



Adelaide's East End tramline: Effects on modal shift and carbon reduction

Ha Anh Nguyen^a, Ali Soltani^{b,c,*}, Andrew Allan^b

^a Department of Railway Transport Economics, University of Transport and Communications, Hanoi, Viet Nam

^b School of Art, Architecture, and Design, University of South Australia, Adelaide 5000, Australia

^c School of Art and Architecture, Shiraz University, Shiraz, Iran



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ABSTRACT

The popularity of public transport especially rail-based transit in urban areas replacing the role of motorised transport has been widely discussed. Among rail transit options, the modern tram is considered as one of the most efficient modes of transport with significant effects on establishing a sustainable urban transport system with a decrease automobile dependency and carbon emissions. This article justifies the potential contributions of the new tram line to the East End of Adelaide's Central Business District (CBD) in South Australia to reduce the use of private vehicles by shifting current car users to the new tram services, with an associated reduction of carbon dioxide as a result of the modal shift. Firstly, a projection of the modal shift of current car users to the new tram transit service was estimated using statistical analysis with data collected from the implementation of an intercept survey with different groups of participants on the proposed tram route (North Terrace, Adelaide). More importantly, the calculation of carbon dioxide reduction based on the likely modal shift was also revealed to demonstrate the positive environmental implications of the tram line extension. Based on these research outcomes, this paper provides reliable justifications to support the priority of having investments in public transport system to mitigate car dominance in Adelaide that has been mentioned in the future transport policy of the State. The paper also makes a significant contribution to formulate the foundation of future studies with regard to the developments of other tram transits in Metropolitan Adelaide.

1. Introduction

The concept of sustainability has emerged in the late 20th century, and it has been studied by various scholars all over the world and researchers in the transportation field are not the exception. Notably, numerous transport-related issues have been occurred such as traffic congestion as a result of high car dependency, an unbalanced relationship between people's travel demand in city areas and the deficiency as well as the inefficiency of transport provision especially public transport, and environmental issues caused by the use of fossil fuel in transportation vehicles. These problems have resulted in the need of building a sustainable urban transport system which not only meets travel demand of people in urban areas but also seeks to establish a more efficient and environmentally friendly fleet of transport that can mitigate the transport emissions especially carbon dioxide (CO₂).

Following the concept of sustainable development, *The 30-Year Plan for Greater Adelaide* regulated by the Government of South Australia envisaged the future evolution of this capital city by promoting

Adelaide as a Carbon Neutral City. To achieve that, the plan to bring tram back to the city has received the highest priority for strengthening urban transport system, which is now dominated by private cars and inefficient bus-based services (Department of Planning, Transport, and Infrastructure, 2015). It should be noted that the current tram system of Adelaide just consists of one single tramline from the Entertainment Centre to Glenelg via the city centre. This unique tram transit serves a significant number of passengers annually, at 2.9 million passengers from 2011 to 2012 (Currie and De Gruyter, 2016). Compared to Melbourne (6.4 million) and Sydney (3.89 million), the number of passengers using the Adelaide's tram is relatively low. However, with a city of just 1.3 million people, tram services have produced their best performances to serve mobility demand of people across Adelaide. Furthermore, electric trams had a long history of development in Adelaide since the 1900s and trams used to be the pivotal type of travel mode until the late 1950s before replacing by bus-based system (Department of Planning, Transport, and Infrastructure, 2015). Hence, in order to take back the important role of tram in Adelaide's public transit system,

Abbreviations: ABS, Australian Bureau of Statistics; AdeLINK, Adelaide LINK (new tramline system of Adelaide); BITRE, Bureau of Infrastructure/Transport/and Regional Economics; CBD, central business district; DPTI, Department of Transport, Planning, and Infrastructure; CO₂, carbon dioxide; TRB, Transportation Research Board; UniSA, University of South Australia

* Corresponding author at: School of Art and Architecture, Shiraz University, Shiraz, Iran.

E-mail addresses: nguyenhaanh@utc.edu.vn (H.A. Nguyen), ali.soltani@unisa.edu.au (A. Soltani), andrew.allan@unisa.edu.au (A. Allan).

the expansion plan of tram across Adelaide Metropolitan under the banner *AdeLINK* (Adelaide LINK) had been proposed in *The Integrated Transport and Land Use Plan*. The extension plan of tramline to the City's East End is the opening stage of rolling out Adelaide's future tram system namely AdeLINK. Arguably, the proposed extension plays an essential role in reducing car dependency, thereby attracting more public transit patronages. Furthermore, due to reduced usage of private vehicles, high emissions of carbon dioxide released from automobiles will also be decreased.

Taking these considerations into account, this paper fleshes out the future contributions of the tram extension to the City's East End in Adelaide's CBD regarding its effects on shifting car users to the new tram services. Moreover, the paper also focuses on one of the most topical issues in the planning field associated with determining feasible solutions to mitigate CO₂ emissions from motorised transport. In this regard, public transport is identified as the dominant sector, which can aid in reducing the release of CO₂. Interestingly, the tram extension project with its electric propulsion potentially lowers levels of CO₂. Therefore, based on the calculation of a modal shift from private cars to the tram transit, the future projection of CO₂ reduction was also clearly determined.

