Passing the Community Test- A co-benefits approach to evaluating the case for light rail in Canberra, Australia.

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Abstract

The city of Canberra (Australia national capital), is in the early phases of the design and implementation of a light rail rapid transit (LRT) system for this predominantly suburban community of approximately 350,000 people. In an effort to sustain community support, this project is being promoted as having far greater impacts outside the direct benefit to future commuters; especially its potential to change urban form, connectivity, accessibility and behaviour change, as well as attracting economic investment.

This paper reports on the development of conceptual framework to identify the potential impact of LRT on the Canberra community using a co-benefits approach. The paper uses concepts developed by Walker and Salt (2012) as an organising principle to identify key variables of concern for the Canberra community with regards to the introduction of the LRT.

This proposed conceptual model uses a matrix to identify the tangible (e.g. intermodal) and intangible (i.e. social and cultural) connections that are important to transforming people's behaviour, perceptions and expectations with respect to the LRT in Canberra. We establish a systematic approach to identifying the potential co- benefits and unintended consequences of LRT projects in the published literature. We argue that by adopting a conceptual framework based on resilience theory, researchers are better able to engage with the issues that are of most concern to the Canberra community. As part of a larger research project, this paper seeks to identify specific emergent impacts resulting from the development and early adoption of LRT in Australia's National Capital.

Introduction

The aim of this paper is to identify the potential impact on the Canberra community of the new Light rail rapid transit (LRT) system by exploring the potential co-benefits and unintended consequences associated with the introduction of LRT through the prism of a resilience framework developed by Walker and Salt (2012) that derives from systems thinking. Thinking of cities as systems is attractive for understanding complex interactions. Christopher Alexander's "A city is not a Tree Parts I and II" (1965) has been cited 949 times according to Google Scholar yet application of resilience practices deriving from systems thinking have by and large been developed in terms of landscape scale management in non-urban settings (Walker and Salt 2012). More recently the development of systems thinking into policy and practical outcomes has emerged in the literature around resilience; largely in response to complex questions about how to intervene in a system to affect positive change. Resilience theory has provided significant insight into socio-ecological interventions and landscape scale change but offers less in terms of urban systems. Despite the long history of systems thinking being applied to urban issues (Sallis, Cervero et al. 2006) resilience theory and application are relatively new.

Despite the fact that LRT systems have emerged as part of public transport strategies for many cities in the last 20 years, the research literature as to the broader impacts is relatively new. Along with other mass transit systems, LRT has the potential to offer significant positive impacts on urban, economic, social and environmental development, however empirical evidence is sparse. Significantly

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LRT has been identified as having a positive effect on stimulating land development by increasing competitiveness in property markets reflected in property value uplift close to transit corridors (Al-Mosaind, Dueker et al. 1993). Similarly LRT is expensive to construct compared to other on road systems while the operating costs are similar to on road bus transit systems. LRT is between 4-20 times more expensive than bus transit systems and therefore limited in the scope and speed at which LRT can be developed (Deng and Nelson 2010). However, as the up-front investment in LRT is much higher than comparable on road mass transit systems, LRT is considered to be more permanent and therefore more likely to influence planners and decision makers in terms of property investment along a transit corridor (Deng and Nelson 2010). Such short and long term economic impacts are key determinants of the viability or likely return to the tax payer for such projects as LRT and is almost exclusively subsidised by government in construction and operation. In addition, as identified by Tricker, these effects might be cumulative and they depend on specificity of the location (Tricker, 2007). Thus, in order to understand the way in which LRT will affect the communities we need to take a place specific approach as well as determining the co-benefits and cumulative effects as emergent elements.

Developing a co-benefits approach to understanding changes to urban infrastructure has become an important focus in urban design and planning (Dannenberg, Jackson et al. 2003). In the case of specific projects such as Canberra's LRT, co-benefits have been cited in supporting the case for public investment. For example, public transport infrastructure and associated changes in the urban form and land use regulations have been shown to increase social connection, physical activity, and benefit population health. Specific co-benefits include: increased residential density around transport nodes, improved walkability and access to local amenity, street connectivity, the preservation and creation of green space and improved aesthetic qualities of the built environment (Dannenberg, Jackson et al. 2003, Giles-Corti, Badland et al. 2014). A key to developing a resilience approach to evaluating the co-benefits of the Canberra LRT is to develop a model that considers the impacts that most concern the community affected by the proposed system.

