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Light rail transit cost performance: Opportunities for future-proofing

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ABSTRACT

The cost performance of Light Rail Transit (LRT) systems have been scrutinized by the popular press and public sector infrastructure agencies as they have been prone to incurring cost increases in their capital expenditures (CAPEX). In tackling such increases, emphasis is placed on mitigating strategic misrepresentation and optimism bias, which has hindered the public sectors ability to embrace innovation, particularly with regard to the justification and adoption of LRT. More often than not, operational expenditure (OPEX) is neglected, and is not considered a part of the transportation cost performance literature. The aim of this paper is to examine the equivocality that surrounds the determination of cost performance of LRT projects. It is suggested that the public sector should move beyond focusing on strategic misrepresentation and optimism bias, as many governments worldwide now have in place mechanisms to address such issues, and instead focus on future-proofing their assets. It is suggested that the key enablers of future-proofing LRT are (1) private finance; (2) delivery strategy (e.g. design-build-finance-operate); (3) digitization (e.g. building information modelling); and (4) asset management (e.g. smart technologies). If the public sector is to provide an LRT system that is cost effective and able to respond to the demands imposed by climate change, then it needs to be considered from a life-cycle perspective and funding sought from the private sector to ensure its viability.

1. Introduction

The efficient provision of transportation infrastructure assets provides the hallmark of a well-functioning economy. Yet, the delivery of such assets has been and continues to be the *bête noire* for the public sector; they consistently experience cost overruns and fail to deliver their expected benefits (Terrill and Danks, 2016). In urban environments, Light Rail Transit (LRT) (i.e. mid-sized electrified rail technology) is often selected as preferred mode of transportation in lieu of Bus Rapid Transit (BRT) (i.e. buses that run-on rubber tires on exclusive paved roadways and powered by diesel) by travelers in developed countries (Hensher et al., 2015; Hensher and Mulley, 2015). According to Hensher (2016) LRT dominates as it simply deemed to be 'sexy and buses are boring, and that it offers a much better value for money than BRT' (p. 289).

When choosing between BRT and LRT options their costs parameters attract the most attention from decision-makers. In Australia, for example, the mean capital expenditure (CAPEX) per kilometer for BRT is $36.58 million compared to $63.5 mil-

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lion for LRT. In the United States (US) the Government Accountability Office found CAPEX costs of light rail to be 2.5 times that of BRT based on studies of LRT systems from the 1980s and onwards (GAO, 2001). While the CAPEX is significantly higher for LRT, its operating costs vary according to scheme characteristics. The GAO (2001) found operating costs of LRT to be significantly higher per vehicle revenue mile, but lower per passenger trip in high density areas. Vuchic (2005) suggested a similar relationship between costs and passenger density. Furthermore, LRT may be prone to producing lower CO_2 emissions (Vincent and Jerram, 2006). Regularly around the world, political imperatives trump economic policy and the choice for LRT is taken to simply appease the public (Novak, 2014); there is an underlying perception that it can transform modern cities by stimulating development, increase transit usage, and curb congestion.

Irrespective of the cost effectiveness, ridership and environmental impact of LRT and BRT over their life, there has been and continues to be intense debate over their merits (e.g., Mosche and Takayuki, 2002; Vuchic, 2005; Hensher et al., 2015; Hensher, 2016; Mulley et al., 2017). Egregious examples of LRT projects that have experienced significant growth in their CAPEX such as the Edinburgh Trams in the United Kingdom (UK), which has experienced a cost overrun in excess of 50% (City of Edinburgh Council, 2014). The adverse financial and social impact of the Edinburgh Tram LRT on taxpayers has led to a formal public inquiry being initiated.

The on-going public inquiry led by the Rt. Hon. Lord Hardie that commenced in 2015 to establish why the Edinburgh Trams project incurred significant cost increases, delays, and reductions in scope, which delivered significantly less than was originally projected, aims to provide recommendations as to avert such failures in the future for major tram and light rail infrastructure projects of a similar nature in the UK (Edinburgh Tram Inquiry, 2017). Without doubt, lessons will be learned from this 'unmitigated' disaster. Whether this will lead to effective changes in future policy that can be translated into practice and ensue that projects are delivered on time and to schedule, and with value for money (V*f*M) being embedded throughout the life-cycle management of an asset, is debatable. Meanwhile, in Sydney, Australia, a $2.1 billion LRT line running the length of George Street in its Central Business District (CBD), which will also extend to its Eastern suburbs, commenced construction in October 2015. It is expected to be in operation in 2019, but has begun to be dogged by delays and cost increases.

An inquiry by the New South Wales (NSW) Auditor General revealed that the original capital budget of $1.6 billion established in 2013 increased by $549 million mainly due to mispricing and omissions in the business case (NSW Auditor-General, 2016). Due to scope changes, the cost benefit ratio decreased from 2.4 to 1.4. Naturally, it would have been expected that the problems encountered with the delivery of the Edinburgh Trams would have provided invaluable lessons for the NSW State Government in Australia to consider, but in this instance a case of *déjà vu* has seemingly occurred. Previous research has already demonstrated that scope changes after the completion of final engineering studies, environmental impact assessments and the decision-to-build (DtB) has been made, can be costly and thus negatively impact the ability to future-proof an asset (Love et al., 2017).

Future-proofing is defined as "making provision for future developments needs or events that impact particular infrastructure through its current planning, design, construction or asset management process" (Masood et al., 2014: p. 1). Innate features of future-proofing are: (1) resilience to unexpected/uncontrollable events and circumstances; and (2) capability to adapt or respond to changing, uses and capacities (Masood et al., 2015). Future-proofing therefore contributes to the delivery of environmentally sustainable assets that can reduce CO_2 emissions and are more robust in their resilience and adaptability to climate change.

The aim of this paper is to examine the equivocality (i.e. different interpretations) that surrounds the determination of cost performance of LRT projects. As a result, it is proposed that there is a need to move beyond focusing on the measuring the cost performance of LRT projects based upon CAPEX (i.e. funds to acquire and/or upgrade physical assets), but to also include their operational expenditure (OPEX) (i.e. operating costs). If the cost performance of LRT projects is to improve, then the way that they are delivered needs to fundamentally change. Thus, key issues that may in the future guarantee the cost effectiveness and the future-proofing of LRTs are proposed once the decision to opt for this mode of transit has been made by an incumbent government.

2. The equivocality of light rail transit CAPEX performance

The cost overruns in the Edinburgh Trams and Sydney Light Rail projects are not isolated incidents for LRT projects. Evidence provided by Pickrell (1990) and O'Toole (2015)'s analysis of reports produced by the Federal Transit Authority (FTA)[1] in the US over a 25 year-period, for example, reveal that CAPEX overruns have been a recurring theme with LRTs (O'Toole, 2015). Table 1 presents the actual and predicted Full Funding Grant Agreement (FFGA) CAPEX amount for a sample of LRT projects constructed in the US. This data for LRT has been extracted from the work presented in Pickrell (1990), denoted by (∗), and O'Toole (2015). In Pickrell's (1990) research, the forecasted capital costs were established at the completion of the preliminary engineering study, when a Design to Build (DtB) was undertaken.

Pickrell (1990) notes that "it is reasonable to expect some errors (both under-and overestimates) in forecasting project capital costs and financial flows associated with planned schedules for their construction" (p. 32). It is this point of reference that has been widely adopted by planners to compare the forecast and actual values of both real and nominal capital outlays

[1] Refer to the following FTA reports for the data presented in Table 1, published in 2003, 2007, 2008, and 2011–2013.