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Auckland Experience of the Bus Rapid Transit (BRT)

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Abstract

This paper applied principles of public transport network planning: line structure, frequency, transfers and fare systems, on the Bus Rapid Transit (BRT) in Auckland, New Zealand. The data concerning the BRT and its associated network was collected from policy and planning documents, timetables and websites. The data was further verified by conducting detailed field work on the selected network. The results show that the BRT exhibits some network planning principles such as a simple straight line route, high frequency and transferrable fares. However, the BRT is poorly coordinated with the surrounding bus network which could be improved to achieve integrated transport planning. The analysis indicates that the poor performance of public transport in Auckland can be addressed in the short term by improving public transport services at relatively little cost.

Keywords: BRT, Network planning, Auckland

Introduction

Efficient public transport such as the Bus Rapid Transit (BRT) is integral in improving the economic, social and environmental sustainability of city transport system (Vuchic 2005; Cervero 1998). However, there are a range of long term and short term factors that influence the development of BRT system. The physical (Newman & Kenworthy 1999), social and economic characteristics of a city (Dargay et al. 2007), its political system (Stone 2013), and institutional arrangements (Sohail et al. 2006) are long term factors that need to be considered in making BRT successful. The short term factors include improvements in frequency, reliability, transferring and fares by adopting simple and grid-based line structures (Mees et al 2010; Stone et al. 2012). The aim of this paper is to investigate the short term factors that are capable of improving the existing BRT services in Auckland.

This paper first reviews the short-term factors of improving BRT services from network planning perspective, followed by the research design and the reasons for selecting the Northern Express (the only BRT line) in Auckland. The analysis of the Auckland BRT in the following section focuses on various elements of network planning such as line structure, frequency, reliability, fare structure and transferring, followed by a discussion and conclusion.

BRT Improvements in Short Term – Literature Review

The short term factors include improving BRT services at relatively little cost. These fixes may include improvements in frequency, reliability, transferring and fares by adopting simple and grid-based line structures adopted as a network.

a) Line or route structures: The network planning approach to BRT demands the adoption of a straight line principle, moving from origin to destination using the most direct path possible given the surrounding land uses and topography (Mees 2000; Nielson 2005). The primary reason for this is that straight line patterns offer the most direct and quickest travel paths for passengers and develop a simple system which can be easily understood by passengers. Mees et al. (2010) argue that BRT lines should be a 'defined and unchanging physical route with a fixed stopping pattern, a specific timetable, and a unique name and number' (p.20). The straight line structure is adopted in cities like Zurich and Toronto to minimise travel time and make the public transport network more efficient, and achieved efficiency without a BRT system in place (Mees 2000, 2010; Stone et al. 2012; Nielson 2005; Thompson 1977). by adopting a straight line principle, BRT and its associated public transport line structure moves in a cross-city pattern where the outer suburbs and central city are not the start and end destinations. Instead, BRT operates north-south and east-west directions, creating a grid pattern, where passengers can 'go anywhere, anytime' using the most direct path possible (Thompson 1977). As a result, a very comprehensive public transport service network is created as all areas of the city can be accessed from any other part. The only requirement is normally for passengers to transfer at least once to reach their final destination. This pattern is also suitable for today's dispersed travel patterns as activities become more decentralised. For example, the CBDs in United States' cities contain less than 10 per cent of city jobs (Thompson & Matoff 2003), and therefore a city wide public transport network is needed. In line with this principle, this paper explores the types of BRT line structures present in Auckland.

b) Transferring: Shifting between modes or services to reach an end destination is a key concept in the grid-based network planning approach. Coordinated transfers offer a greater range of travel destinations and improve operational flexibility and efficiency, ultimately achieve integrated public transport network (Lo et al. 2003; Mees 2010; Stone et al. 2012; Nielson, 2005). In Hong Kong, travellers often need to transfer three or four times to reach their end destination (Lo et al. 2003). Similarly, 70 per cent of all Munich and London underground trips, 40 per cent of all Paris public transport trips and 30 per cent of New York subway trips require at least one transfer to reach an end destination (Guo & Wilson 2011). Due to well-designed transfers, patronage levels remain high in these cities because 'transfers open travel paths to and from non-CBD destinations that are reachable in radial systems only by lengthy and circuitous travel' (Thompson and Mataoff 2003, p.298). However, if timely and quality transfers are not provided, transfer becomes a negative element in BRT travel as 'riders may perceive it to be more acceptable to take modified routes that eliminate transfers, even if initial waits and riding consume more time' (Horowitz & Zlosel 1981, p. 282). Therefore, the provision of quality transfer points and a connected network needs to be a priority in BRT service design. This research seeks to investigate whether BRT in Auckland facilitates transfers between different lines and modes.