This research uses Walker and Salts (2012) transformability model to identify the impact and potential co-benefits to the local community of the proposed LRT system for Canberra. In doing so it examines the transformational capacity of LRT from a resilience perspective. This paper is divided into four parts. The first part explains the Canberra LRT project and the ACT Government's strategic planning objectives substantially informed by the Canberra2030 'Time to Talk' consultation process (ESDD 2012). The second part describes the basic concepts of a LRT system as it applies to Canberra. The third part proposes a conceptual method for identifying the issues of most concern to the Canberra community based on the findings of ACT government's consultation process. Fourthly, the paper draws conclusions about how the model can support the ACT government and the community to capitalise on the co-benefits while managing the potential unintended consequences of LRT in Canberra.

The case for LRT in Canberra's strategic plan

In 2012 the ACT government replaced its 2004 Spatial Plan with the ACT Planning Strategy in 2012 as the key reference for guiding urban development. The goal of the new strategy was to retain the metropolitan spatial structure of the city while changing the built form and retaining the quality of the urban character at a local and district level. This Strategy reinforced the Government's intention to create a more compact and efficient city by adopting a more integrated, systemic approach to addressing the issues associated with balancing development and conservation objectives. The outcomes and actions, in response to Time to Talk: Canberra 2030, reinforced the principles behind the 1984 metropolitan structure known as the Y plan set out by the then Federal planning body responsible for the development of Canberra, the National Capital Development Commission. Importantly the Y plan incorporated the transport corridors such as that proposed by the Capital Metro project.

The 2012 ACT Planning Strategy reinforced the identifiable town centres and directly linked land use and transport planning while advocating residential intensification in the town centres and along the major public transport routes. This strategy was the means by which the essential elements of the urban spatial structure could be preserved. Despite persistent criticism of the Capital Metro project, the first stage of the project between Gungahlin Town Centre to Civic (Canberra CBD) (Figure 1) is consistent with the broader objectives of transforming the urban form over time. Indeed the challenge for the project is to be accepted by the community as transformational. Indeed the promotion of the project is framed in those terms. The Capital Metro website say as much; [The] "*Urban renewal and transformation along the transport corridor is expected to drive new opportunities for Canberra as a whole, such as employment opportunities and new investment "(ACT Government 2015).*

