



Improving public transport usage: A review of the route network design

¹Nur 'Amirah Mhd. Noh and ²Ahmad Hilmy Bin Abdul Hamid

^{1,2}School of Housing, Building and Planning, Universiti Sains Malaysia

ARTICLE INFO

Article history:

Received 12 October 2014

Received in revised form 26 December 2014

Accepted 1 January 2015

Available online 17 February 2015

Key words:

public transport, public bus, bus usage, bus route, route network design

ABSTRACT

The increasing demand for mobility across the whole region has created problems such as road traffic congestion, insufficient parking, pollution and road safety problems. People nowadays seem to be tolerating the problems when they choose private transportation for comfort and reliable journey as compared to the public bus transportation which is being described as hectic and inefficient. However, bus operators along with the authorities need to review the public bus transport planning process as this can help design of an efficient bus network system and attract greater bus transport usage. Route network design is an important phase in network planning consisting of several elements where the appropriate design of route network will affect the subsequent four phases in network planning. With the call for an efficient route network system mounting, the operators and the authorities need to enhance the public bus transport system as a whole with deeper understanding of user demand rather than just considering profits issues alone. Thus, the public bus usage should be advantageous not only from the perspective of users, operators and authorities but will also positively affect the environment thus leading to a sustainable public bus transportation system.

© 2015 AENSI Publisher All rights reserved.

To Cite This Article: Nur 'Amirah Mhd. Noh and Ahmad Hilmy Bin Abdul Hamid., Improving public transport usage: A review of the route network design. *Adv. Environ. Biol.*, 9(5), 53-55, 2015

INTRODUCTION

Public transportation is unpopular as it has been labeled as an unreliable mode of transport compared to private transport [1]. Deciding to own a private transport rather than riding on the public transport has been a major decision made by road users as they seem to be tolerating traffic congestion and parking problems. Despite the advantages of the private transport, public transport has many benefits and advantages too. Fan and Machemehl [2], Shrivastava and O'Mahony [3] agreed that public transport could decrease traffic congestion and preserve the environment at the same time. Fan and Machemehl [2] mentioned that public transport is capable of lowering energy consumption and ease mobility. It is not only advantageous in terms of environmental protection but it can also decrease the level of injuries and number of deaths [4]. Ning [5] stated that public transport has benefits in three different perspectives; socially, economically and environmentally which are (1) availability of ample job vacancies, (2) profit to the operators' side and (3) environment protection. However, the existence of a few disadvantages of the public transport system has reduced travel via public transport.

Issues with Public Bus Transport:

Overall, public transport is facing a few issues one of which is a reduction in patronage. In China, the demand of public transport is increasing gradually [6] but the public bus system operating in China is mixed with motorized and non-motorized vehicles that has created massive traffic congestion and this situation had forced enhancement programs to be introduced to overcome the problem [7]. In western countries like Sweden, unreliable public transport system was reported by Andersson and Scalia-Tomba [8] in which unfeasible management between the irregularities and scheduling had brought the whole system into becoming an inefficient bus system. Similar situation happened in Ireland in which the lack of coordination between the timing and the trip distribution had forced the bus system to be in a feeble condition [9]. These poor situations encountered by many parties, including the government and operators, have led to them to engage each other to find solutions to these issues.

Corresponding Author: Ahmad Hilmy Bin Abdul Hamid, School of Housing, Building and Planning, Universiti Sains Malaysia
E-mail: hilcom@usm.my

Malaysia also is not excluded from this transport related issue. As reviewed by Almselati et al [10], Malaysia faces a problematic situation in which two major issues i.e. poor public transport system and an increase in private transport ownership are highlighted. Poor financial performance by the operators in sustaining the public transport system had contributed to the failure of the public transport system [11]. The operators not only had failed in term of the financial capabilities, but also in terms of the infrastructural elements. According to Leong et al [1], public transport became an insignificant mode of transport as consumers reported that limited access in getting to the public transport is one of the factors contributing to lower public transport usage. Consumer's feedback regarding the quality, adequacy and availability of public transport is low and this had contributed to an inefficient public transport system as a whole. Besides looking at the user and operators perspective, integration between land use planning and the public transport system is also crucial in producing an efficient and effective service that can attract and satisfy the consumers. A public transport system had always been a typical component to be considered in town and city planning even as the main focus of planners is often the movement of private vehicles especially cars [12].

