situation and lack of habit in public transportation, making them indifferent to travel costs.

Socioeconomic variables	Questionnaire items	Travel cost (p-value)
Gender	Male	0.379
	Female	-
Age	Under 18	0.607
	19-25	0.096*
	26-35	0.014**
	36-45	0.028**
	46-55	0.033**
	56-64	0.034**

Table 4-16 Regression analysis of socioeconomic variables and travel cost (continue)

Socioeconomic variables	Questionnaire items	Travel cost (p-value)
	65-70	0.12
	71-80	0.101
	81-90	0.39
	Above 91	-
Educational level	Non-educational	0.251
	Elementary school or below	0.462
	Junior high	0.779
	Senior high	0.244
	College	0.508
	Graduate school or above	-
Place of residence	Taitung County	0.278
	Beinan Township	0.636
	Luye Township	0.259
	Yanping Township	0.308
	Guanshan Township	0.166
	Chishang Township	0.562
	Other	-
Job occupation	Student	0.291
	Military/Public servant	0.852
	Healthcare worker	0.122
	Service industry	0.788
	Technology industry	0.884
	Finance/Insurance industry	0.61
	Secondary industry	0.414
	First industry	0.212
	Self-employed	0.98
	Unemployed	0.055*

Table 4-16 Regression analysis of socioeconomic variables and travel cost (continue)
Socioeconomic variables	Questionnaire items	Travel cost (p-value)
	Homemaker	0.784
	Other	-
	No income	0.000***
	Below 20,000 NTD	0.000***
	20,000-40,000 NTD	0.000***
Monthly income	40,000-60,000 NTD	0.000***
	60,000-80,000 NTD	0.000***
	80,000-100,000 NTD	-
	Above 100,000 NTD	-
	Possession of car and motorcycle licenses	0.018**
Car and motorcycle licenses	Only possesses a car license	0.118
ownership	Only possesses a motorcycle license	0.000***
	Do not have a car or motorcycle license	-
	0	0.726
		0.748
		0.611
		0.828
Car ownership	4	0.886
	5	0.269
	6	0.379
	7	0.416
	9	-
	0	0.324
Motorcycle ownership	1	0.477
	2	0.652
	3	0.721
	4	0.398

Table 4-16 Regression analysis of socioeconomic variables and travel cost (continue)

Socioeconomic variables	Questionnaire items	Travel cost (p-value)
	5	0.415
	6	-
Frequency of using public transportation per week	Less than once a week	0.819
	1-3 times per week	0.902
	4-6 times per week	0.258
	7-9 times per week	0.57
	More than10 times per week	-

Table 4-16 Regression analysis of socioeconomic variables and travel cost (continue)

- ***p<0.01, **p<0.05, *p<0.1
- 4. Importance of comfort

In terms of job occupations, unemployed individuals show a higher emphasis on the comfort of DRTS services. Monthly income below 80,000 NTD (p-value of 0.000***) and all motorcycle ownership (pvalue of 0.000***) are identified as the primary factors influencing respondents' evaluations of comfort. Regarding car ownership, it is observed that in general the higher the number of vehicles, the greater the concern for comfort, especially 6 car ownership (p-value of 0.061*).

Table 4-17 Regression analysis of socioeconomic variables and comfort (continue)

Socioeconomic variables	Questionnaire items	Comfort (p-value)
Gender	Male	0.166
	Female	-

Socioeconomic variables	Questionnaire items	Comfort (p-value)
	Under 18	0.672
	19-25	0.956
	26-35	0.593
	36-45	0.768
۸œ	46-55	0.975
Age	56-64	0.727
	65-70	0.758
	71-80	0.861
	81-90	0.932
	Above 91	-
	Non-educational	0.628
	Elementary school or below	0.911
Educational laval	Junior high	0.336
	Senior high	0.706
	College	0.841
	Graduate school or above	-
	Taitung County	0.151
	Beinan Township	0.204
	Luye Township	0.291
Place of residence	Yanping Township	0.155
	Guanshan Township	0.215
	Chishang Township	0.264
	Other	-
	Student	0.676
	Military/Public servant	0.177
Job occupation	Healthcare worker	0.138
	Service industry	0.107
	Technology industry	0.852

Table 4-17 Regression analysis of socioeconomic variables and comfort (continue)

Socioeconomic variables	Questionnaire items	Comfort (p-value)
	Finance/Insurance industry	0.303
	Secondary industry	0.319
	First industry	0.06*
	Self-employed	0.445
	Unemployed	0.026**
	Homemaker	0.327
	Other	-
	No income	0.000***
-	Below 20,000 NTD	0.000***
-	20,000-40,000 NTD	0.000***
Monthly income	40,000-60,000 NTD	0.000***
-	60,000-80,000 NTD	0.000***
	80,000-100,000 NTD	-
-	Above 100,000 NTD	-
	Possession of car and motorcycle licenses	0.949
Car and motorcycle licenses	Only possesses a car license	0.942
ownership	Only possesses a motorcycle license	0.241
-	Do not have a car or motorcycle license	-
	0	0.651
-	1	0.774
	2	0.666
Car ownership	3	0.818
	4	0.656
	5	0.197
	6	0.061*
	7	0.215
	9	-
Motorcycle ownership	0	0.000***

Table 4-17 Regression analysis of socioeconomic variables and comfort (continue)

Socioeconomic variables	Questionnaire items	Comfort (p-value)
	1	0.000***
	2	0.000***
	3	0.000***
	4	0.000***
	5	-
	6	-
	Less than once a week	0.298
Frequency of using public transportation per week	1-3 times per week	0.976
	4-6 times per week	0.425
	7-9 times per week	0.349
	More than10 times per week	-

Table 4-17 Regression analysis of socioeconomic variables and comfort (continue)

5. Importance of frequency

According to the analysis results, age is an extremely significant variable, respondents from under 18 to 80 years old consistently show a high importance on frequency (p-value of 0.000***), indicating that there are statistically significant differences in the evaluation of DRTS service frequency among different age groups. Additionally, it is observed that respondents who only possess a motorcycle license show an extreme emphasis on service frequency (p-value of 0.008***).

Moreover, monthly income (p-value of 0.998) and motorcycle ownership (p-value of 0.998) do not affect the importance placed on frequency by the respondents.

Socioeconomic variables	Questionnaire items	frequency (p-value)
Gender	Male	0.122
Gender	Female	-
	Under 18	0.000***
	19-25	0.000***
	26-35	0.000***
	36-45	0.000***
A go	46-55	0.000***
Age	56-64	0.000***
	65-70	0.000***
	71-80	0.000***
	81-90	-
	Above 91	-
	Non-educational	0.761
	Elementary school or below	0.43
Educational loval	Junior high	0.341
Educational level	Senior high	0.409
	College	0.221
	Graduate school or above	-
	Taitung County	0.355
	Beinan Township	0.572
Place of residence	Luye Township	0.489
	Yanping Township	0.498
	Guanshan Township	0.304
	Chishang Township	0.884
	Other	-
Job occupation	Student	0.403

Table 4-18 Regression analysis of socioeconomic variables and frequency (continue)

Socioeconomic variables	Questionnaire items	frequency (p-value)
	Military/Public servant	0.34
	Healthcare worker	0.792
	Service industry	0.34
	Technology industry	0.62
	Finance/Insurance industry	0.191
	Secondary industry	0.299
	First industry	0.13
	Self-employed	0.781
	Unemployed	0.22
	Homemaker	0.917
	Other	-
	No income	0.998
	Below 20,000 NTD	0.998
	20,000-40,000 NTD	0.998
Monthly income	40,000-60,000 NTD	0.998
	60,000-80,000 NTD	0.998
	80,000-100,000 NTD	0.998
	Above 100,000 NTD	-
	Possession of car and motorcycle licenses	0.256
Car and motorcycle license	Only possesses a car license	0.737
ownership	Only possesses a motorcycle license	0.008***
	Do not have a car or motorcycle license	-
	0	0.588
	1	0.61
Car ownership	2	0.504
	3	0.648
	4	0.371

Table 4-18 Regression analysis of socioeconomic variables and frequency (continue)

Socioeconomic variables	Questionnaire items	frequency (p-value)
	5	0.164
	6	0.22
	7	0.166
-	9	-
	0	0.998
-	1	0.998
	2	0.998
Motorcycle ownership	3	0.998
	4	0.998
	5	0.998
	6	-
	Less than once a week	0.922
Frequency of using public transportation per week	1-3 times per week	0.618
	4-6 times per week	0.808
	7-9 times per week	0.436
	More than10 times per week	-

Table 4-18 Regression analysis of socioeconomic variables and frequency (continue)

6. Importance of boarding convenience

Based on the analysis results, respondents of all age groups from under 18 to 80 years old and above place extremely high importance on boarding convenience in DRTS services (p-value of 0.000***). In terms of job occupations, individuals working in the military/public servant (p-value of 0.022**), healthcare worker (p-value of 0.011**), service industry (p-value of 0.011^{**}), finance/insurance industry (p-value of 0.035^{**}), first industry (p-value of 0.009^{***}), and unemployed (p-value of 0.017^{**}) significantly prioritize the convenience of boarding. Additionally, respondents with a car license also exhibit statistically significant in their evaluation of boarding convenience (p-value of 0.047^{**}). Individuals possessing only a motorcycle license demonstrate an extremely high level of significance in their assessment of boarding convenience (p-value of 0.000^{***}).

The results also indicate that respondents who own 6 (p-value of 0.058*) or 7 (p-value of 0.062*) cars place higher importance on boarding convenience. This is likely because these respondents are accustomed to comfortable and convenient travel, making them more concerned about the ease of boarding.