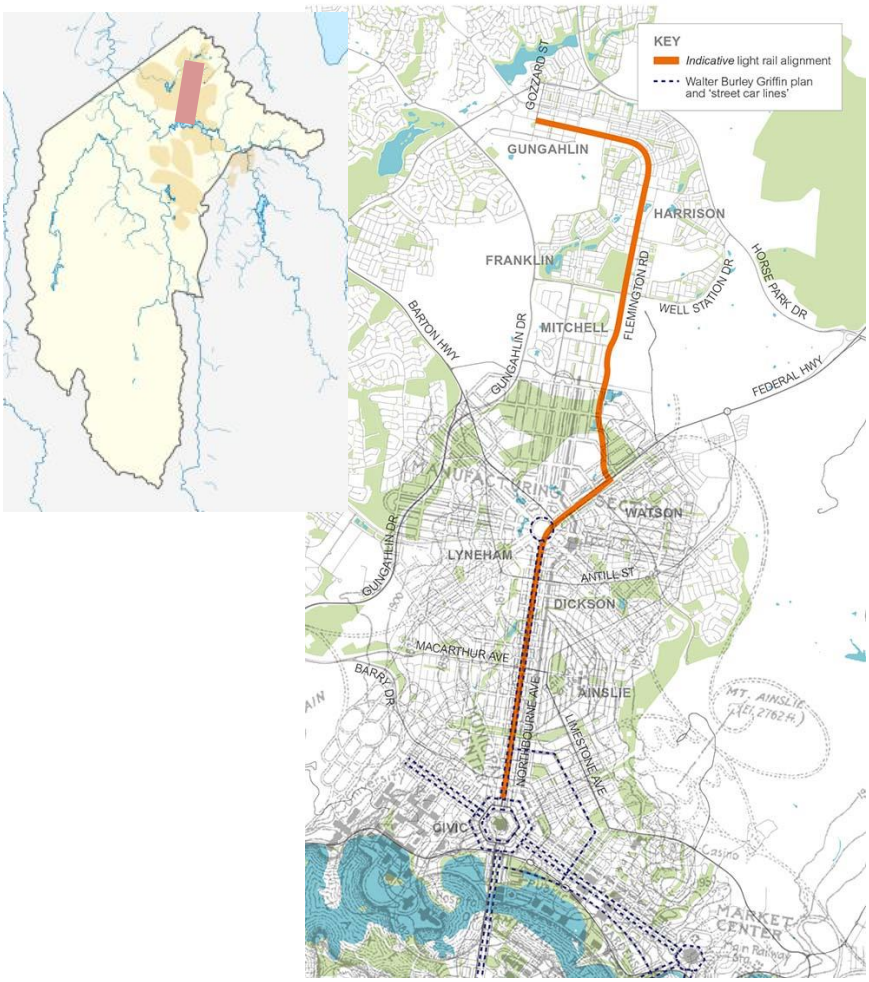

Figure 1- The proposed route for stage one of the capital metro project (ACT 2015).

The vision of a LRT in Canberra can be traced back to the first metropolitan plan develop for the city in 1925 based on Walter Burley Griffins original design. However the decision to develop the Capital Metro in its current form was to a large extent a condition of the only Greens member of the legislative assembly forming minority government with the incumbent government lead by the ALP. The political dimensions of the decision to proceed with the LRT only served to antagonise the opponents of the project describing it as opportunistic and economically reckless. On 5 July 2013, the cost benefit analysis for the project was released by Minister Corbell estimating a return to the tax payer of $2.34 for every $1 invested[3]. These figures were used to justify the proceeding to developing the business case for the project on the basis that it was financially viable. Regardless the project remains

[3] Capital Metro light rail to transform the national capital Simon Corbell Media Release 15/09/2014

controversial with a poll of 1446 ACT residents conducted on 28 May 2015 by Unions ACT indicating a majority of respondents are opposed to the project (Mcilroy 2015).

Concepts and components of LRT in the Canberra context

LRT is one of a range of mass transit systems characterised by high running speed, high passenger carrying capacity running on exclusively right of way routes between destinations (Deng and Nelson 2010). The components of an LRT system include the route, the stations, the vehicle, the type of service and route structure and the information technologies systems designed to enhance the efficiency, safety and reliability of service.

The Canberra LRT system (Capital Metro) is still in the early phases of development and therefore the known components of the system are the route and the station locations. The route for LRT needs to satisfy the criteria of connecting key destinations, increasing accessibility, maximising ridership (including both dependant and non-dependant riders), offering strong potential for value capture reflected through uplift in property prices adjacent to the route and offering a dedicated right of way (Mueller and Dooling 2011). The station locations need to satisfy the criteria of maximising access for riders through proximity to existing residential areas, or potential for new residential development. Station location should also enhance multiple opportunities for activities over and above transport to work, such as shopping, child care and recreation (Kuby, Barranda et al. 2004). Together the design of the route and the location of the stations should encourage development to achieve the goals of transit oriented development (TOD). TOD reduces transport costs and car dependence especially for low and middle income families (Soursourian 2010), reduces traffic congestion, increases physical activity and socialisation (Knowles 2012) and improves air quality (Deng and Nelson 2010). In this context Canberra's LRT project has the potential to catalyse new development in concert with the operation of the new light rail to achieve many of the goals identified in transit oriented development.