Bus Route Network Design:

In network design and planning of the public transport, Ceder and Wilson [13] outlined five sequential planning approach that should be followed by the practitioners i.e. (1) route network design, (2) frequency setting, (3) timetable design, (4) fleet assignment and (5) crew assignment. When considering the five elements mentioned, route network design is the more vital part in the design and planning of an efficient bus network. As stated by Ngamchai and Lovell [14], integrating route network design in the public transport system will affect the frequency setting and timetable design and crew assignment simultaneously. Rigorous research has been undertaken on route network design with integration of other elements in the design and planning phase. Studies done by I-Jy Chien [15] dealt with route network design and fleet assignment while Szeto and Wu [7] coordinated route network design with the frequency setting. Nonetheless, some studies [8, 15-18] had only focused on route network design where the authors believed that route network design is very crucial compared to the other elements.

Thus in route network design, several elements (Table 1.1) should be considered by the planners, bus operators and also the government. As a matter of fact, historically, demand and route criteria are the basic knowledge that should be studied by the designers [19]. As forwarded by Ceder and Wilson [13] for route network design, three major elements should be taken into account i.e. demand, supply and route performance in which these three elements resulted either in route changes or the establishment of new route set. Chien et al [20] listed another three important elements which are headways, zoning and line spacing that should not be excluded in route network design. Shrivastava and O'Mahony [3], Guihaire and Hao [19], Černá, Černý [21] added zoning element in route design while Ngamchai and Lovell [14], Tom and Mohan [22] respectively introduced two other elements which are cost and time. Above all, the most important element for route design is demand as demand is the decisive element in determining an efficiency of the public transport system.

Conclusion:

The challenge here is to design an efficient and an effective public transport network system that is beneficial to many parties, not only from the users' perspectives but also for the government and operators even though operators' main concern are often focused on profit [7]. Despite the problematic issues created by the system, finding the relevant and applicable solutions for the design and planning phase can enhance and produce an efficient network system. It is obvious that current bus route selection in Malaysia is simply a continuation of historical route services with little or no consideration for changing land use patterns. It is not uncommon to find that new developments do not have proper bus services or if any exist they do not serve the locality satisfactorily. Literature reviews showed few studies that attempt to revise route selection for the Malaysian public transport users. Route design elements from previous studies provide a starting point for identifying the relevant parameters that may influence Malaysian bus route design.

Table 1.1: Route Design Elements in previous studies

No.	Author (Year)	Route Design Element							
		Demand	Supply	Headways	Zone	Line spacing	Scheduling	Cost	Time
1	Ceder and Wilson [13]	√	√						
2	Ngamchai and Lovell [14]	√					√	√	√
3	Tom and Mohan [22]	√						√	√
4	Guihaire and Hao [19]	√			√				
5	Chen, Yu [6]	√		√					
6	Shrivastava	√			√			√	

	and O'Mahony [3]								
7	Černá, Černý [21]	√			√				
8	Wirasinghe and Vandebona [23]	√		√			√		√