 Table 4-19 Regression analysis of socioeconomic variables and boarding convenience (continue)

Socioeconomic variables	Questionnaire items	Boarding convenience (p-value)
Gender	Male	0.667
Gender	Female	-
Age	Under 18	0.000***
	19-25	0.000***
	26-35	0.000***
	36-45	0.000***
	46-55	0.000***

Socioeconomic variables	Questionnaire items	Boarding
		(p-value)
	56-64	0.000***
	65-70	0.000***
	71-80	0.000***
	81-90	-
	Above 91	-
	Non-educational	0.289
	Elementary school or below	0.243
Educational level	Junior high	0.16
Educational level	Senior high	0.288
	College	0.147
	Graduate school or above	-
	Taitung County	0.17
	Beinan Township	0.104
	Luye Township	0.263
Place of residence	Yanping Township	0.204
	Guanshan Township	0.414
	Chishang Township	0.344
	Other	-
	Student	0.618
	Military/Public servant	0.022**
	Healthcare worker	0.011**
Job occupation	Service industry	0.011**
	Technology industry	0.852
	Finance/Insurance industry	0.035**
	Secondary industry	0.173
	First industry	0.009***
	Self-employed	0.088*

Table 4-19 Regression analysis of socioeconomic variables and boarding convenience (continue)

Socioeconomic variables		Boarding
	Questionnaire items	convenience
	Lucanalored	(p-value)
	Unemployed	0.01/**
	Homemaker	0.105
	Other	-
	No income	0.998
	Below 20,000 NTD	0.998
	20,000-40,000 NTD	0.998
Monthly income	40,000-60,000 NTD	0.998
	60,000-80,000 NTD	0.998
	80,000-100,000 NTD	0.998
	Above 100,000 NTD	-
	Possession of car and motorcycle licenses	0.047**
Car and motorcycle license	Only possesses a car license	0.718
ownership	Only possesses a motorcycle license	0.000***
	Do not have a car or motorcycle license	-
		0.528
	HON R	0.639
	2	0.503
	3	0.521
Car ownership	4	0.971
	5	0.208
	6	0.058*
	7	0.062*
	9	-
	0	0.998
Motorcycle ownership	1	0.998
	2	0.998
	3	0.998

Table 4-19 Regression analysis of socioeconomic variables and boarding convenience (continue)

Socioeconomic variables	Questionnaire items	Boarding convenience (p-value)	
	4	0.998	
	5	0.998	
	6	-	
Frequency of using public transportation per week	Less than once a week	0.284	
	1-3 times per week	0.522	
	4-6 times per week	0.544	
	7-9 times per week	0.453	
	More than10 times per week	-	

Table 4-19 Regression analysis of socioeconomic variables and boarding convenience (continue)

7. Importance of reservation convenience

From the perspective of income levels, the results indicate a significant emphasis on the evaluation of the reservation convenience of DRTS services across all income groups (p-value of 0.000***), highlighting the universal importance of reservation convenience for users from different economic backgrounds. Additionally, respondents with both car and motorcycle licenses show a statistically significant difference (p-value of 0.016**). Furthermore, individuals possessing only a motorcycle license exhibit an extremely high level of significance in their emphasis on reservation convenience (p-value of 0.002***), indicating a particular sensitivity to the convenience of reservation services within this specific group. Motorcycle ownership is also a

significant factor influencing respondents' importance of reservation convenience (p-value of 0.000***).

Socioeconomic variables	Questionnaire items	Reservation convenience (p-value)
Gender	Male	0.361
Gender	Female	-
	Under 18	0.711
	19-25	0.579
	26-35	0.506
	36-45	0.509
Δαρ	46-55	0.74
Age	56-64	0.392
	65-70	0.593
	71-80	0.702
	81-90	0.345
	Above 91	-
	Non-educational	0.761
	Elementary school or below	0.795
Educational loval	Junior high	0.613
	Senior high	0.544
	College	0.499
	Graduate school or above	-
	Taitung County	0.308
Place of residence	Beinan Township	0.611
	Luye Township	0.422
	Yanping Township	0.666

Table 4-20 Regression analysis of socioeconomic variables and reservation convenience (continue)

Socioeconomic variables	Questionnaire items	Reservation convenience
	Guanshan Township	(p-value)
	Chishang Township	0.325
		0.847
	Other	-
	Student	0.779
	Military/Public servant	0.661
	Healthcare worker	0.888
	Service industry	0.369
	Technology industry	0.548
Job occupation	Finance/Insurance industry	0.314
Job occupation	Secondary industry	0.757
	First industry	0.139
	Self-employed	0.31
	Unemployed	0.11
	Homemaker	0.595
	Other	-
	No income	0.000***
	Below 20,000 NTD	0.000***
	20,000-40,000 NTD	0.000***
Monthly income	40,000-60,000 NTD	0.000***
	60,000-80,000 NTD	0.000***
	80,000-100,000 NTD	-
	Above 100,000 NTD	-
	Possession of car and motorcycle licenses	0.016**
Car and motorcycle license ownership	Only possesses a car license	0.874
	Only possesses a motorcycle license	0.002***
	Do not have a car or motorcycle license	-
Car ownership	0	0.716

Table 4-20 Regression analysis of socioeconomic variables and reservation convenience (continue)

Socioeconomic variables	Questionnaire items	Reservation convenience (p-value)
	1	0.723
	2	0.697
	3	0.864
	4	0.52
	5	0.202
	6	0.712
	7	0.434
	9	-
	0	0.000***
	1	0.000***
		0.000***
Motorcycle ownership		0.000***
		0.000***
	5	-
		-
	Less than once a week	0.174
Frequency of using public transportation per week	1-3 times per week	0.55
	4-6 times per week	0.236
	7-9 times per week	0.516
	More than10 times per week	-

Table 4-20 Regression analysis of socioeconomic variables and reservation convenience (continue)

8. Importance of accessibility

In assessing the accessibility of DRTS services, the results indicate that military/public servant (p-value of 0.056*), healthcare workers (p-value of 0.037**), service industry (p-value of 0.073*), individuals employed in the first industry (p-value of 0.036**), and unemployed individuals (p-value of 0.036**) show a higher emphasis on accessibility. Furthermore, income is a critical factor influencing the importance individuals place on accessibility. Finally, respondents with both car and motorcycle licenses express a significantly higher importance on accessibility (p-value of 0.005***), and individuals with only a motorcycle license (p-value of 0.005***), no motorcycles owned at home (p-value of 0.044**), also show a statistically significant emphasis on accessibility.

Table 4-21 Regression analysis of socioeconomic variables and accessibility (continue)

Socioeconomic variables	Questionnaire items	Accessibility (p-value)
Gondor	Male	0.463
Gender	Female	-
	Under 18	0.804
Age	19-25	0.514
	26-35	0.269
	36-45	0.306
	46-55	0.51
	56-64	0.236
	65-70	0.462
	71-80	0.397

Socioeconomic variables	Questionnaire items	Accessibility (p-value)
	81-90	0.432
	Above 91	-
	Non-educational	0.628
	Elementary school or below	0.158
Educational level	Junior high	0.504
	Senior high	0.795
	College	0.782
	Graduate school or above	-
	Taitung County	0.153
	Beinan Township	0.297
	Luye Township	0.187
Place of residence	Yanping Township	0.193
	Guanshan Township	0.297
	Chishang Township	0.262
	Other	-
	Student	0.53
	Military/Public servant	0.056*
	Healthcare worker	0.037**
	Service industry	0.073*
	Technology industry	0.932
Job occupation	Finance/Insurance industry	0.199
300 occupation	Secondary industry	0.217
	First industry	0.036**
	Self-employed	0.147
	Unemployed	0.036**
	Homemaker	0.233
	Other	-

Table 4-21 Regression analysis of socioeconomic variables and accessibility (continue)

Socioeconomic variables	Questionnaire items	Accessibility (p-value)
	No income	0.000***
	Below 20,000 NTD	0.000***
	20,000-40,000 NTD	0.000***
Monthly income	40,000-60,000 NTD	0.000***
	60,000-80,000 NTD	0.000***
	80,000-100,000 NTD	-
	Above 100,000 NTD	-
	Possession of car and motorcycle licenses	0.005***
Car and motorcycle license	Only possesses a car license	0.128
ownership	Only possesses a motorcycle license	0.000***
	Do not have a car or motorcycle license	-
	0	0.636
		0.634
		0.558
	3	0.751
Car ownership		0.582
	5	0.11
	6	0.998
	7	0.188
	9	-
	0	0.044**
	1	0.217
Motorcycle ownership	2	0.463
	3	0.45
	4	0.265
	5	-
	6	-

Table 4-21 Regression analysis of socioeconomic variables and accessibility (continue)

Socioeconomic variables	Questionnaire items	Accessibility (p-value)
Frequency of using public transportation per week	Less than once a week	0.231
	1-3 times per week	0.815
	4-6 times per week	0.58
	7-9 times per week	0.506
	More than10 times per week	-

Table 4-21 Regression analysis of socioeconomic variables and accessibility (continue)

9. Importance of transfer convenience

According to the results, respondents in the age groups under 18 (p-value of 0.02**), 19-25 (p-value of 0.029**), 46-55 (p-value of 0.018**), 65-70 (p-value of 0.018**), 71-80 (p-value of 0.011**), and 81-90 (p-value of 0.012**) express a significant sign that emphasis on transfer convenience. Individuals aged 26-35 (p-value of 0.005***), 36-45 (p-value of 0.007***), and 56-64 (p-value of 0.002***) highly prioritize the convenience of transfers.

In terms of job occupations, individuals employed in the service industry (p-value of 0.094*), the first industry (p-value of 0.041**), and the self-employed (p-value of 0.084*) show a greater emphasis on transfer convenience compared to other occupations.

Additionally, respondents who only possess a motorcycle license (p-value of 0.021**) also show higher importance on the transfer convenience of public transportation. Regarding motorcycle ownership,

regardless of the number of motorcycles respondents own, all show a high importance on transfer convenience (p-value of 0.000***).

~ · · · · · · · ·		Transfer
Socioeconomic variables	Questionnaire items	convenience
		(p-value)
Gender	Male	0.205
Gender	Female	-
	Under 18	0.02**
	19-25	0.029**
	26-35	0.005***
	36-45	0.007***
Age	46-55	0.018**
nge	56-64	0.002***
	65-70	0.018**
	71-80	0.011**
	81-90	0.012**
	Above 91	-
	Non-educational	0.788
	Elementary school or below	0.714
Educational level	Junior high	0.646
	Senior high	0.492
	College	0.468
	Graduate school or above	-
	Taitung County	0.439
	Beinan Township	0.811
Place of residence	Luye Township	0.533
	Yanping Township	0.451
	Guanshan Township	0.637

Table 4-22 Regression analysis of socioeconomic variables and transfer convenience (continue)

Socioeconomic variables	Questionnaire items	Transfer convenience (p-value)
	Chishang Township	0.945
	Other	-
	Student	0.977
	Military/Public servant	0.104
	Healthcare worker	0.146
	Service industry	0.094*
	Technology industry	0.943
Lab accuration	Finance/Insurance industry	0.288
Job occupation	Secondary industry	0.477
	First industry	0.041**
	Self-employed	0.084*
	Unemployed	0.403
	Homemaker	0.393
	Other	-
	No income	0.000***
	Below 20,000 NTD	0.000***
	20,000-40,000 NTD	0.000***
Monthly income	40,000-60,000 NTD	0.000***
	60,000-80,000 NTD	0.000***
	80,000-100,000 NTD	-
	Above 100,000 NTD	-
	Possession of car and motorcycle licenses	0.138
Car and motorcycle license ownership	Only possesses a car license	0.901
	Only possesses a motorcycle license	0.021**
	Do not have a car or motorcycle license	-
	0	0.862
Car ownership	1	0.962

Table 4-22 Regression analysis of socioeconomic variables and transfer convenience (continue)

0	One dia maine itema	Transfer
Socioeconomic variables	Questionnaire items	convenience
		(p-value)
	2	0.916
	3	0.979
	4	0.677
	5	0.373
	6	0.772
	7	0.436
	9	-
	0	0.000***
	1	0.000***
	2	0.000***
Motorcycle ownership	3	0.000***
		0.000***
		-
	6	-
	Less than once a week	0.363
Frequency of using public transportation per week	1-3 times per week	0.498
	4-6 times per week	0.466
	7-9 times per week	0.473
	More than10 times per week	-

 Table 4-22 Regression analysis of socioeconomic variables and transfer convenience (continue)

***p<0.01, **p<0.05, *p<0.1

4.3.3 Summary of Regression Analysis

Table 4-23 is the regression analysis summary results for various socioeconomic variables on DRTS service factors are presented.