Like the Capital Metro for Canberra, other LRT projects have been defined as transformative in their potential to impact on urban systems. While transformation is a term often used to account for large infrastructure projects, the dimension of how transformation occurs as part of a broader system is rarely articulated beyond aspirational statements by proponents to communities in order to argue the case for the investment in the first place. Transformability from a resilience perspective assumes that components of the current system is in need of radical change (Walker and Salt 2012). Used in the context of evaluating the resilience of a system, components of transformability (Figure 2) are concerned with the ability of system and the affected community to cope with this change. The conceptual model identifies three objectives;

a. To establish the case for change
b. To develop alternatives
c. To enhance the capacity for change

In the context of the LRT, the anticipated co-benefits of a project are based on the assumption that other parts of the system (such as housing, road transport, and commercial centres) will also significantly change and this is almost always framed as a positive outcome. By developing a conceptual framework to identify some of these changes brought about by the introduction of light rail, this paper proposes that the changes may not always be positive but need to be identified to enhance the capacity for change during the project implementation and early phases of operation and to gauge the overall future co-benefits and unintended consequences.

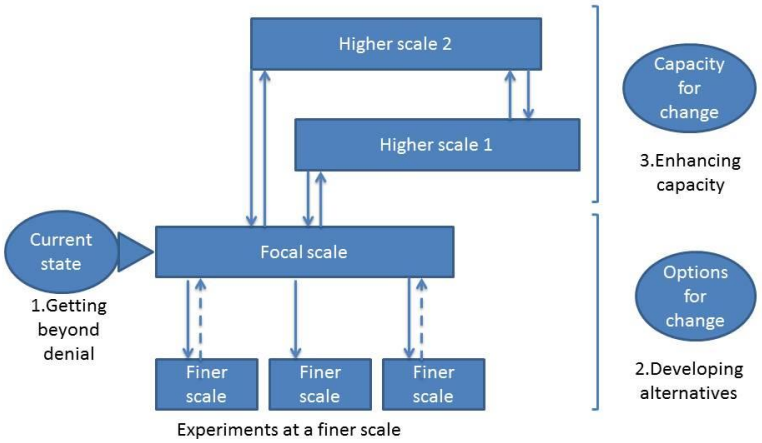

Figure 2 – Components of Transformability (based on Walker and Salt 2012)

This conceptual framing tool uses the Government's consultation process Time to Talk Canberra: 2030 which provided evidence of the community's priority concerns and incorporated into the 2012 ACT Planning Strategy (ACT 2012). The outcomes of the report reflected the views, comments and formal submissions to the ACT Government between August and November 2010. Background issues papers had been prepared and formed the substantive content of the community engagement process. The consultation analysis formulated key messages back to government, these messages are summarised in Table 1.

DOMAIN	SCALE			
	Issues from ACT Strategic Plan	**Station or Stop (individual impacts)**	**District/Suburb (community impacts)**	**Metropolitan (metropolitan impacts)**
	Canberra is easy to get around but less dependent on the motor vehicle	Real time information supporting the operation of facilities for cyclists and pedestrians	Integrate location of terminals that support easy transfer across modes of transport	New integrated transport networks are more efficiently and effectively mobilised.
	Canberra provides choice and meets the needs of the young, older people and those with disabilities	Design standards for signage and software applications to improve information using universal design principles.	Co-locate terminals with services, amenities and facilities to enhance sociability.	The location and provision of services is better spatially integrated into transport network.
	Canberra supports more diverse communities and neighbourhoods	Improved understanding of the cultural barriers to modal shift through dialogue.	Suburbs can become distinguishable - offer something different and more accessible than exisitng suburbs.	Canberra's poly-centric layout reinforces place building and identity.
	Canberra is a place that supports improved health and well being	Ensuring active transport is easy, safe and convenient and a good sense of belonging in the community.	Stations and approaches designed with passive surveillance	Social interactions reinforce social capital through improving access to and use of the public realm.
	Canberra has a cultural identity (especially important for young people)	Connect progressive ways of living and moving around.	City of stories - each community has a distinct identity that matures with the changing development of town centres.	Reasserts Canberra as an innovative progressive national capital.
	Canberra will be a city of good urban amenity and quality	Residents identify terminals as more than interchanges between different modes of transport.	Enable more meeting places with meaningful, safe, legible urban public space	Improves the accessibility, legibility and hierarchy of Canberra's public realm
	Canberra will retain its bush capital feel and landscape vistas	The transport experience is travelling through the city in the landscape.	The integrity of the city in the landscape is reinforced rather than compromised through development.	Improves access to appreciation of and sense of belonging to Canberra's open, natural spaces; conservation of most critical natural spaces.
	Canberra will be more sustainable, responsibly managing its energy use, water, minimising waste	The commuter belongs to a community of like minded travellers, socially and environmentally responsible.	Opportunities for green energy production and new technologies to be introduced at the district level	Help achieve the ACT's emission reduction targets.
	Canberra's has a sustainable economy and important regional centre offering employment in clean, 'green' knowledge industries	LRT has a greater influence on peoples choices about where to live, work and play.	Improved opportunities for more people to work from home or close to home - new service industries in local centres can be supported.	Integrate the spatial distribution of employment nodes, tourism opportunities, and introduction of new technologies in work life balance.
	Leadership and collaboration across government, business and the community is highly valued.	The community values the investment's greater potential for change.	Implementation of spatial, social and economic plans for the city through the building of the light rail and associated projects	Measure implement review and evaluate processes and governance arrangements

