Associations Between Socioeconomic and Trip Characteristics of Bus Passengers to Plan for Transfer-Based Bus Transport Operations.

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I. Introduction

There are mainly two types of bus routes in Sri Lanka. They are main routes and secondary routes. Secondary routes connect main town centers to secondary-level townships, while main routes often connect two main towns or city centers. Secondary bus routes' extensive service, including feeder buses, can create a lap length, impacting supply and demand cycles. In response to this challenge, the concept of a transfer-based bus transport network (TBBTN) emerges as a potential solution. Specifically, the study aims to discern the influence of socioeconomic factors and travel characteristics, thereby illuminating critical insights for the development of a system that maximizes operational efficiency while minimizing passenger inconvenience. By testing the associations between these key variables, this research endeavors to contribute to the advancement of a more effective and responsive bus transport network in Sri Lanka.

II. Literature Review

Urban traffic issues required public transportation (PT) [1], which required coordination and satisfaction [2]. Transfer-based systems were used in developed countries [3]. However, the whole industry depended on customer satisfaction [4]. Surveys and analysis of socioeconomic and trip characteristics were crucial for understanding passenger satisfaction and improving public bus transportation [5].

Different traveler groups had varying opinions about their trips [6] influenced by factors like age, gender, income, and time. Public transportation usage could be influenced by factors like price and parking issues [4]. Reasons to avoid public transportation included safety, comfort, and time efficiency. Passengers expected better services for higher satisfaction levels [7].

Female travelers faced challenges with travel planning, with low-income travelers often choosing the least expensive transportation [6]. They expected less out-of-vehicle time and prefer public transport for its affordability and relaxation [5]. However, they avoided PT due to parking issues, high time consumption, and safety concerns during night travel.

Planning for a door-to-door trip involves considering factors like waiting times, journey duration, and transfers, which were often overlooked in public transport accessibility studies and decision-support systems [8]. Factors such as cost, transfers, walking distance, safety, and convenience could affect trip satisfaction [5].

China prioritized urban passenger transport development, focusing on rapid rail transit, ground buses, and feeder buses. Research on transfer convergence was necessary for efficient, timely, and integrated transport [9]. Coordination of transfers could speed up service connectivity and reduce wait times [2].

III. Materials and Methods

The research focused on transportation systems for passengers, operators, and regulators. Background study and pilot test were used to identify variables. A questionnaire was designed which included details on passenger socioeconomic characteristics and trip characteristics of the passengers for their current trips and the perceived satisfaction on their existing and the to be proposed transfer-based bus transport networks. The questions targeted the alternative hypothesis that of there were associations between Socioeconomic and Trip Characteristics of Bus Passengers.

The Annual Reports of the Central Bank of Sri Lanka were used to identify the categories for the chosen variables such as passengers' age, gender, and income. Categories for trip characteristics such as reasons for using public transport, cost, waiting time, trip purpose, frequency and time of bus usage were developed based on the literature and the background study. A Likert scale was used to measure trip characteristics such as convenience and safety. Current trip information such as departure and arrival time, waiting time, cost, mode, and distance of each step of the journey were also collected. Information on the level of satisfaction on the current and the to be proposed TBBTN were collected through a rating scale. In addition, passengers were requested to rate the perceived bus fare for the proposed TBBTN considering 100 percentage for the bus fare for their current trip.

Data was collected from nearly 300 passengers through interviews. Cross-tabulation analysis (chi-square test) was conducted to test the existence of statistically significant association between the socioeconomic characteristics and the trip characteristics.

IV. Results and Discussion

The survey results are shown in Table 1. These findings underscore a statistically significant association between gender and safety, as well as convenience in the context of bus travel. Female travelers were more concerned with safety and expected seats and less standing time compared to male passengers. This finding holds true as women were more likely than men to be assigned the characteristics "travel shy," "reassurance seeker," and "cautious planner." [6]. The survey results revealed that passengers perceived switching to TBBTN could reduce the total waiting time and travel time since the frequency was higher. Therefore, it was suggested that regulators and operators should plan the TBBTN to provide less waiting time and walking distances. This would help with female passengers regarding their safety, expected services issues.