1. Importance of **waiting time**: the analysis results indicate that **age** (p-value of 0.000***) is an important factor influencing the importance of waiting time.

2. Importance of **travel time**: the analysis results indicate that **monthly income** (p-value of 0.000***) is an important factor influencing the importance of travel time.

3. Importance of **travel cost**: the analysis results indicate that **monthly income** and **possessing a motorcycle license** (p-value of 0.000***) are important factors influencing the importance of travel cost.

4. Importance of **comfort**: the analysis results indicate that **monthly income** and **motorcycle ownership** (p-value of 0.000***) are important factors influencing the importance of comfort.

5. Importance of **frequency**: the analysis results indicate that **age** (p-value of 0.000^{***}) is an important factor influencing the importance of frequency.

6. Importance of **boarding convenience**: the analysis results indicate that **age** and **possessing a motorcycle license** (p-value of 0.000***) are important factors influencing the importance of boarding convenience.

7. Importance of **reservation convenience**: the analysis results indicate that **monthly income** and **motorcycle ownership** (p-value of 0.000***) are important factors influencing the importance of reservation convenience.

8. Importance of **reservation accessibility**: the analysis results indicate that

monthly income and **possessing a motorcycle license** (p-value of 0.000***) are important factors influencing the importance of reservation accessibility.

9. Importance of **transfer convenience**: the analysis results indicate that **monthly income** and **motorcycle ownership** (p-value of 0.000***) are important factors influencing the importance of transfer convenience.

The findings indicate a negative correlation between age and the importance of waiting time, individuals under 18 prioritize waiting time more than those aged 18 and above. In terms of job occupations, healthcare workers and the finance/insurance industry tend to place higher importance on waiting time. For travel time and cost, the analysis reveals higher importance among those with no income, low-income groups, and individuals with only a motorcycle license. Additionally, comfort is more crucial for those without a job, no income, and low-income individuals, indicating groups that rely more on public transportation tend to emphasize the comfort of their travel experience. Motorcycle ownership is negatively correlated with the importance of comfort. In summary, age, income, job occupations, and car and motorcycle license ownership are significant socioeconomic variables influencing DRTS service factors.

Variable	Questionnaire items	Estimate	SD	Wald	Sig.
	Under 18	-19.815	1.159	292.081	0.000***
	19-25	-18.866	1.017	343.825	0.000***
	26-35	-18.759	.913	422.226	0.000***
	36-45	-18.581	.891	435.286	0.000***
	46-55	-18.932	.895	447.220	0.000***
Importance of waiting time	56-64	-18.304	.898	415.675	0.000***
	65-70	-19.080	.897	452.285	0.000***
	71-80	-19.091	.832	527.070	0.000***
	Healthcare worker	2.389	1.139	4.400	0.036**
	Finance/Insurance industry	3.914	1.795	4.756	0.029**
	Only possesses a motorcycle license	-1.267	.632	4.016	0.045**
	First industry	1.865	.889	4.401	0.036**
	Unemployed	2.767	1.348	4.213	0.04**
	No income	-17.893	1.183	228.902	0.000***
I	Below 20,000 NTD	-18.740	1.180	252.155	0.000***
Importance of travel time	20,000-40,000 NTD	-18.356	1.155	252.484	0.000***
	40,000-60,000 NTD	-18.253	1.171	243.084	0.000***
	60,000-80,000 NTD	-17.845	1.217	214.997	0.000***
	Only possesses a motorcycle license	-1.954	.660	8.768	0.003***
	26-35	5.314	2.161	6.048	0.014**
	36-45	4.719	2.145	4.842	0.028**
	46-55	4.590	2.150	4.558	0.033**
	56-64	4.534	2.143	4.476	0.034**
	No income	-17.720	1.121	250.033	0.000***
In auton of the value of	Below 20,000 NTD	-18.712	1.120	279.213	0.000***
Importance of travel cost	20,000-40,000 NTD	-18.482	1.094	285.642	0.000***
	40,000-60,000 NTD	-18 541	1.113	277.664	0.000***
	60,000-80,000 NTD	-17.572	1.152	232.658	0.000***
	Possession of car and motorcycle	-1.400	.591	5.606	0.018**
	licenses				
	Only possesses a motorcycle license	-2.997	.676	19.636	0.000***
Importance of comfort	Unemployed	3.105	1.397	4.942	0.026**

Table 4-23 Significant variables influencing DRTS service factors (continue)

Variable	Questionnaire items	Estimate	SD	Wald	Sig.
	No income	-18.376	1.172	245.755	0.000***
	Below 20,000 NTD	-18.865	1.172	259.012	0.000***
	20,000-40,000 NTD	-18.804	1.144	269.972	0.000***
	40,000-60,000 NTD	-19.222	1.162	273.701	0.000***
	60,000-80,000 NTD	-19.039	1.198	252.765	0.000***
	No motorcycles	-24.212	1.314	339.770	0.000***
	1 motorcycle	-23.984	1.269	357.381	0.000***
	2 motorcycles	-23.341	1.262	342.263	0.000***
	3 motorcycles	-23.054	1 272	328.570	0.000***
	4 motorcycles	-23.638	1.348	307.424	0.000***
	Under 18	-17.938	1.228	213.437	0.000***
	19-25	-16.831	1.078	243.576	0.000***
	26-35	-17.127	.948	326.605	0.000***
	36-45	-17.661	.916	371.349	0.000***
Importance of frequency	46-55	-18.612	.920	409.157	0.000***
	56-64	-17.238	.925	347.233	0.000***
	65-70	-18.579	.920	407.931	0.000***
	71-80	-19.122	.857	497.538	0.000***
	Only possesses a motorcycle license	-1.778	.669	7.067	0.008***
	Under 18	-18.024	1.245	209.629	0.000***
	19-25	-17.322	1.067	263.538	0.000***
	26-35	-16.618	.967	295.256	0.000***
	36-45	-17.061	.933	334.428	0.000***
	46-55	-17.995	.938	368.315	0.000***
Importance of boarding	56-64	-16.749	.945	313.973	0.000***
convenience	65-70	-18.196	.938	375.939	0.000***
	71-80	-17.135	.874	384.304	0.000***
	Military/Public servant	2.174	.952	5.216	0.022**
	Healthcare worker	3.061	1.207	6.427	0.011**
	Service industry	2.408	.947	6.460	0.011**
	Finance/Insurance industry	2.924	1.389	4.431	0.035**

Table 4-23 Significant variables influencing DRTS service factors (continue)

Variable	Questionnaire items	Estimate	SD	Wald	Sig.
	First industry	2.362	.907	6.782	0.009***
	Unemployed	3.352	1.406	5.683	0.017**
	Possession of car and motorcycle	-1.241	.624	3.947	0.047**
	licenses				
	Only possesses a motorcycle license	-2.501	.695	12.951	0.000***
	No income	-19.141	1.219	246.677	0.000***
	Below 20,000 NTD	-20.480	1.215	284.360	0.000***
	20,000-40,000 NTD	-19.623	1.188	272.889	0.000***
	40,000-60,000 NTD	-19.494	1.200	264.086	0.000***
	60,000-80,000 NTD	-18.399	1.264	211.910	0.000***
Importance of reservation	Possession of car and motorcycle	-1.486	.615	5.832	0.016**
convenience	licenses				
	Only possesses a motorcycle license	-2.162	.682	10.033	0.002***
	No motorcycles	-20.859	1.508	191.440	0.000***
	1 motorcycle	-19.744	1.460	182.819	0.000***
	2 motorcycles	-18.996	1.457	170.043	0.000***
	3 motorcycles	-19.243	1.465	172.651	0.000***
	4 motorcycles	-20.263	1.536	174.051	0.000***
	Healthcare worker	2.473	1.184	4.365	0.037**
	First industry	1.878	.895	4.407	0.036**
	Unemployed	3.200	1.522	4.421	0.036**
	No income	-18.121	1.198	228.854	0.000***
Importance of accessibility	Below 20,000 NTD	-18.908	1.195	250.305	0.000***
	20,000-40,000 NTD	-18.915	1.170	261.224	0.000***
	40,000-60,000 NTD	-19.056	1.187	258.587	0.000***
	60,000-80,000 NTD	-18.133	1.278	201.232	0.000***
	Possession of car and motorcycle	-1.833	.654	7.847	0.005***
	licenses				
	Only possesses a motorcycle license	-2.773	.719	14.891	0.000***
	No motorcycles	-2.932	1.455	4.058	0.044**
Importance of transfer	Under 18	5.022	2.154	5.436	0.02**
convenience	19-25	4.727	2.169	4.748	0.029**

Table 4-23 Significant variables influencing DRTS service factors (continue)

Variable	Questionnaire items	Estimate	SD	Wald	Sig.
	26-35	6.021	2.147	7.862	0.005***
	36-45	5.741	2.131	7.257	0.007***
	46-55	5.078	2.138	5.643	0.018**
	56-64	6.767	2.149	9.913	0.002***
	65-70	5.030	2.119	5.634	0.018**
	71-80	5.289	2.077	6.483	0.011**
	81-90	5.504	2.180	6.374	0.012**
	First industry	1.846	.904	4.170	0.041**
	No income	-17 437	1.241	197 363	0.000***
	Below 20,000 NTD	-18.467	1.235	223.588	0.000***
	20,000-40,000 NTD	-18.470	1.208	233.625	0.000***
	40,000-60,000 NTD	-18.407	1.221	227.193	0.000***
	60,000-80,000 NTD	-16.985	1 325	164.391	0.000***
	Only possesses a motorcycle license	-1.580	.685	5.325	0.021**
	No motorcycles	-20.521	1.300	249.337	0.000***
	1 motorcycle	-20.023	1.242	259.734	0.000***
	2 motorcycles	-19.500	1.235	249.179	0.000***
	3 motorcycles	-19.569	1.247	246 466	0.000***
	4 motorcycles	-19.956	1.332	224.614	0.000***

Table 4-23 Significant variables influencing DRTS service factors (continue)

4.4 Investigation of Willingness to Pay

Given the perennial financial challenges faced by public transportation, requiring government subsidies for operations, the second part of this research questionnaire assesses the improvement of various services and the willingness to pay of respondents, aiming to contribute to reasonable fare strategies. This part of the questionnaire considers passengers' needs from the perspectives of waiting time, fare, comfort, and accessibility, helping analyze public transportation services that are more tailored to actual demands and centered around passenger satisfaction.