Table 1- The alternative regimes matrix (adopted from Walker and Salt 2012) plots themes (domains) derived from the Time to talk 2030 on the y axis against alternative regimes derived from the literature on the x axis.

Figure 3 adapts the components of transformability model to apply in the Canberra LRT context. We identified that the scale of most concern (the focal scale) to the community is likely to be at the suburban level based on the prevalence of themes emerging from the 2030 time to talk consultation and identified in table 1.

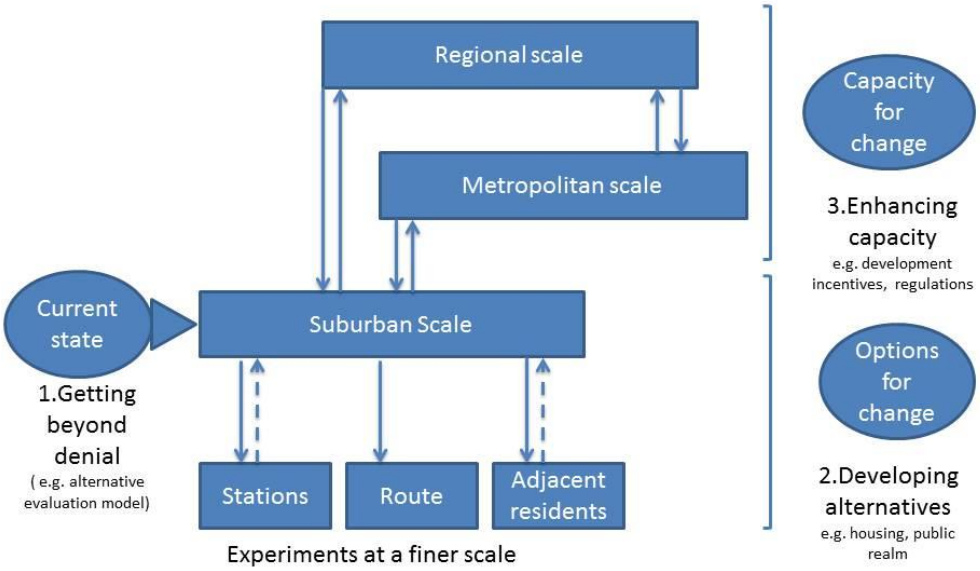

Figure 3 the components of transformability model are applied to the scale and context of Canberra's LRT project.

While all the themes from the time to talk 2030 are plotted on the matrix, their relevance to the LRT project varies. Despite the richness in different possible approaches to examining possible co-benefits, not all the possible impacts can be known or predicted and so it is important to focus on the impacts that can be identified and measured. For the purposes of this paper the possible effects on urban form and associated co-benefits for residents in those areas impacted by the light rail are the key factors of interest. From the list of issues identified in table 1 we chose to model 'Canberra is a place that supports improved health and wellbeing' as the identified literature could provide evidence of the possible impacts and co-benefits of change in this area (Figure 4).