Table 1. Survey results and summery

Finding	Value	Sig. value
Female travelers expected more services and safety	80.3% females were concerned about safety	0.000
When age rose, expectations went high	Average of 73.6% elderly age passengers expected seats etc.	0.000
Middle aged people expected lesser travel time	74.6% of middle-aged passengers highly expected less travel time	0.000
Low-income travelers under age 25 mostly traveled for educational purposes while middle aged and older passengers mainly used for business purposes	82.6% of low incomers age less than 25. 93.2% of young passengers engaged in educational trips. 60% of middle-elderly passengers used buses for business trips	0.000
Passengers were concerned about the cost of a trip	75.3% passengers were concerned about the cost and expected a discount with the perceived stage	0.000

As per to data collected, it was noted that as age rose, passenger expectations were high. These findings hold true as passengers aged, they had higher expectations for services such as frequent bus service and short walking distances. Senior passengers encountered numerous challenges when using public transportation, such as physical and mental obstacles, availability, restrictive routing, and unreliability [6]. This finding could also be encouraging for aged passengers as TBBTN could increase service frequency. But the challenging factor was that aged passengers would not like frequent transfers.

According to data collected, low-income travelers under age 25 traveled mostly for educational purposes, while middle-aged and older passengers primarily traveled for business. Youngsters who happened to be categorized under 25, mostly were students who did not have earnings. Younger individuals worried more about the cost of the trip than other age groups. This finding was useful for determining the bus fare for the TBBTN. TBBTN should be operated in a manner that it could reduce the travel cost for the entire trips. But the existing transfer-based operations incurred more travel costs compared to direct based bus operations. Therefore, this finding emphasized the need to revise the bus fare.

Middle-aged people expected less travelling time. Middle-aged people were more concerned about punctuality as most of them were making work-based trips. Therefore, when properly planned, TBBTN could reduce overall travel time compared to the existing direct based transport operations as TBBTN could enable an increase in service frequency.

V. Conclusion

This study concludes that there were associations with socioeconomic characteristics of the passengers with their trip characteristics. These existing associations confirmed that increasing service frequency, reducing travel time, minimizing transfers, adjusting the bus fare, and providing service quality to bus operations could be the successive factors for TBBTN operations.

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References

[1] Ling Xu, Yan Huang, and Pengyao Ye, “Transfer study on public transport modes”, ICTE 2015, 1675-1679.

[2] Liu, T., Cats, O. and Gkiotsalitis, K., (2021) “A review of public transport transfer coordination at the tactical planning phase,” Part C 133, 1-3

[3] Emily, G., Stewart, A.F., and Ahmed, E., (2021) “Planning a high-frequency transfer-based bus network: How do we get there?” Vol. 14, No. 1, 864-865

[4] Emily, G. and Ahmed, E., (2019) “Transferring Matters: Analysis of the Influence of Transfers on Trip Satisfaction,” 9, 254-256.

[5] Iseki, H. and Taylor, B.D., (2010) “Style versus Service? An Analysis of User Perceptions of Transit Stops and Stations,” 13, 39-40.

[6] Susilo, Y.O. and Cats, O. (2014) “Exploring Key Determinants of Travel Satisfaction for Multi-Modal Trips by Different Traveler Groups. Transportation Research Part A: Policy and Practice,” Vol. 67, 2-7

[7] Sara H., Rocio D. O., Andres M., “Urban transport interchanges: Importance-Performance analysis for evaluating perceived quality.” Transportation Research Part A, 84, 31-43.

[8] Rainer K., Christoffer W., Milos N. M., Jari S., “Travel times and transfers in public transport: Comprehensive accessibility analysis based on Pareto-optimal journeys” Computers, Environment and Urban Systems 67 (2018), 41–54.

[9] Hugo Badia, Juan Argote-Cabanero, Carlos F. Daganzo “How network structure can boost and shape the demand for bus transit” Transportation Research Part A 103 (2017), 83–94