R4TLI
ISSN: 2513-2504

STRATEGIES FOR THE DEPLOYMENT OF ELECTRIC BUSES IN SRI LANKA

Lasith Samarawickrama[1], Thillaiampalam Sivakumar[2]
Department of Transport Management and Logistics Engineering, University of Moratuwa, Sri Lanka.
[1]*lasithsamarawickrama@gmail.com*, [2]*tsivakumar@uom.lk*

ABSTRACT – Transportation in Asian cities faces significant challenges due to the increasing demand for mobility, population growth, and urbanization. In this context, electric buses (Ebs) have emerged as a promising solution to address the transportation sector's sustainability and environmental challenges. The objective of this study is to explore the possible strategies for the deployment of Ebs in Sri Lanka. An in-depth analysis of the possible strategies of EB deployment in Sri Lanka has been investigated, where it focuses on six main domains: General, Technological, Location and Deployment model, Charging Infrastructure, Policy framework and Fleet Replacement. The strategies were identified by interviewing experts, regulatory bodies, and Existing bus operators. Through the analysis it was identified that there is a significant reduction in overall transportation challenges due to EB deployment and strategies were also identified while the scope will extend to identify modal shift significance with EB deployment in future studies.

Keywords: Electric buses; Deployment strategies; Sustainable Transportation; Urban Transport; Green Gas Emissions

1. INTRODUCTION

The world is rapidly surging towards sustainable transportation solutions, and Electric Buses (Ebs) have become a popular option worldwide for reducing the environmental impact of public transportation. Cities such as Amsterdam, Berlin, Kanagawa, and London are on top, where different policies have been implemented to promote Ebs. Many studies have been conducted on the assessment of various strategies such as charging infrastructure, fleet replacement and sustainable assessment. Accordingly, a modelling framework to optimize electric bus recharging schedules was presented in [1], while an optimal location of charging stations was determined using a gridded Affinity Propagation (AP) clustering algorithm in [2]. A scenario-based electric bus operation has been done to find the possibility to operate electric buses by replacing conventional buses, taking the city of Putrajaya, Malaysia as the case study [3]. Further, studies on a life cycle cost analysis and a total cost of ownership analysis have been conducted as a pre-feasibility study to implement electric buses.

Sri Lanka, as a signatory of the EU horizon with the goal of achieving zero emission by 2050, is actively exploring and seeking sustainable transportation solutions to align with this commitment. Road transportation has the highest contribution towards Greenhouse Gas (GHG) emissions in Sri Lanka. The deployment of Ebs along the Galle Road Corridor in Sri Lanka has gained significant attention from policymakers, researchers, and the public due to the high demand for transportation services with 16% peak hour passenger demand and 14% peak hour road traffic out of the seven main corridors to Colombo Metropolitan Region [4]. However, it poses various challenges such as high capital costs, limited charging infrastructure, and limited public awareness and fare acceptance of Ebs. Therefore, the objective is to identify suitable EB deployment strategies for Sri Lanka.

2. MATERIALS AND METHODS

2.1. Participant Selection

Expert interviews are often considered a reliable source of information, as it provides accurate and unbiased insights based on their knowledge and expertise. Thus, data was collected (n=50) from experts in western province which includes academics from different educational institutions, private and public industrial consultants in transportation discipline, professionals from bus regulatory organizations, professionals from the public bus operating organization in Sri Lanka and private bus operators through a structured questionnaire.

2.2. Methodology

The selected area to conduct this survey was the Galle corridor, which is one of the busiest roads in Colombo, with a high volume of both private and public transportation. The questionnaire covers six major strategies selected through a literature survey: Technology, Location, and deployment model, Charging infrastructure, Policy framework, Fleet replacement. In addition, existing challenges were also identified. A mix of Likert scale, ranking, close-ended and open-ended questions was added to the questionnaire to gain comprehensive inexpert, from the experts and it was distributed in both Sinhala and English languages.