1. Willingness to pay for waiting time

The current bus service between Luye and Taitung City in Eastern Top Transportation with a peak-hour frequency of every 15 minutes, while during off-peak hours, the frequency is reduced to every 1-2 hours. Insufficient frequency of bus services can directly lead to residents being unwilling to use public transportation. To address this issue, the future DRTS plans to increase the frequency of bus services. To research the appropriate fare after improving the service quality, this survey investigates the willingness to pay an extra fee for a 5-minute/10-minute waiting time. The survey results show that if the waiting time is reduced to 5 minutes, over 40% of the respondents are willing to pay an additional fee of 15 NTD. If the waiting time is reduced to 10 minutes, 36.7% of the respondents are willing to pay an additional fee of 10 NTD.



Figure 4-2 Willingness to pay for extra fee for a 5-minute waiting time



Figure 4-3 Willingness to pay for extra fee for a 10-minute waiting time

To analyze how various socioeconomic variables influence the willingness to pay, this study selected significant variables affecting waiting time from Table 4-23 and conducted a cross-analysis with the willingness to pay. The results show that, if the waiting time is 5 minutes, the age group of 36 to 45 has the highest proportion of respondents willing to pay the highest additional fee, in terms of age, younger individuals may prioritize time efficiency, thus they are willing to pay additional fees to shorten waiting times. Healthcare workers are more reluctant to pay than those in the finance/insurance industry.

If the waiting time is 10 minutes, the age group of 36 to 45 has the highest proportion of respondents unwilling to pay additional fee. The proportions of healthcare workers who chose 10, 15, and 20 NTD options are equal because they hold similar values or acceptability.





Figure 4-4 Cross-analysis with the willingness to pay (5-minute waiting time)



Figure 4-5 Cross-analysis with the willingness to pay (10-minute waiting time)

2. Willingness to pay for travel cost

Currently, the full fare for Eastern Top Transportation from Taitung to Luye is 84 NTD, with a travel time of approximately 40-50 minutes. In investigating the acceptable future fare for DRTS among the public, this study found that 43.6% of the respondents consider the current fare reasonable and are unwilling to pay additional costs for DRTS service. On the other hand, 56.4% of the respondents are willing to accept a fare ranging from 90 to 105 NTD. In other words, more than half of the respondents are willing to pay a higher fare for a more convenient, comfortable, and demand-responsive public transportation



Figure 4-6 The reasonable fare for DRTS from Luye Township to Taitung City

To analyze how various socioeconomic variables influence the willingness to pay, this study selected significant variables affecting travel cost from Table 4-23 and conducted a cross-analysis with the willingness to pay. From the analysis of people's income, the group with no income, approximately half are unwilling to pay a higher fare, while the other half are willing to pay more than the current fare. The group with a monthly income exceeding 60,000 NTD shows almost no preference for higher fare options.

From the group of individuals holding both car and motorcycle licenses, it can be observed that their choices regarding DRTS fares concentrate on lower fare levels. The group that only possesses motorcycle licenses exhibits a more flexible approach in their choice of ticket prices, showing a certain proportion of selections across various price levels. However, overall, there is still a tendency towards unwillingness to pay or lower willingness to pay.



Figure 4-7 Cross-analysis with travel cost and the willingness to pay

3. Willingness to pay for comfort

The current bus type from Taitung City to Luye Township is a 40seater bus. However, due to the size of the bus, it cannot drive through small roads and alleys, making it inconvenient and uncomfortable for individuals with disabilities who require door-to-door services. In the future, if DRTS begins operations, the intention is to improve the service by reducing the vehicle size, decreasing the number of passengers on each trip, and providing passengers with more spacious seating, aiming to extend services into residential areas. Therefore, this section of the survey investigates if the public accepts changes in vehicle types and their willingness to pay additional fees. From the results, we can observe that if changed to a medium-sized bus (18-seater), 33.7% chose to pay 10 NTD; if the vehicle type is changed to a small-sized bus (9-seater), 40.9% chose to pay 20 NTD. This indicates that the public has a higher acceptance of smaller bus types and is willing to pay some additional fees for more comfortable services.



Figure 4-8 Additional fee of willingness to pay from 40-seater bus to 18-seater bus


Figure 4-9 Additional fee of willingness to pay from 40-seater bus to 9-seater bus

Students and first industry have low unwillingness to pay proportion and higher willingness to pay. Regarding income and the Motorcycle ownership, it can be observed that whether the bus is changed to a medium-sized or small-sized, the proportion of respondents unwilling to pay remains similar. However, there is a noticeable increase in the proportion of respondents willing to pay an additional small fee.

For medium-sized buses, the willingness to pay is roughly similar across all motorcycle ownership groups. However, those with more than one motorcycle tend to have a slightly higher willingness to pay compared to less than owned one motorcycle per household. This suggests that economic conditions may influence people's willingness to pay for comfort. On the other hand, for small-sized buses, the overall willingness to pay is relatively higher. This indicates a generally higher acceptance of additional fees for this smaller bus type. It can be observed that if the bus type is changed to a small-sized bus, the proportion willing to pay an additional fee of 20-25 NTD will be the highest.



Figure 4-10 Cross-analysis with comfort and the willingness to pay (18-seater medium-sized bus)



Figure 4-11 Cross-analysis with comfort and the willingness to pay (9-seater small-sized bus)

4. Willingness to pay for accessibility

Due to the high proportion of elderly and disabled individuals in Luye Township, the walking distance from home to the station is a crucial factor influencing people's willingness to use public transportation. This survey investigates whether residents would be willing to pay an additional fee in exchange for more convenient services if DRTS could provide more stations, reducing the time required for individuals to walk to the station.

From the results, there are more individuals unwilling to pay extra fees if walking to the DRTS station is reduced to 5 minutes. If the walking time to the DRTS station is reduced to 3 minutes, more than half of the people are willing to pay an additional fee of 5~10 NTD. If the walking time to the DRTS station is reduced to 5 minutes, the proportion of unwillingness to pay noticeably increases. The highest number of people are willing to pay an additional fee of 8 NTD.

From the result, whether the walking time to the DRTS station is shortened to 3 or 5 minutes, the option with the highest extra fee still has over 10% of people willing to pay.



Figure 4-12 Willingness to pay of walking 3 minutes to the DRTS station



Figure 4-13 Willingness to pay of walking 5 minutes to the DRTS station

Based on the cross-analysis with significant socioeconomic variables, it is observed that nearly 40% of respondents in the first industry are willing to pay an additional fee of 8 NTD to reduce the walking time to 5 minutes. It can be observed that students, military/public servant, and service industry respondents have a higher overall willingness to pay. Additionally, it can be noted that approximately 90% of respondents with no income are willing to pay extra fees, and they exhibit a higher willingness to pay compared to other income groups. The willingness to pay for each option among passengers holding motorcycle licenses is similar, as there is a certain proportion of respondents selecting each option. In summary, a higher percentage of the population is more willing to pay an additional fee for reducing the walking time to the station to 3 minutes.



Figure 4-14 Cross-analysis with accessibility and the willingness to pay

(Reduced walking to the DRTS station to 3 minutes)



Figure 4-15 Cross-analysis with accessibility and the willingness to pay (Reduced walking to the DRTS station to 5 minutes)

4.4.1 Price Elasticity Analysis of Demand

Price elasticity is a crucial metric that measures the sensitivity of quantity demanded to change in price, providing valuable insights into consumer behavior. This section explores the price elasticity of the DRTS prices based on survey data, aiming to find out the potential responsiveness of passengers to alterations in fare structures.

The calculation of price elasticity involves dividing the percentage change in quantity demanded by the percentage change in price. The values of price elasticity can be classified into three categories: First, Elasticity greater than 1: demand is highly sensitive to price changes, and even a slight price increase may result in a significant decrease in demand. Second, Elasticity equal to 1: demand responds proportionally to price changes. Third, Elasticity less than 1: demand is not very sensitive to price changes, and even with a price increase, the decrease in demand is small. The formula can be expressed as follows:

$$E_D = \frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$
(5)

 ΔQ is the change in demand, and ΔP is the change in DRTS ticket price. Due to the absence of DRTS in Luye Township, actual demand data before and after price changes is unavailable. Therefore, price elasticity calculations are based on survey participants' responses to various fare options, serving as the basis for estimating price elasticity. The results of price elasticity from 85NTD to 90 \sim 95 \sim 100 \sim 105NTD are illustrated in Table 4-24.

Options	Sample Number (Demand)	Percent	Valid Percent	Cumulative Percent	Price Elasticity
85NTD	158	43.6	43.6	43.6	-
90NTD	99	27.3	27.3	71.0	-6.34
95NTD	36	9.9	9.9	80.9	-6.57
100NTD	65	18.0	18.0	98.9	-3.34
105NTD	4	1.1	1.1	100.0	-4.14
Total	362	100.0	100.0		

Table 4-24 The reasonable fare for DRTS from Luye Township to Taitung City

These results indicate the responsiveness of demand to changes in price. A negative elasticity value indicates that demand decreases as price increases. The values of the elasticity suggest the degree of sensitivity: the larger the absolute value, the more responsive the demand is to price changes. In this case, the demand appears to be highly elastic across all price changes, indicating that small price increases lead to significant decreases in demand.

4.4.2 Summary of Willingness to Pay

Based on the analysis of the survey results, the conclusions are listed below.

Firstly, concerning waiting time, the study indicates that the age group of 36 to 45 shows a higher willingness to pay. Additionally, students exhibit the highest willingness to pay additional fees, likely due to their prioritization of time efficiency and reliance on public transportation. The overall willingness to pay ranges between 10 to 15 NTD.

Secondly, regarding ticket prices, over half of the respondents willingness

to pay higher fares for DRTS. Individuals holding only motorcycle licenses tend to prefer lower ticket prices, indicating their sensitivity to costs and focus on cost-effectiveness. More than 65% of respondents are willing to accept fares not exceeding 90 NTD.

Furthermore, concerning comfort, most respondents prefer to pay additional fees for smaller bus types. Students and first industry demonstrate a higher willingness to pay for comfort, likely due to their transportation needs and remote working places. The overall willingness to pay for small-sized buses is around 20 NTD.

Lastly, regarding accessibility, the survey indicates that residents show a higher willingness to pay to reduce the walking time to bus stations compared to other service factors. This suggests insufficient bus station numbers in Luye Township, especially considering the high proportion of elderly and disabled residents. Improving service accessibility significantly influences residents' willingness to use public transportation.