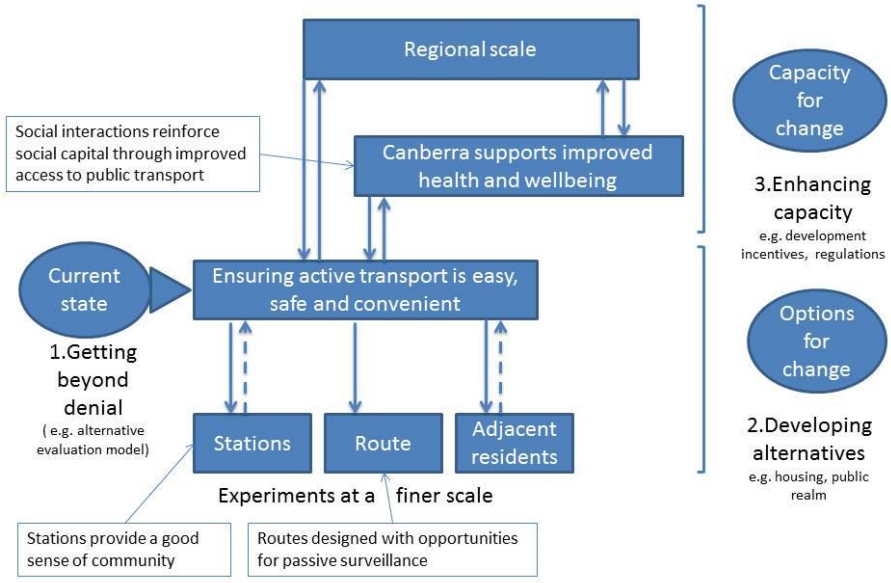

Figure 4- Applying one of the Strategic Plan themes to the components of transformability allows the researcher to identify the scale of most concern and how options for change can derive co-benefits.

Discussion

In trialling this approach the team could identify two main themes that could derive evidence from the literature that should be considered in the development of community dialogue around the co-benefits and unintended consequences of LRT in Canberra. These were LRT and its impact on urban form at a suburban scale and potential health co-benefits at a metropolitan scale. The final part of this paper discusses the literature in these areas that could inform how Capital Metro could better understand the components of transformation impacting the city from the LRT project.

Light rail transit and urban form

Research that focusses on urban planning and design has shown that LRT is most often linked with transit oriented development (Bailey, Grossardt et al. 2007, Atkinson-Palombo and Kuby 2011). Research at the metropolitan scale identifies the relationship between specific health outcomes and LRT and identifies some other health co-benefits. LRT systems that have been designed to improve access for citizens on the urban fringe of cities do not necessarily alleviate transport costs for commuters in poorer areas due to the high cost of fares (Lau 2010, Lau 2011). This can be alleviated by increased competition from other public transport modes such as rapid bus systems; however governments often adopt measures to minimise competition by removing competing transport options. As a result, expensive rapid transit systems provide little benefit to many urban poor (Lau 2011, Mueller and Dooling 2011).

There are also those who argue that these kinds of developments produce negative impacts such as: unintended gentrification (Joshi, Guhathakurta et al. 2006) and densification affecting personal freedom (O'Toole 2004). Similarly the desirability of LRT systems tends to be supported in large cities where the social benefit are experienced in areas where the community is already gentrified (Joshi, Guhathakurta et al. 2006, Winston and Maheshri 2007). Similarly LRT systems tend to attract commuters from other modes of public transport, but with limited impact on private car use (Lane 2008, Lee and Senior 2013).

Quantifying the social benefits arising from LRT is difficult whereas the operating and capital costs are explicit and easier to measure. As a result the potential social benefits are often over looked and do not factor into policy making (Raju 2008). However LRT, when incorporated into a broader metropolitan public transport system with coordinated, integrated planning approaches can improve the overall mix of transport choice and reduce car travel (Tricker 2007, Lane 2008).