3. RESULTS AND DISCUSSION

3.1. Transport challenges along the Galle corridor

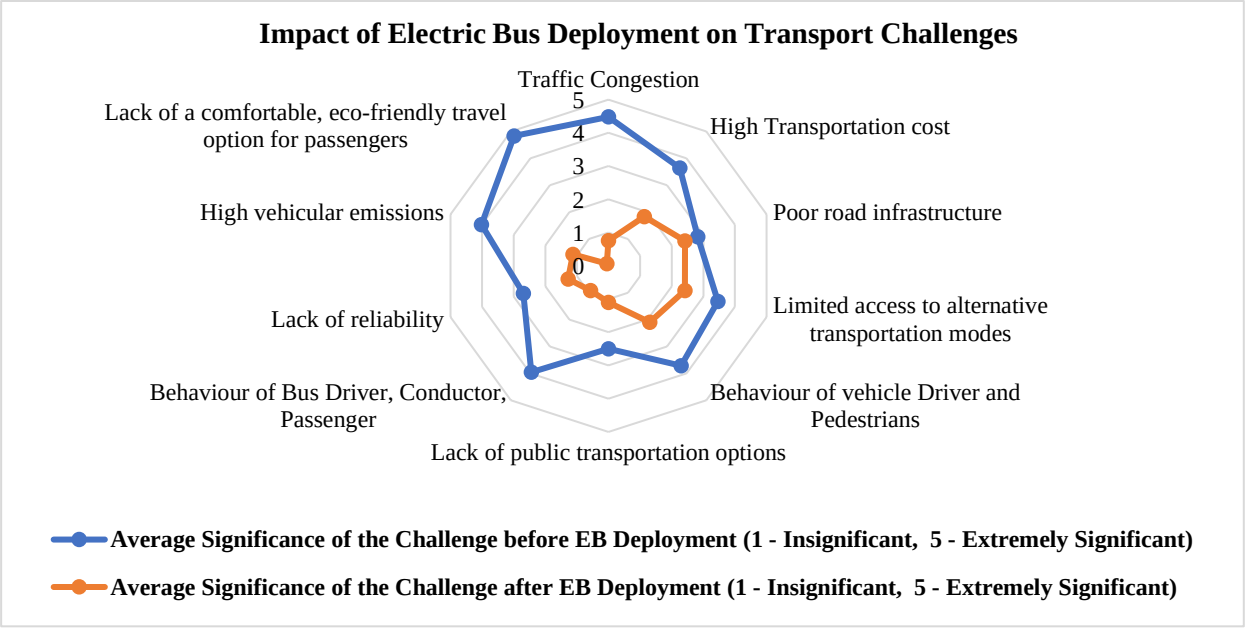

Figure 1. Impact of Electric bus deployment on Transport Challenges

According to **Error! Reference source not found.**, traffic congestion, lack of comfortable and eco-friendly t ravelling, and behaviour of public transport users were identified as extremely significant and emissions as significant challenges where electric bus deployment are believed to be a substantial solution to address them. High transportation costs are also recognized as a challenge, although electric buses are perceived to have a slightly lower effectiveness in mitigating this specific issue. The **Error! Reference source not found.** shows i mpact of Ebs on the above identified transport challenges. The two tailed test indicates whether EB deployment actually reduces challenges or amplifies them. Accordingly, it can be concluded that with 95% significance level, that there is a significant reduction of transport challenges with the deployment of electric buses in Sri Lanka.

Table 1. t-Test: Paired Two Sample for Means

	Overall significance of transport challenges before EB Deployment	*Overall significance of transport challenges after EB Deployment*
Mean	3.61	1.40
Variance	0.10	0.27
Observations	50	50
Hypothesized Mean Difference	0	
Df	49	
t Stat	22.71	
P(T<=t) two-tail	**0.00**	
t Critical two-tail	2.01	

Further, in terms of technology, they recommended going for battery electric buses emphasizing that it is the more suitable rather than going for a hybrid at the initial phase and transitioning to fully electric-powered buses later. Further, they suggested deploying electric buses in short distance routes where Overnight Charging (Depot/ Night parks), Opportunity Charging (Mainly at the start and end nodes) was preferred by majority. Gradual transition was preferred where procuring cost was identified as the top ranked factor to be give the priority and was analyzed using the weighted average technique, where rank no.1 with the most critical factor and rank no.10 with the least importance. The ranks were multiplied by the number of responses received to obtain the sum product. The lowest value was considered as the most important factor.

4. CONCLUSION

In conclusion, it was identified that there is a significant reduction of existing transport challenges through EB deployment where p value is less than 0.05. Also, other strategies were identified such as deploying battery electric buses on short-distance routes, adopting overnight charging and opportunity charging at two ends, prioritizing financial policies for procurement and fleet replacement factors etc.

REFERENCES

1. Y. Wang, Y. Huang, J. Xu, and N. Barclay, “Optimal recharging scheduling for urban electric buses: A case study in Davis,” *Transp Res E Logist Transp Rev*, vol. 100, pp. 115–132, Apr. 2017, doi: 10.1016/j.tre.2017.01.001.
2. Y. Zhang, J. Deng, K. Zhu, Y. Tao, X. Liu, and L. Cui, “Location and expansion of electric bus charging stations based on gridded affinity propagation clustering and a sequential expansion rule,” *Sustainability (Switzerland)*, vol. 13, no. 16, Aug. 2021, doi: 10.3390/su13168957.
3. L. E. Teoh, H. L. Khoo, S. Y. Goh, and L. M. Chong, “Scenario-based electric bus operation: A case study of Putrajaya, Malaysia,” *International Journal of Transportation Science and Technology*, vol. 7, no. 1, pp. 10–25, Mar. 2018, doi: 10.1016/j.ijtst.2017.09.002.
4. “Urban Transport System Development Project for Colombo Metropolitan Region and Suburbs Technical Report 6: Urban Transport Master Plan,” 2014.