CHAPTER 5 MODEL ESTIMATION AND DISCUSSION

The main purpose of this study is to discuss the factors of DRTS and the preferences of the public for these service factors. It aims to construct a model of DRTS factor selection using an ordered logit model, considering socioeconomic variables that influence selection behavior. The study collects questionnaire survey data and uses an ordered logit model to select significant independent variables for analyzing the importance of public transportation service factors among residents in Taitung City and Luye Township. The analysis used the SPSS statistical software for utility function estimation.

This study used Maximum Likelihood Estimation (MLE) to conduct model estimation, adjusting model parameters to maximize the likelihood function of observed data for parameter estimation. The Likelihood-Ratio Index (ρ^2) is commonly used to assess the goodness of fit of the model. Typically, ρ^2 ranging from 0.2 to 0.4 indicates a considerable degree of good explanation in the model (凌瑞賢, 2004).

This chapter is divided into two main parts, with the first presenting the results of model estimation, and the second providing a comprehensive discussion of the data analysis results.

5.1 Variable Descriptions

Variables in this study can be categorized into dependent variables and independent variables, detail is listed below:

1. Dependent variable

The main target of this study is to investigate how travelers value various DRTS factors. When travelers consider a service factor to be of very importance, it represents 5. If travelers consider it important, it represents 4. General is rated as 3, while not important factors are rated as 2, and not important at all is rated as 1.

- 2. Independent variable
 - (1) Gender: male as 1 and female as 0.
 - (2) Age: Respondents aged under 25 are set as 1, those between 26 and 45 are set as 2, and those between 46 and 64 are set as 3, aged above 65 are set as 4.
 - (3) Educational level: using "senior high" as the reference group, the educational level variable can be categorized into the following groups: "below high school," "college," and "graduate school or above."
 - (4) Place of residence: using "Luye Township" as the reference group, the other two dummy variables for "Taitung City" and "Other Areas."
 - (5) Job occupation 1: students set as 1, others set as 0.
 - (6) Job occupation 2: military/public servant set as 1, others set as 0.
 - (7) Job occupation 3: service industry set as 1, others set as 0.

- (8) Job occupation 4: first industry set as 1, others set as 0.
- (9) Job occupation 5: unemployed set as 1, others set as 0.
- (10) Monthly income: no income is set as 1, below 20,000 NTD is set as 2, 20,000-40,000 NTD is set as 3, 40,000-60,000NTD is set as 4.60,000 NTD and the above are set as 5.
- (11) Car and motorcycle license ownership: has a car or motorcycle license as 1 and doesn't have a car or motorcycle license as 0.
- (12) Car ownership: continuous variable.
- (13) Motorcycle ownership: continuous variable.
- (14) Frequency of using public transportation per week: setting the frequency of more than once a week as 1, and the frequency of less than once a week as 0.

5.2 Model Estimation

The model estimation section will be divided into nine parts, each focusing on estimating the importance of DRTS factors.

5.2.1 Model Estimation for The Importance of Waiting Time

The regression analysis results of this study indicate that age, job occupations, and driver's license possession have a significant impact on DRTS waiting time. Therefore, only these three significant variables are included in the model estimation in this section. Based on the model estimation results, individuals aged below 25 and between 26 and 64 years old exhibit significant effects on the dependent variable. The population under 25 years old and non-students may tend to prioritize DRTS waiting time more.

The overall model estimation results indicate a relatively low goodness of fit, suggesting a limited explanation of the model for the observed data.

Explanation of variables	Estimate	Std. Error	t-value
Under 25	1.031	0.512	2.014**
Between 26 and 45	0.933	0.317	2.943**
Between 46 and 64	0.673	0.311	2.164**
Aged above 65		-	-
Non-student	1.013	0.510	1.986**
Student		-	-
Non-military/public servant	0.230	0.316	0.728
Military/Public servant	21/5 (-	-
Non-service industry	0.193	0.327	0.590
Service industry	-	-	-
Non-first industry	-0.083	0.323	-0.257
First industry	-	-	-
Employed	-0.338	0.833	-0.406
Unemployed	-	-	-
Doesn't have a car or motorcycle license	-0.035	0.326	-0.107
Own a car or motorcycle license	-	-	-
LL*	205.187		
<i>LL</i> (0)	221.386		
ρ^2		0.079	

Table 5-1 Ordered logistic regression analysis results (age, job occupation, and license)

**means significant at the 0.05 level

5.2.2 Model Estimation for The Importance of Travel Time

The regression analysis results of this study indicate that job occupations, monthly income, and driver's license possession have a significant impact on DRTS waiting time. Therefore, only these three significant variables are included in the model estimation in this section.

The results indicate that the absolute value of the estimate for non-students (7.488) is greater than that for students (5.754), this indicates that non-students place a higher importance on travel time than students. Non-military/public servants place a higher importance on travel time than military/public servants, and those without a driver's license place a higher importance on travel time than those with a driver's license.

Overall, the model's goodness of fit is relatively low, indicating limited explanatory power of the model for the observed data. With a ρ^2 value of 0.089, indicating that the model explains approximately 8.9% of the variance in the observed data, while the remaining variance is unexplained by the model.

Explanation of variables	Estimate	Std. Error	t-value
Non-student	-7.488	1.449	-5.168**
Student	-5.754	1.300	-4.426**
Non-military/public servant	-3.655	1.268	-2.882**
Military/Public servant	-1.631	1.256	-1.299
Non-service industry	0.390	0.350	1.114
Service industry	-	-	-
Non-first industry	-0.121	0.348	-0.348
First industry	-	•	-
Employed	-0.601	0.338	-1.778
Unemployed	-	-	-
No income	-0.618	0.334	-1.850
Below 20,000 NTD	-	-	-
20,000-40,000 NTD	-0.734	0.834	-0.880
40,000-60,000NTD	うどの		-
60,000 NTD and above	-0.490	0.502	-0.976
Doesn't have a car or motorcycle license	-1.305	0.521	-2.505**
Own a car or motorcycle license	-0.813	0.461	-1.764
LL*		219.602	
<i>LL</i> (0)	241.087		
ρ^2		0.089	

Table 5-2 Ordered logistic regression analysis results (job occupation, income, and license)

**means significant at the 0.05 level

5.2.3 Model Estimation for The Importance of Travel Cost

The regression analysis results of this study indicate that age, monthly income, and driver's license possession have a significant impact on DRTS waiting time. Therefore, only these three significant variables are included in the model estimation in this section. The results indicate that the group aged between 26 and 45 tends to place greater emphasis on travel cost compared to those aged below 25 and between 46 and 64. The model indicates that the age group between 26 and 64 has a significant impact on the dependent variable. However, with ρ^2 is below 0.2, it suggests that the explanation of this model is relatively limited.

Explanation of variables	Estimate	Std. Error	t-value
Under 25	0.523	0.348	1.503
Between 26 and 45	1.616	0.316	5.114**
Between 46 and 64	1.098	0.311	3.531**
Aged above 65	H D C	-	-
No income	0.126	0.443	0.284
Below 20,000 NTD	-0.746	0.481	-1.551
20,000-40,000 NTD	-0.443	0.435	-1.018
40,000-60,000NTD	-0.468	0.477	-0.981
60,000 NTD and above	57%	-	-
Doesn't have a car or motorcycle license	-0.002	0.320	-0.006
Own a car or motorcycle license	-	-	-
LL*		244.813	
<i>LL</i> (0)	281.465		
ρ^2		0.13	

Table 5-3 Ordered logistic regression analysis results (age, income, and license)

**means significant at the 0.05 level

5.2.4 Model Estimation for The Importance of Comfort

The regression analysis results of this study indicate that job occupations, monthly income and motorcycle ownership have a significant impact on DRTS waiting time. Therefore, only these three significant variables are included in the model estimation in this section.

All households, regardless of the number of motorcycles they own, place a high importance on comfort, and this is statistically significant. As the number of motorcycles owned increases, the importance placed on comfort slightly decreases, but this change is minimal, and the importance remains at a high level. This indicates that, regardless of the number of motorcycles owned by a household, their expectations for comfort are very high.

Overall, the model indicates a significant impact of motorcycle ownership on the dependent variable. Additionally, the explanation of this model is relatively moderate, with ρ^2 value approaching 0.2.



Explanation of variables		Estimate	Std. Error	t-value
Employed		-1.325	0.882	-1.502
Unemployed		-	-	-
No income		-0.400	0.433	-0.924
Below 20,000 NTD		-0.767	0.476	-1.611
20,000-40,000 NTD		0.071	0.437	0.162
40,000-60,000NTD		-0.447	0.478	-0.935
60,000 NTD and above		-	•	-
	0	-19.885	1.047	-18.992**
	1	-19.661	1.025	-19.181**
	2	-19.389	1.036	-18.715**
Motorcycles ownership	3	-19.367	1.052	-18.410**
	4	-19.264	1.117	-17.246**
	5	-19.160	0.000	-
	6		-	-
LL*		156.573		
<i>LL</i> (0)		193.095		
ρ^2		0.189		

Table 5-4 Ordered logistic regression analysis results (job occupation, income, motorcycles ownership)

**means significant at the 0.05 level

5.2.5 Model Estimation for The Importance of Frequency

The regression analysis results of this study indicate that age and driver's license possession have a significant impact on DRTS waiting time. Therefore, only these two significant variables are included in the model estimation in this section.

Based on the model estimation results, it can be observed that the group

aged 26-45 values the frequency of DRTS services the most. This age group represents individuals in the prime working age, indicating that the frequency of public transportation services is crucial for them, especially for commuting to work. Overall, the model indicates that the age groups below 25 and between 26 and 64 significantly influence the dependent variable. Additionally, regarding model fitness, the explanatory power of this model is relatively moderate, with a ρ^2 value of 0.198.

Explanation of variables	Estimate	Std. Error	t-value
Under 25	0.726	0.353	2.057**
Between 26 and 45	1.296	0.303	4.277**
Between 46 and 64	0.730	0.303	2.409**
Aged above 65		-	-
Doesn't have a car or motorcycle license	0.023	0.314	0.073
Own a car or motorcycle license	Ē)	-	-
LL*	555	76.675	
<i>LL</i> (0)	エンへつ	95.568	
$ ho^2$		0.198	

Table 5-5 Ordered logistic regression analysis results (age and license)

**means significant at the 0.05 level

5.2.6 Model Estimation for The Importance of Boarding Convenience

The regression analysis results of this study indicate that age, job occupation and driver's license possession have a significant impact on DRTS waiting time. Therefore, only these three significant variables are included in the model estimation in this section.