At the local scale, studies of the neighbourhoods before and after the introduction of the light rail show that there are significant number of positive changes, such as: housing and cost improvements (Cervero 2006), economic opportunities (Brown and Werner 2011),an increase in sense of community and neighbourhood reputation and safety (Duncan and Christensen 2013). The design and location of the transit stops (Kuby, Barranda et al. 2004), along with residents attitudes towards public transport (Schwanen and Mokhtarian 2005, Kim, Ulfarsson et al. 2007) impacted on LRT ridership. Negative environmental impacts were also reported, for example increased noise and reduction in parking spaces at park and ride facilities (Brown and Werner 2011). Similarly development along the corridor targeted future growth potential consistent with the goals of transit oriented development rather than considering the impact of existing residents living along the corridor (Mueller and Dooling 2011).

Health co-benefits of light rail transit

There is a substantive body of research, which suggests that the built environment influences health behaviours and health risk e.g. physical inactivity. It is well documented in the literature, that use of public transportation and transit oriented development (often characterized through high walkability, and compact, mixed land use) can offer many health benefits including: increased physical activity (reduced BMI), better mental health and social capital, reduced traffic emissions and less traffic injuries.

Very few research studies however, were identified in this review that examined the broader health benefits specifically of LRT development. One of the few that has been evaluated was a detailed study (Macdonald, Stokes et al. 2010) using data from a pre–post longitudinal study examining the effects of using the light rail in Charlotte NC USA. MacDonald (2010) found that the association between LRT use and meeting weekly recommended physical activity levels of walking was in the positive direction but not statistically significant. The authors concluded “the results of this study suggest that improving neighbourhood environments and increasing the public's use of LRT systems could provide improvements in health outcomes for millions of individuals” (ibid p .105)

Stokes, Macdonald et al. (2008), developed a model to assess the potential cost savings in public health that would be realized from the investment in a new LRT. The authors estimated the net additional walking patterns enabled by a new LRT system for transit users of on average 30 min more a day compared to those who drive their car, would potentially save $12.6 million in the first 9 years of the operation of the LRT system. The authors point out that while their results indicate that the potential cost benefits are relatively small compared to the costs associated with constructing and operating LRT, there are many other benefits that LRT can bring such as: land use changes that increase pedestrian-friendly street planning, denser development around stations, increased accessibility, improved streetscape, economic investment etc.

Similar findings for a natural pre-and post-experiment in Salt Lake City, showed that for residents living within 0.5 miles of a new light rail stop, obesity was much higher among non-riders (65%) than new riders (26%) and continuing riders (15%) when adjusted for income and employment (Brown and Werner 2008).

From these few studies, LRT can potentially increase physical activity and help decrease obesity amongst patrons. No studies were identified which assessed the broader health benefits of LRT, such as for example: social capital, accessibility to local amenity in areas more distal to the LRT and benefit to those who are disadvantaged or marginalised. The current literature on health co-benefits

for LRT focuses on the local neighbourhood scale of immediate benefit to those within very close proximity to the light rail station.

Conclusion

The greatest challenge for the ACT government and the Capital Metro Authority has been one of persuasion and brining the community with them. That is to say – providing evidence of the benefits needs to be balanced in the mind of the community against the costs. The costs of the project can be measured in dollar terms and while the initial cost-benefit analysis has claimed a considerable return to the community, this has been heavily criticised.

Using the components of transformability adapted from Walker and Salt (2012) for this paper, the researchers established a method for investigation into the possible impacts of LRT on the Canberra community. It provides evidence based approaches to evaluating an otherwise complex interaction between the proposed project and the affected community. In addition, it allows for more focussed research to identify possible co-benefits and unintended consequences of such a project.

This paper has developed an evaluation framework for targeting areas of most concern to the Canberra community affected by a large infrastructure project that will potentially transform the surrounding urban form and the way the community interacts. The primary goal of further evaluation based on this method will be to focus on the ACTs existing strategic priorities and the community's aspirations. The framework can also provide insight to decision makers about the transformational capacity and adaptability of the urban system to change resulting from the introduction of the LRT. Along with identifying and measuring the health co-benefits of large urban infrastructure, the conceptual framework can also serve to identify potential unintended consequences that can be incorporated into developing policies for Canberra long after the first passengers ride the new light rail from the suburban edge to the centre of Canberra in 2019.

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