c) Frequency: Frequency of BRT refers to how often a bus travels along a particular route. Often, frequency is determined by patronage levels at particular times; if BRT patronage falls, then frequency levels will be reduced and vice versa (Carey & Crawford 2007; Ceder 2007). This approach creates a demand responsive system in which evening and weekend services are irregular, infrequent and even non-existent because of low demand.

Network planning requires a supply-led approach based on desired levels of BRT services (Mees 2000; Nielson 2005). This approach involves looking at the entire public transport network and then allocating BRT frequencies so that services become integrated with one other. This in turn ensures that they operate as a singular network and not as individual BRT line. This supply-led approach involves providing a consistently high quality service that will operate using a 24 hour schedule. Where possible, high frequency corridors need to be offered with services running at least once every ten minutes. When this is not practical, services must then be coordinated using a method such as the 'pulse timetable' technique (Mees, 2000, 2010; Stone et al. 2012; Nielson 2005) to ensure that the lower frequency will not make users uncomfortable. The pulse timetable technique involves timing different public transport lines so that they arrive and depart on BRT stations at the same time. This works to address long waits involved with low frequency services and allows passengers to transfer without missing connecting services (ibid). This research explores the frequency levels of BRT services in Auckland.

d) Fare structures: Fare structures refer to how passengers are charged to use BRT services. The most common structures are; 1) flat fares where passengers pay the same price for BRT tickets regardless of distance travelled 2) zonal fares where price is dependent on distance travelled (Leutze & Ugolik 1979; Rock, 1975). Network planning requires a zonal fare system which allows for transfer between services without imposing additional costs on passengers (Nielson 2005). By coupling a zonal system with transferable fares, passengers pay an appropriate price for their total travel distance. Such an approach means that public transport looked upon as a single entity rather than a series of individual components. Transfer charges reduce the willingness of passengers to transfer or to use service at all. However, it is difficult to organise such a fare system when multiple operators run services within one network (Stone et al. 2012). Cross subsidies required from profitable to less profitable services which is only possible if the regional public transport agency pools fare revenue and allocates routes via a competitive tendering process (Nielson 2005). This arrangement has become successful in many European cities, Singapore and Perth. Therefore, when choosing fare systems, it is important to consider the need for transfer-friendly fares and integrated ticketing. This research asks the question, do fare structures in Auckland encourage the use of BRT and its associated public transport network?

In summary, BRT service provision principles include: straight line and grid-type line structures, high or timed frequency corridors, the provision of quality transfer interchange points and the provision of transferable friendly fares, these are all key components in making short-term improvements to BRT.

Methodology

The research has been conducted in Auckland, the largest city in New Zealand with a population of approximately 1.5 million people (Statistics New Zealand 2013). Public transport in Auckland comprise of rail, BRT, buses and ferry services and cater for only seven per cent of all journey to work trips (ibid). There are several agencies at multiple levels of government responsible for transport planning in Auckland. At the central government level, the New Zealand Transport Agency (NZTA) provides occasional funding to public transport infrastructure while Kiwi Rail is responsible for managing the rail network. At the metropolitan level, Auckland Council and its subsidiary Auckland Transport (AT) is responsible for formulating transport strategies and planning. Public transport was deregulated in 1989 and several bus companies operate services in Auckland. Due to the deregulated environment, there is a competition between bus services and rail services (Stone et al. 2012).

The desktop data analyses relevant transport planning documents, timetables and other information publically available on websites. Detailed fieldwork was conducted for two weeks recently in relatively warm weather to count and observe transfer behaviour in different BRT stations. Fieldwork confirms waiting times, ticket prices, walking distance between transfers, fare structures, and frequencies on transferring lines.