A particularly special finding reveals that among all age groups, those under 25 prioritize boarding convenience the most. This outcome may be attributed to their daily activities and lifestyle. Young individuals typically engage in more social and recreational activities, often requiring more frequent use of public transportation. Additionally, young people may rely on public transportation more compared to other age groups, making the ease of boarding convenience even more critical for them.

The model indicates that age groups below 25 and between 26 and 64, as well as non-student groups and those who don't own a driver's license, significantly influence the dependent variable. The explanation of this model approaches 0.2, indicating a moderate level of explanatory capability, with the

 ρ^2 value of 0.193.



Explanation of variables	Estimate	Std. Error	t-value
Under 25	1.358	0.543	2.501**
Between 26 and 45	1.191	0.327	3.642**
Between 46 and 64	0.657	0.317	2.073**
Aged above 65	-	-	-
Non-student	1.175	0.540	2.176**
Student	-	-	-
Non-military/public servant	-0.377	0.329	-1.146
Military/Public servant	-	-	-
Non-service industry	-0.353	0.341	-1.035
Service industry	-	-	-
Non-first industry	-0.640	0.336	-1.905
First industry	-	-	-
Employed	-0.247	0.851	-0.290
Unemployed			-
Doesn't have a car or motorcycle license	0.708	0.344	2.058**
Own a car or motorcycle license		-	-
LL*		146.47	
<i>LL</i> (0) 181.493			
ρ^2	2 R K	0.193	

Table 5-6 Ordered logistic regression analysis results (age, job occupation, and license)

**means significant at the 0.05 level

5.2.7 Model Estimation for The Importance of Reservation Convenience

The regression analysis results of this study indicate that monthly income, driver's license possession and Motorcycle ownership have a significant impact on DRTS waiting time. Therefore, only these three significant variables are included in the model estimation in this section. According to the estimates, the group with income below 20,000 NTD shows the highest estimate, indicating that they prioritize this factor more compared to other income groups.

All households, regardless of the number of motorcycles they own, place high importance on reservation convenience, which is statistically significant. Households with fewer motorcycles tend to value it slightly more, but the difference is minimal overall. All households have very high expectations for reservation convenience.

The estimation results of this model indicate that motorcycle ownership has a significant impact on the dependent variable. Moreover, the ρ^2 value of the model falls within the theoretical range of 0.2 to 0.4. Thus, it suggests that the model constructed in this study possesses a considerable degree of explanation.



Explanation of variables		Estimate	Std. Error	t-value
No income		-0.836	0.491	-1.703
Below 20,000 NTD		-1.774	0.524	-3.385**
20,000-40,000 NTD		-0.860	0.483	-1.781
40,000-60,000NTD		-0.943	0.522	-1.807
60,000 NTD and abov	e	-	-	-
Doesn't have a car or motorcycle license		-0.472	0.268	-1.761
Own a car or motorcycle license		-	-	-
	0	-19.814	1.215	-16.308**
	1	-19.631	1.190	-16.497**
	2	-19.080	1.200	-15.900**
Motorcycles ownership	3	-19.558	1.214	-16.110**
	4	-19.794	1.269	-15.598**
	5	-18.149	0.000	-
	6	NEG.	-	-
LL*			181.601	
<i>LL</i> (0)		227.033		
ρ^2			0.200	

Table 5-7 Ordered logistic regression analysis results (income, license, motorcycle ownership)

**means significant at the 0.05 level

5.2.8 Model Estimation for The Importance of Accessibility

The regression analysis results of this study indicate that job occupation, monthly income, and driver's license possession have a significant impact on DRTS waiting time. Therefore, only these three significant variables are included in the model estimation in this section. From the results, it can be observed that monthly income below 20,000 NTD has a significant impact on the dependent variable, suggesting that this group is more likely to face constraints in public transportation accessibility. The reasons may include inadequate public transportation services and a heavier burden of transportation costs.

The explanation of this model is relatively low, with the ρ^2 value of 0.160. This indicates that the model's explanation is relatively low, with approximately 16% of the variance in the observed data explained by the model.

Explanation of variables	Estimate	Std. Error	t-value
Non-student	0.315	0.358	0.880
Student	-	-	-
Non-military/public servant	-0.292	0.361	-0.809
Military/Public servant	H DC	-	-
Non-service industry	-0.453	0.347	-1.305
Service industry		-	-
Non-first industry	-0.398	0.340	-1.171
First industry		-	-
Employed	-1.856	1.134	-1.637
Unemployed		-	-
No income	-0.958	0.549	-1.745
Below 20,000 NTD	-1.492	0.566	-2.636**
20,000-40,000 NTD	-0.943	0.512	-1.842
40,000-60,000NTD	-0.928	0.536	-1.731
60,000 NTD and above	-	-	-
Doesn't have a car or motorcycle license	0.404	0.337	1.199
Own a car or motorcycle license	-	-	0.880
LL*	160.530		
<i>LL</i> (0)	191.006		
ρ^2		0.160	

Table 5-8 Ordered logistic regression analysis results (job occupation, income, and license)

**means significant at the 0.05 level

5.2.9 Model Estimation for The Importance of Transfer Convenience

The regression analysis results of this study indicate that age, job occupation, monthly income, driver's license possession, and motorcycle ownership have a significant impact on DRTS waiting time. Therefore, only these five significant variables are included in the model estimation in this section.

The age group between 26 and 45 places more importance on transfer convenience compared to other age groups because they are actively engaged in various activities, such as work, family responsibilities, and social engagements. As a result, they may need to transfer between different modes of transportation more frequently, making transfer convenience a significant factor for them. Furthermore, households with an income below 20,000 NTD and between 40,000-60,000 NTD, as well as those without motorcycles or with 1 to 4 motorcycles, all place significant importance on transfer convenience a little more than those with motorcycles. These groups have a need and expectation for the transfer convenience.

From the model estimation results, it is evident that the overall explanatory power of the model is limited. Additionally, variables between the ages of 26 and 64 demonstrate statistically significant effects on the dependent variable.

		,	1/	
Explanation of variab	les	Estimate	Std. Error	t-value
Aged below 25		0.941	0.536	1.756
Between 26 and 45		1.256	0.340	3.694**
Between 46 and 64		0.930	0.329	2.827**
Aged above 65		-	-	-
Non-student		1.397	0.540	2.587**
Student		-	-	-
Non-military/public ser	vant	-0.222	0.372	-0.597
Military/Public serva	int	-	-	-
Non-service industr	у	-0.074	0.360	-0.206
Service industry		-	-	-
Non-first industry		-0.359	0.350	-1.026
First industry		-	-	-
Employed		0.640	0.874	0.732
Unemployed			-	-
No income		-0.349	0.589	-0.593
Below 20,000 NTD		-1.294	0.599	-2.160**
20,000-40,000 NTD		-1.047	0.539	-1.942
40,000-60,000NTE		-1.113	0.560	-1.988**
60,000 NTD and abo	ve		-	-
Doesn't have a car or motorcy	cle license	0.377	0.363	1.039
Possesses a car or motorcyc	le license	SOK	-	-
	0	-19.962	1.066	-18.726**
	1	-19.672	1.028	-19.136**
	2	-19.308	1.038	-18.601**
Motorcycles ownership	3	-19.523	1.053	-18.540**
	4	-19.623	1.124	-17.458**
	5	-19.100	0.000	-
	6	-	-	-
LL*			399.176	
<i>LL</i> (0)			451.411	
ρ^2		0.116		

Table 5-9 Ordered logistic regression analysis results (age, job occupation, income, license, and motorcycle ownership)

**means significant at the 0.05 level

CHAPTER 6 DISCUSSION AND POLICY-RELATED RECOMMENDATIONS

The main content of this chapter involves discussing the data analysis results of regression analysis and investigation of willingness to pay. Based on these results, recommendations are provided for future DRTS operations and policy planning.

6.1 Discussion on The Importance of DRTS Factors

This study selected some groups that showed particularly notable results in the regression analysis for further discussion.

1. Unemployed individuals: the analysis revealed that unemployed individuals highly emphasize multiple DRTS factors, warranting special attention. According to the regression analysis results, unemployed individuals show a higher emphasis on travel time, comfort, boarding convenience, and accessibility of DRTS. According to Table 6-1, most unemployed individuals possess a car or motorcycle license and have a car or motorcycle at home. Therefore, it is likely that the unemployed in the area are accustomed to using private vehicles.

Age	Number of individuals	Percent
26-35	3	50%
36-45	2	33%
65-70	1	17%
Possession of driver's licenses	Number of individuals	Percent
Possession of car and motorcycle licenses	4	67%
Only possesses a car license	1	16.5%
Do not have a car or motorcycle license	1	16.5%
Car ownership	Number of individuals	Percent
0	2	33%
1	2	33%
5	1	17%
6		17%
Motorcycle ownership	Number of individuals	Percent
0	4	67%
1 523	261	16.5%
5		16.5%

 Table 6-1 Basic information (unemployed)

Figure 6-1 indicates that most unemployed individuals do not frequently use public transportation, consistent with the findings of (Wang *et al.*, 2015). Despite this, they still place high importance on various DRTS service factors, which indicates that unemployed individuals are accustomed to convenient and comfortable modes of travel, this may reflect their expectations for potential improvements in public transportation or indicate that these factors are critical conditions for them to choose public transportation, even if their current usage frequency is low. They might believe that better service quality could increase their willingness to use public transportation. Therefore, the unemployed may potentially constitute a significant customer base for DRTS in the future.



Figure 6-1 The using public transportation frequency (unemployed)

2. First industry (agriculture/forestry/fishing/animal husbandry): the first industry represents a high proportion (13.5%) among the respondents, and regression analysis results show significance across factors such as travel time, boarding convenience, accessibility, and transfer convenience regarding DRTS service. It warrants a discussion to investigate their preferences and behaviors. Table 6-2 is the basic information of first industry individuals. A significant portion of the first industry respondents are in the age groups 56-64 (21%) and 71-80 (19%), and most (82%) possess both car and motorcycle driver's licenses.

This indicates that those in the first industry are predominantly older individuals, who may have limited mobility due to age-related factors. Therefore, their travel needs prioritize boarding convenience and accessibility. According to previous studies, older individuals may rely more on public transportation, and most elderly individuals lose the ability to drive cars (Kersting et al., 2021a; Knierim & Schlüter, 2021). This is also evident from Table 6-2, which shows that more than half of the workers in the first industry do not own cars. Figure 6-2 indicates that respondents engaged in the first industry in this study's research area rarely use public transportation, and their usage rate is lower than that of other groups. Despite this, they place significant importance on various service factors. This suggests that the current public transportation may not meet their needs, leading to low usage. It also indicates a strong potential to increase public transportation usage if services are improved to address their concerns regarding travel time, boarding convenience, accessibility, and transfer convenience. Improving these factors could significantly enhance the quality of life for older individuals in the first industry by providing more reliable and accessible transportation options.