This paper is divided into five main sections. Following this introduction, four other sections are included as follows. Section 2 discusses previous studies of three key research themes, which are the notion of sustainable urban transport, the projection of modal shift from private cars to the tram transit and the estimation of CO₂ reduction as the current car users shift to the new tramline. Section 3 justifies the research methodology and the main research methods to collect data. Details of the data analysis procedure with the support of SPSS software was also presented. Section 4 provides details of key findings in this research with regards to the modal shift to tram transit of current car users and influential factors that affect the shift. The calculation of CO₂ reduction was clearly justified in this section. Section 5 summarises the achievements of the research in relation to its new contributions to this field of study. The limitations and recommendations of future work were also determined.

2. Background studies

Three main research themes about sustainable urban transport, modal shift from private cars to tram transit, and CO₂ reduction from the switch of car users to the tram services are discussed to formulate the theoretical framework of this paper.

2.1. Sustainable urban transport

Based on the concept of sustainability, which has been emerged from the Brundtland Commission in 1987, researchers have sought to apply this notion into transportation field. According to Richardson (2005, p. 30), sustainable transport is defined as 'the ability to meet today's transportation needs without compromising the ability of future generations to meet their transportation needs'. Indeed, sustainable transport is created by important factors within the concept of sustainable development (Curtis, 2008).

Adding to this, there has been an increasing interest in determining the main indicators of sustainable development for a transport system. Banister's study (2000) aims at building a sustainable transport system in which reduces air pollutants released from private vehicles and minimises the use of non-renewable energy in transport vehicles to mitigate the increase of greenhouse gases. In particular, 'levels of energy use and emissions' are the key indicators required to formulate a sustainable transportation system (Kenworthy, 2008). Hence, it is necessary to reduce energy consumption, thereby creating low levels of transport-related emissions.

The negative impacts of transport vehicles, such as high levels of energy consumption and air pollutants, are crucial to minimize before the formulation of a sustainable transport system (Bertolini, 2008). In

other words, sustainable development of a transportation system heavily restricts the negatives influences on the environment (Bajdor and Grabara, 2013).

The decrease of car dependency or potential shift of current car users to public transport is another pivotal indicator that needs to be taken into account for the creation of a sustainable transportation system. To explain, the necessity of having a better public transport provision for people's daily travel has been discussed by Litman and Burwell (2006) to reduce the reliance on private automobiles. Several studies have observed that the positive benefits involved economic, social, health and environmental aspects of a transportation system could be attained with less use of private vehicles (Rojas-Rueda, De Nazelle, Teixidó and Nieuwenhuijsen, 2012; Hammadou and Papaix, 2015; Soltani and Hoseini, 2014). Hence, a more balanced transportation system will also be created and 'the shifts to non-automobile modes can be considered sustainability indicators' (Litman, 2007). Banister (2000) had an emphasis on the importance of limiting car dependency for a future sustainable development of a transportation system and suggested regulating appropriate policies to attract more passengers to use public transport. Three types of structural strategies could be applied: financial measures, legal regulations and physical (urban form) changes (Steg, 2007). Therefore, a sustainable transport system could be built with the cautious consideration of two key indicators, including the switch of cars users to the new public transport services and the positive influences in environmental conditions due to the usage of public transport. Some scholars argue that a sustainable solution for transport problems is not transport. As car using appears as a habit, psychological strategies aimed at altering personal perceptions, beliefs, values, attitudes, and norms could be more efficient to reduce car use (Steg, 2007).

2.2. Modal shift from private cars to the tram transit

Different transport-related scholars have investigated the modal shift of people from private cars to the tram transit as the introduction of new tram services. Loo (2009) states that there has been an increasing use of a new tramline from those who were former car users. In terms of the Australian context, the shift to tram has occurred widely within 'car-centric cities' and Melbourne is a particular example to support this argument (Newman, Beatley and Boyer, 2009). Indeed, research of the Australian Transport Council (2006) points out that 49% of car users would switch to use the new tramline upon completion of Bundoora's tram project (a northern suburb of Melbourne). Sharing the same research outcomes, 63% of car users responded that they would like to choose new tram transit following the survey results conducted by the City of Darebin (2010) regarding the tram extension plan in this city. This trend could be explained by the improved quality of services and better technical provision of tram transit; therefore, this mode of public transport has become an integral part of urban transportation systems in Australian cities and attracted much more ridership (Steffen, Percival and Flannery 2015, p. 338).

Internationally, a number of studies have also determined the likely shift of car users to the new tram services as the completion of tram development. The research team of Pradono et al. (2015) concluded that 41% of current car drivers wished to transfer to the new tram in Surabaya city (Indonesia). Most recently, car ownership in Stockholm (Sweden) were also identified as the first group of passengers that utilized the new tram system according to the research outcomes of Termida, Susilo, and Franklin (2016). In other words, there has been a tendency of reducing car use in Stockholm and people would prefer shifting to the tram for their travel. More importantly, the number of new passengers will continue to rise because they need time to adapt with the advantages and drawbacks of using this new transport option. Apparently, the modal shift of people from private cars to tram transit could be significantly demonstrated after this inspection period (Douglas, 2003).

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