There are some limitations to this research design. This research did not gain access to commercially sensitive information such as patronage data for individual public transport lines, which would have enabled a more in-depth analysis. Moreover, conducting interviews to ascertain stakeholders' perspectives would have further strengthened and validated the research findings.

Auckland BRT (The Northern Express) - Service Provision Analysis

This section critically assesses the state of public transport services in north Auckland by identifying the type of line structures, frequency, transfers and fare structure of the BRT and the surrounding network.

a) Line structure analysis: Auckland is notorious for its overly complex bus line network (Auckland Regional Transport Authority, 2010b). However, the BRT provides a good example of a simple bus line as it travels straight from north Auckland (Albany station) to the CBD by using the most direct route. This bus line travels along the first bus right of way to be built in New Zealand. The BRT service commenced in November 2005, but the infrastructure was formally opened in February 2008, including five stations along the corridor – Albany, Constellation, Sunnynook, Smales Farm and Akoranga.

The BRT is proving to be very successful, with patronage levels continuously increasing from 0.3 million passengers in 2006 to 2.3 million passengers in 2013 as show in Figure 1. By comparison with the BRT, most other bus lines take indirect routes, meander around many local streets and travel long distances before reaching their destinations. These service designs create a complex network which transport planners are simplifying. In short, the simple and direct line structure of the BRT contributes to the success of public transport in northern Auckland and, as a consequence, is being applied to other parts of Auckland.

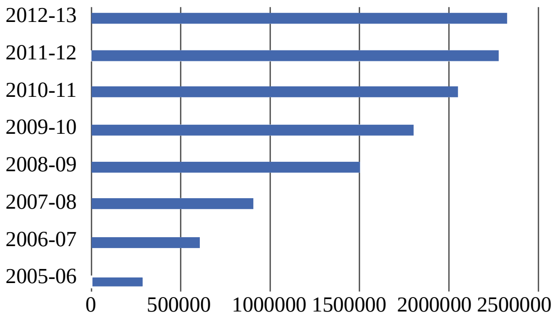

Figure 1 Northern Express patronage

Source: Data compiled by authors from the Auckland Transport and ARTA Annual reports

Note: Data represents financial year starting July to June. BRT service commenced in November 2005 and therefore 2005-06 data is from November 2005 to June 2006.

b) Frequency analysis: The BRT provides a good example of a 'forget the timetable' high frequency corridor. The BRT offers frequency levels of one bus every 4 minutes during morning peak periods, 10 minutes during the daytime, and 15 minutes late at night, and at weekends and public holidays.

The reliability of the BRT has been achieved by providing bus lanes and bus rights of way. Therefore, buses take around 24 minutes to travel from the origin (Albany Station) to destination (Britomart Station in the CBD). This is compared to a 45 minute journey when travelling by car (Auckland Regional Transport Authority, 2010c). However, outside of the bus right of way, the buses are subject to local traffic conditions. This becomes a problem, particularly during peak hours. With the motorway becoming full by 7am during the morning peak period, the journey in some sections becomes very slow (such as between Albany and Constellation, and again soon after Akoranga to Britomart). With the Harbour Bridge is being the only road access to downtown Auckland traffic bottlenecks at this point making bus travel unreliable and slow. Nevertheless, travelling along this bus corridor is still faster than car travel because of the presence of the busway. In short, frequent services on dedicated lanes provide reliable bus network services as in the case of BRT.

c) Transfer analysis: Generally, the public transport services in Auckland discourage transferring due to the provision of highly complex, indirect and radial bus routes. In order to analyse the transferability, transfer data was collected during the fieldwork for the BRT and its surrounding bus network. The BRT provides the best infrastructural set-up in the city to potentially foster transfer opportunities between services. For the BRT analysis, the five stations along the line were used as transfer points, with data being collected on ten local or suburban buses arriving at these stations. Figure 2 shows a map of the BRT and the suburban bus routes studied. For the BRT, the bus line was tested on the basis of city bound trips with suburban buses arriving into the transfer points and then transferring onto a BRT heading to downtown Auckland.