Age	Number of individuals	Percent
19-25	1	2%
26-35	6	12%
36-45	6	12%
46-55	7	14%
56-64	10	21%
65-70	6	12%
71-80	9	19%
81-90	3	6%
Above 91	1	2%
Possession of driver's licenses	Number of individuals	Percent
Possession of car and motorcycle licenses	40	82%
Only possesses a car license	1	2%
Only possesses a motorcycle license	5	10%
Do not have a car or motorcycle license	3	6%
Car ownership	Number of individuals	Percent
0	46	58%
	21	26%
2	10	13%
3	2	3%
6	551	1%
Motorcycle ownership	Number of individuals	Percent
0	10	20%
1	27	55%
2	8	16%
3	1	2%
4	3	6%

Table 6-2 Basic information (first industry)



Figure 6-2 The using public transportation frequency (first industry)

3. Individuals with only a motorcycle license: according to the results of regression analysis, those with a motorcycle license place great importance on waiting time, travel time, travel cost, frequency, boarding convenience, reservation convenience, accessibility, and transfer convenience. Therefore, this study will separately discuss the public transportation preferences of this group.

From Table 6-3, it is evident that the majority (65%) of these individuals are students, and their monthly income is below 40,000 NTD, this also confirms that groups with lower income levels are more accustomed to using motorcycles, which have lower ownership costs. It is also understandable why individuals with only a motorcycle license, accustomed to the high flexibility and extreme convenience of private vehicles, are less willing to use public transportation and have higher expectations for future DRTS. Affordable transportation is crucial for low-income groups, making travel cost a significant factor. Additionally, because the students place greater importance on time-related factors, transfer convenience and travel time significantly influence their willingness to use public transportation (Nelson & Phonphitakchai, 2012; Te Morsche *et al.*, 2019; Wang *et al.*, 2015; Weckström *et al.*, 2018).

Age	Number of individuals	Percent
19-25	5	16%
26-35	2	6%
36-45	5	16%
46-55	3	10%
56-64	3	10%
65-70	5	16%
71-80	6	19%
81-90	2	6%
Job occupation	Number of individuals	Percent
Student	48	65%
Military/Public servant	2	3%
Service industry	3	4%
Secondary industry	3	4%
First industry	5	7%
Self-employed	1	1%
Homemaker	10	14%
Other	2	3%
Monthly income	Number of individuals	Percent
No income	17	55%
Below 20,000 NTD	5	16%
20,000-40,000 NTD	9	29%

 Table 6-3 General information (only possesses a motorcycle license)



Figure 6-3 The using public transportation frequency (only possesses a motorcycle license)

6.2 Discussion on The Willingness to Pay

1. Waiting time: according to the investigation of willingness to pay, if the waiting time is 10 minutes, the age group of 36 to 45 has the highest proportion of respondents unwilling to pay additional fee, this age group constituting approximately 45% of the total respondents, likely has busy lifestyles and work routines. Therefore, they may prioritize time efficiency, and waiting for 10 minutes is not attractive. The reason why the proportions of healthcare workers chose 10, 15, and 20 NTD options is equal may be because these price options hold similar value or acceptability for them. This could reflect their sensitivity to prices and relatively consistent perception of the value of waiting time if the demand remains stable across different price levels, then the price elasticity is likely to be low. Thus, they might not have distinct preferences when making choices among these options.

2. Travel cost: According to responses from individuals with no income, more than half of them are willing to pay higher fares to enjoy DRTS services. This indicates both the dependency of the no-income group on public transportation and highlights the importance of rural transportation for no-income individuals (Asgari & Jin, 2020). Furthermore, this study found that passengers with a monthly income exceeding 60,000 NTD are nearly unwilling to pay higher fares than the current ones, this could be attributed to their access to a wider range of transportation choices, and they may prefer more comfortable and convenient modes of travel rather than relying on DRTS services (Anburuvel *et al.*, 2022).

The willingness to pay of respondents holding both car and motorcycle licenses is low, this suggests that they may have alternative transportation options and prefer using their vehicles rather than relying on DRTS services. The overall trend of individuals who possess a motorcycle license towards lower ticket prices indicates their higher sensitivity towards pricing and emphasis on cost-effectiveness. Individuals holding only motorcycle licenses may prefer more economical ticket options, showing they may rely on DRTS services.

Analyzing the willingness to pay based on the place of residence reveals differences between residents of Luye Township and other places. The analysis results show that the proportion of Luye Township residents willing to pay 85 NTD is significantly higher than that of other areas, indicating a difference in willingness to pay between local people and other residents. In contrast, other regions show no clear preference for any specific fare, reflecting diverse views on the value of the service. Based on this, a significant fare increase would likely affect the willingness to use DRTS of Luye Township. Therefore, it is recommended to adjust fares carefully. Moreover, the proportion of other areas unwilling to pay is lower than that of Luye Township residents, indicating the lower fare elasticity.



Figure 6-4 Travel cost across different townships

3. Comfort: Throughout the survey process, many respondents mentioned that they did not perceive the medium-sized bus (18-seater) to be more comfortable than the 40-seater bus. However, there was a generally higher
acceptance for the small-sized bus (9-seater) that could provide accessibility facilities, and replacing large bus types with smaller bus types can reduce user travel time and waiting time (Alsaleh *et al.*, 2023). There are approximately 19% of the respondents in this study are aged 65 and above, the provision of accessibility services, passenger capacity, and comfort level are crucial factors for these respondents.

From the analysis results, it can be observed that students' willingness to pay is significantly higher than that of respondents from other occupations, this is consistent with the findings of (Nyga *et al.*, 2020). The reason may be that students lack private vehicles. According to Figure 6-5, most of the students don't have driver's licenses, so they must rely on public transportation, consistent with the findings of Simons *et al.* (2017), which might place greater importance on DRTS passenger capacity and comfort.

On the other hand, workers in the first industry also show a great emphasis on comfort. The reason may be that they often operate in remote areas and need a longer travel time to reach their workplaces where smaller vehicle types are more practical for accessibility and provide a more private travel experience, enhancing the comfort of public transportation. Therefore, despite the relatively low income of respondents in the first industry (with over 70% monthly income less than 20,000 NTD), this group is still willing to pay higher fees for more comfortable DRTS services.



Figure 6-5 Possession of driver's licenses (student)

4. Accessibility: From the result, whether the walking time to the DRTS station is shortened to 3 or 5 minutes, the option with the highest extra fee still has over 10% of people willing to pay. This result suggests that residents living in Luye Township may not be satisfied with the current accessibility, the importance placed on accessibility and the distance to bus stations are significant for the interest in using DRTS (Zhao *et al.*, 2024). As the ongoing "Eastern Taiwan Regional Transport Planning Series Studies," conducted by the Ministry of Transportation and Communications (MOTC), has not yet been completed, the average trip length for daily travel of local residents in Taitung County cannot be obtained. Hence, it is not possible to ascertain the daily travel distance of local residents or estimate the acceptable distance for the DRTS stations.

Table 6-4 shows the bus routes and stations in Luye Township. With a total

of 20 bus stations, the area of Luye Township is 90 square kilometers, resulting in an average of 4.5 square kilometers per station. Moreover, most of these stations are located along the main road, Taiwan Number 9 Highway. Combining the above observations, there are not enough bus stops and service areas in Luye Township. There is still a huge step to achieving seamless transportation in the area. Additionally, with a significant proportion of the local population being elderly or disabled, reducing walking time to the DRTS station significantly enhances residents' travel convenience and willingness to travel.

8170	8161	8163	8165	8166	8167	8168
Luye Train Station	Wing On Farm	Wing On Farm	Jingfeng(景豐)	Jingfeng(景豐)	Wing On Farm	Yongan Community
Luye Junior high	Yongxing (永興)	Yongxing (永興)	Xinfeng (新豐)	Xinfeng (新豐)	Yongxing (永 興)	Zhongzhuang (中庄)
Longtian Elementary School	Flying Dream Factory	Flying Dream Factory	Ruihe Train Station	Ruihe Train Station	Flying Dream Factory	Xialuliao (下鹿 寮)
Guangrong (光榮)	Wing Long (永隆)	Wing Long (永 隆)	Ruixing (瑞興)	Ruixing (瑞興)	Wing Long (永 隆)	Yongchang tribe
Lung Tin (龍 田)	Water source (水 源地)	Water source (水 源地)	Ruiyuan (瑞源) Church	Ruiyuan (瑞源) Church	Water source (水源地)	Water source (水源地)
Hu Di (湖底)	Luye Library	Luye Library	Ruiyuan Farmers Association	Ruiyuan Farmers Associati on	Luye Library	Luye Library

Table 6-4 Bus routes and stations in Luye Township

8170	8161	8163	8165	8166	8167	8168	
Siwei (四維)	Luye Train Station	Luye Train Station	Ruiyuan Train Station	Ruiyuan Train Station	Luye Train Station	Luye Train Station	
	Luye Junior high	Luye Junior high	Luye Township Office	Luye Townshi p Office	Luye Junior high	Luye Junior high	
	Longtian Elementary School	Longtian Elementar y School	Water source (水源地)	Water source (水源地)	Longtian Elementary School	Longtian Elementary School	
	Guangrong (光榮)	Guangron g(光榮)	Luye Library	Luye Library	Guangrong (光 榮)	Guangrong (光 榮)	
	Lung Tin (龍田)	Lung Tin (龍田)	Luye Train Station	Luye Train Station	Lung Tin (龍 田)	Lung Tin (龍田)	
	Hu Di (湖 底)	Hu Di (湖 底)	Luye Junior high	Luye Junior high	Hu Di (湖底)	Hu Di (湖底)	
	Siwei (四 維)	Siwei (四 維)	Longtian Elementary School	Longtian Elementa ry School	Yan Ping Township Office	Yan Ping Township Office	
		ы С	Guangrong (光 榮)	Guangro ng (光 榮)	Siwei (四維)	Siwei (四維)	
			Lung Tin (龍田)	Lung Tin (龍田)			
			Hu Di (湖底)	Hu Di (湖底)			
			Siwei (四維)	Siwei (四維)			

Source: Highway Bureau, Ministry of Transportation and Communications

6.3 Policy-related Recommendations

1. Nelson and Phonphitakchai (2012) found that DRTS are more accepted in environments with low private vehicle ownership. In areas with higher private vehicle ownership, the initial demand for DRTS services may grow slowly. In this study's survey area, nearly 90% of respondents have at least one motorcycle, indicating that initial demand for DRTS may grow slowly. Therefore, it is recommended to enhance publicity and education to raise awareness and acceptance of DRTS and pilot the service in areas with lower motorcycle ownership.

2. Based on the discussion, students may be a significant potential user group for future DRTS. Since students place a higher value on time, it is recommended to increase the frequency of services during peak hours to attract student ridership.