REFERENCES

- [1] Leong, L.V., et al., 2010. *Sensitivity Analysis of Passenger Volume for Public Bus Services: Case Study of Penang Island, Malaysia*. Journal of the Eastern Asia Society for Transportation Studies, pp: 8.
- [2] Fan, W. and R.B. Machemehl, 2006. *Optimal transit route network design problem with variable transit demand: genetic algorithm approach*. Journal of transportation engineering, 132(1): 40-51.
- [3] Shrivastava, P. and M. O'Mahony, 2009. *Use of a hybrid algorithm for modeling coordinated feeder bus route network at suburban railway station*. Journal of Transportation Engineering, 135(1): 1-8.
- [4] Nurdden, A., R. Rahmat, and A. Ismail, 2007. *Effect of transportation policies on modal shift from private car to public transport in Malaysia*. Journal of Applied Sciences, 7(7): 1013-1018.
- [5] Ning, Z., *Bus Route Optimization in Wuhan, China in Faculty of Geo-Information Science and Earth Observation* 2011, University of Twente.
- [6] Chen, X., et al., 2009. *Analyzing urban bus service reliability at the stop, route, and network levels*. Transportation Research Part A: Policy and Practice, 43(8): 722-734.
- [7] Szeto, W. and Y. Wu, 2011. *A simultaneous bus route design and frequency setting problem for Tin Shui Wai, Hong Kong*. European Journal of Operational Research, 209(2): 141-155.
- [8] Andersson, P.-Å. and G.-P. Scalia-Tomba, 1981. *A mathematical model of an urban bus route*. Transportation Research Part B: Methodological, 15(4): 249-266.
- [9] Shrivastava, P. and M. O'Mahony, 2006. *A model for development of optimized feeder routes and coordinated schedules—A genetic algorithms approach*. Transport policy, 13(5): 413-425.
- [10] Almselati, A.S.I., R. Rahmat, and O. Jaafar, 2011. *An overview of urban transport in Malaysia*. Social Sci, 6: 24-33.
- [11] Kiggundu, A.T., 2009. *Financing public transport systems in Kuala Lumpur, Malaysia: challenges and prospects*. Transportation, 36(3): 275-294.
- [12] Disney, J., 1998. *Competing through quality in transport services*. Managing Service Quality, 8(2): 112-118.
- [13] Ceder, A. and N.H. Wilson, 1986. *Bus network design*. Transportation Research Part B: Methodological, 20(4): 331-344.
- [14] Ngamchai, S. and D.J. Lovell, 2003. *Optimal time transfer in bus transit route network design using a genetic algorithm*. Journal of Transportation Engineering, 129(5): 510-521.
- [15] I-Jy Chien, S., 2005. *Optimization of headway, vehicle size and route choice for minimum cost feeder service*. Transportation Planning and Technology, 28(5): 359-380.
- [16] Bielli, M., M. Caramia and P. Carotenuto, 2002. *Genetic algorithms in bus network optimization*. Transportation Research Part C: Emerging Technologies, 10(1): 19-34.
- [17] Euch, J. and R. Mrahi, 2012. *The urban bus routing problem in the Tunisian case by the hybrid artificial ant colony algorithm*. Swarm and Evolutionary Computation, 2: 15-24.
- [18] Huang, B., L. Yao and K. Raguraman, 2006. *Bi-level GA and GIS for multi-objective TSP route planning*. Transportation planning and technology, 29(2): 105-124.
- [19] Guihaire, V. and J.-K. Hao, 2008. *Transit network design and scheduling: A global review*. Transportation Research Part A: Policy and Practice, 42(10): 1251-1273.
- [20] Chien, S., Z. Yang and E. Hou, 2001. *Genetic algorithm approach for transit route planning and design*. Journal of transportation engineering, 127(3): 200-207.
- [21] Černá, A., J. Černý, and V. Příbyl, 2011. *Bus route design in small demand areas*. Transport, 26(3): 248-254.
- [22] Tom, V. and S. Mohan, 2003. *Transit route network design using frequency coded genetic algorithm*. Journal of Transportation Engineering, 129(2): 186-195.
- [23] Wirasinghe, S.C. and U. Vandebona, 2011. *Route layout analysis for express buses*. Transportation Research Part C: Emerging Technologies, 19(2): 374-385.