3. The analysis results indicate that the majority of individuals with only a motorcycle license have lower incomes and are accustomed to the convenience of private vehicles. Therefore, it is recommended to enhance the convenience of the reservation system and provide real-time reservation services to reduce waiting times.

4. Additionally, the public generally finds it more acceptable for DRTS to operate using small bus types. It is recommended that future operations switch to small buses to increase public willingness to use the DRTS service.

5. In terms of accessibility, more than 10% of the respondents are willing to

pay the highest additional fare if the walking time to the station is reduced to 3 to 5 minutes. This indicates a high demand for accessibility among residents. Therefore, it is recommended to appropriately increase the number of DRTS stations. However, increasing the number of stations may also lead to longer travel times, which could negatively impact users' willingness to pay. It is recommended to conduct a careful demand assessment before moderately increasing the number of stations. Additionally, collaborating with local communities and stakeholders to understand the specific needs and preferences of residents can ensure the change of route and stations aligns with user expectations and enhances satisfaction.



CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS

To improve public transportation services in rural areas and increase public transit usage among the population, the implementation of the DRTS project is proposed. This initiative aims to expand the coverage of public transportation services and provide services tailored to the needs of passengers, encouraging private vehicle users to switch to public transportation. The ultimate goal is to increase the utilization rate of public transportation and enhance accessibility for residents in rural areas.

This study investigates the opinions of residents in Luye Township, Taitung County on the DRTS. To understand what are the factors they value in DRTS and their willingness to pay. After collecting the data, the analysis of the results provides insights into the future development goals and direction of public transportation. The conclusions and recommendations of this study are as follows.

7.1 Conclusions

- 1. According to previous research, the factors that people value most in public transportation services are waiting time, travel time, and travel costs. Moreover, the key socioeconomic variables that significantly influence mode choice behavior include income, age, and vehicle ownership.
- 2. This study was conducted through paper-based and online surveys, primarily in Luye Township and Taitung City, Taitung County. A total

of 362 valid responses were collected. The survey mainly investigated the importance of DRTS service factors and the willingness to pay.

- 3. The analysis revealed a balanced gender distribution and a majority of respondents below the age of 65, with many residing in Luye Township. Most respondents had hold a senior high degree, and also another finding is from the whole respondents, a significant portion had no income. Additionally, a majority possessed both car and motorcycle licenses, which possibly may caused the low usage of public transportation.
- 4. According to the survey results on DRTS factors, accessibility is the top priority for the public, followed by boarding convenience, and the third is the convenience of ltransfer.
- 5. From the regression analysis results, it can be inferred that age, income, job occupation, and possession status of car and motorcycle licenses are significant socioeconomic variables influencing DRTS factors.
- 6. Individuals under 18 prioritize waiting time more than other age groups. Healthcare workers and professionals in the Finance/Insurance industry value waiting time highly. Primary sector, especially the elderly, has significant needs for travel time, boarding convenience, accessibility, and transfer convenience in public transportation, but their usage rate of public transport is much lower than other groups. Travel time and cost are crucial for those with no income or low income,

and individuals holding only a motorcycle license. Comfort, accessibility, boarding convenience, and travel time are essential for the unemployed, indicating their expectations for public transportation are higher compared to those who are employed.

7. The willingness to pay findings indicate that the age group of 36 to 45 and students demonstrate a higher willingness to pay for improvements in waiting time. In terms of ticket prices, over half of the respondents are willing to pay higher fares for DRTS. Regarding comfort, individuals show a preference for paying extra for small-sized bus type. Additionally, residents prioritize reducing walking time to bus stations compared to other service factors.

7.2 Recommendations

- 1. In the future, DRTS will have higher costs due to improved service quality and convenience. If fare adjustments are necessary, it is recommended that fares be increased by no more than 105 NTD as a principle, and the most accepted fare range among respondents is 90-100 NTD. Given the high fare elasticity of the local residents, not increase the fare too much at once to avoid affecting their willingness to use public transportation.
- 2. In the future, when formulating DRTS operational strategies, prioritizing the expansion of station numbers should be considered, with a focus on ensuring seamless connections with other modes of

transportation. Secondly, transitioning to smaller-sized buses equipped with accessibility features and offering more flexible routes and improved boarding convenience should be considered and pursued. These measures aim to enhance the overall quality of service and increase the willingness of residents to use public transportation.

- 3. In the future, if DRTS is implemented to operate between Luye Township and Taitung City, subsequent research could explore the changes in public perception before and after its operation.
- 4. If in the future, types of changes of DRTS bus or schedules lead to increased operating costs, it is recommended that subsequent research conduct a cost-benefit analysis. This should include examining the impact of different vehicle types and schedule changes on acquisition, maintenance, fuel, and labor costs, as well as the benefits they bring. Additionally, the study should explore whether subsidy-related strategies are needed.
- 5. As there is currently no DRTS operation between Luye Township and Taitung City, the calculation of fare flexibility will be based on survey data estimates. After the actual operation in the future, more in-depth studies can be conducted on this aspect.

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APPENDIX

親愛的先生/小姐您好:

首先感謝您撥空填答此份問卷,這是一份有關需求反應式公共運輸服務(DRTS)的學術問卷,希望透過您的填答來探討使用者對 DRTS 服務的需求及看法。

本研究純屬學術研究,以不記名方式,所有答案無對錯之分,僅供資料分析,不作個別披露,亦不另作他用。為感謝您撥冗填寫本問卷,填答結束後將<u>贈送面額 35 元之 7-11 飲品禮券一張</u>,麻煩請您仔細填答! 您所提供的資訊與見解,將對本研究有重大的幫助。十分感謝您對學術研 究貢獻的時間與心力。



鹿野鄉 DRTS 簡介↔

需求反應式服務(DRTS)是一種採用小型車輛進行營運之大眾運輸。在台灣普遍被稱為「幸福巴士」或「復康巴士」,鑒於鹿野鄉尚未引入相關服務,東台灣客運擬 推行 DRTS 營運台東市-鹿野鄉之路線,服務內容如下:↩

- 服務特性:提供固定班次及提前預約服務,行動不便乘客可在自家門口直接上 下車,且 DRTS 服務班距較傳統公車密集,可快速便利地服務鄉民。
- 服務範圍:一般乘客可在台東市區及鹿野鄉<u>特定站點(如:鹿野鄉圖書館、超高、台東轉運站)</u>預約上下車;行動不便乘客則可在台東轉運站2公里內之地區以及鹿野鄉自由選擇地點預約上下車。
- 事上設施:採用 9 人或 18 人座車輛營運,車內舒適度與轎車相似。<u>車輛備有</u> 無障礙設施,高齡與身心障礙者可以安心上下車。
- 4. 預約方式:民眾僅需撥打東台灣客運專線就會有專員協助您預約乘坐 DRTS。↩
- b費標準:比照傳統公車收費,孩童、高齡者、身心障礙者及其陪同者可享半 票優惠;若行動不便乘客選擇自由地點上下車則<u>額外加收30元</u>之費用。
 ·

基本資料
1. 性別
□生理男□生理女
2. 年龄
□18 歲以下 □19 歲-25 歲 □26 歲-35 歲 □36 歲-45 歲 □46 歲-55 歲
□56 歲-64 歲□65 歲-70 歲 □71 歲-80 歲 □81 歲-90 歲 □91 歲以上
3. 目前教育程度
□未接受過教育 □國小(含)以下 □國中 □高中/高職 □專科大學 □研究所(含)以上
4. 居住地
□臺東市 □卑南鄉 □鹿野鄉 □延平鄉 □關山鎮 □池上鄉 □其他地區:
5. 職業(現任或退休前主要的職業)
□學生 □軍公教人員 □醫務人員 □服務業 □科技業 □金融保險業 □傳統產業
□農林漁牧業 □自由業 □待業 □家管 □其他:
6. 月所得
□無所得 □20,000 元以下 □20,000-40,000 元 □40,000-60,000 元
□60,000-80,000 元 □80,000-100,000 元 □100,000 元以上
7. 請問您是否擁有汽車與機車駕照?
□擁有汽車與機車駕照 □僅有汽車駕照 □僅有機車駕照 □兩者皆無
8. 請問您家中擁有的車輛數?
汽車:輛 機車:輛
9. 您每週搭乘大眾運輸的頻率
□每週少於1次□每週1-3次□每週4-6次□每週7-9次□每週10次以上

第一部分

	1	2	3	4	5
	非	不	普	重	非
	常	重	通	要	常
	不	要			重
	重				要
	要				
1. 您認為 DRTS 的等車時間是重要的					
2. 您認為 DRTS 的旅行時間(起點到目的地的時間)是重要的					
3. 您認為 DRTS 的票價是重要的					
4. 您認為 DRTS 的舒適性是重要的					
5. 您認為 DRTS 的班次頻率是重要的					
6. 您認為 DRTS 的上下車方便性是重要的					
7. 您認為 DRTS 的預約方便性是重要的					
8. 您認為 DRTS 的可及性(路線所涵蓋的範圍)是重要的					
9. 您認為 DRTS 的轉乘方便性是重要的					

第二部分

	等車時間			願付價格			
1.	如果等待時間為 5分鐘 ,我	不願意支付	15 元	20 元	25 元	30 元	
	願意支付額外費用(目前客運	_	_	_	_	_	
	尖峰班次為15分鐘一班):						
2.	如果等待時間為10分鐘,我	不願意支付	10 元	15 元	20 元	25 元	
	願意支付額外費用(目前客運						
	尖峰班次為15分鐘一班):						
	票價	願付價格					
3.	您認為由鹿野鄉至台東市(開	85 元	00 	95 元	100 	105 元	
	車約 40-50 分鐘)之 DRTS 全	0.5 / 0	JU /L	<i>)))</i>	100 /2		
	票合理票價為多少元?(目前客						
	運票價為 84 元)		0.000				
	舒適性	願付價格					
4.	若 DRTS 車型由甲類大客車	不陌音士什	10 元	15 元	20 	25 	
	(40 人座遊覽車)更換為中型巴	个旗总又们	10 /2	1576	20 /6	25 76	
	士(18人座),我願意支付額外						
	費用:	C 13		117			
5.	若 DRTS 車型由甲類大客車	不願意古什	20 元	25 元	30 元	35 元	
	(40 人座遊覽車)更換為小型巴	THR S X I	20 /6	23 /0	5076	5576	
	士(9人座)我願意支付額外費						
	用:						
	可及性	願付價格					
6.	如果步行到 DRTS 車站的時	不願意支付	5元	10 元	15 元	20 元	
	間縮短至 3分鐘 ,我願意支	_	_		_	_	
	付額外費用:						
7.	如果步行到 DRTS 車站的時	不願意支付	3元	8元	13 元	18 元	
	間縮短至5分鐘,我願意支						
	付額外費用:						