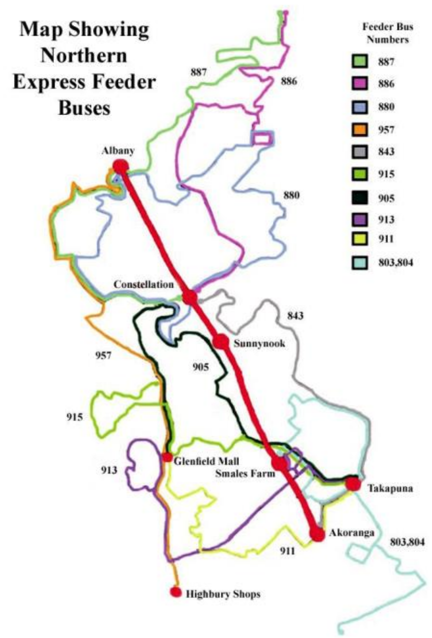

Figure 2 The BRT and suburban buses analysed in the transfer analysis. (Source: Matthews and Imran based on fieldwork)

BRT was tested based on key elements such as the frequency interval of transferring buses, single transferable ticketing, ticket price for return journey, distance between stops, number of passengers transferring and average wait time. The transfer analysis shows the BRT to be performing well against most criteria. This is largely due to the

BRT infrastructure being designed to facilitate transfer. The BRT stations and fares are both designed with transfers in mind, while the surrounding network is not designed in a way that encourages transfer.

Figure 3 shows the significant infrastructural development at Albany Station on the BRT. The BRT transfer points offer design elements such as complete shelter from the weather, real time information, bike stands and lockers, ticketing machines, help and emergency points, and food, drink and newspaper kiosks. By contrast, the 007 bus infrastructure is basic, offering no more than bus shelters.

Figure 3 Northern Express Bus Station (Photos taken by Authors)

Even though the BRT performed well in this analysis, the ranking of transfer factors would have been much lower if the analysis had recorded data for a return journey from downtown Auckland. In particular, the scores for wait time and transferring line frequency would have dropped significantly. This is because the suburban buses do not operate at the same frequency as the BRT, nor do they operate using a pulse timetabling system. Furthermore, the actual design of the suburban bus system hinders attempts to use it as a feeder bus service. This is because it has not been designed to easily connect people from the suburbs with the BRT. Suburban bus routes are indirect, uncoordinated and haphazard (see Figure 2). As a result, people are not using these bus services as feeder services, as seen in the field work investigations. This complex network is therefore, limited by the maximum capacity of the park and ride facilities (See Figure 1), and due to the deficiencies of the suburban bus network the ‘network effect’ needed for a public transport system in Northern Auckland to be successful is absent.

Furthermore, it is also important to note that all day park and ride facilities are provided at only Albany and Constellation stations – 514 at Albany and 273 at Constellation. These facilities become full very early in the morning (just after 7a.m. on weekdays); it is likely that motorists finding them full will continue to drive themselves to their destination. This makes the BRT service seem unreliable to these potential passengers, with their ability to use the bus service being constrained by their inability to access a car park. What this further shows is that the suburban services are not effective in attracting passengers. In short, the BRT does not offer good transfer to and from different suburban services despite the building of high quality bus stations.

d) Fare structures: A zonal-based fare system (locally called Stage) operates in Auckland. Under this system, passengers pay higher fares for longer travel distances. This system, however, is highly complicated due to being there at eight different zones and nine separate public transport providers in the city (Auckland Regional Transport Authority, 2010e). Recently the Auckland Council simplified the system by introducing a smart card (the HOP card), although it is still not useable on all bus services meaning that the fare system still remains complex. To further add to this complexity, there is one exception to the zone based system as the BRT and its surrounding network offers a time-based ticketing system, where passengers pay for their journey time and not the distance. Despite the existence of this anomaly, the zonal-based fare system can still be used on these services (Auckland Regional Transport Authority, 2010e).

Concession tickets allow seniors to travel for free while approved tertiary students can receive a 40 per cent discount on fares (Auckland Transport, 2013). However, because Auckland generally does not offer transferrable fares, users pay each provider and for each mode of transport used. However, transferrable tickets can at times be offered for services provided by a single transport operator, but competing operators do not accept each other's tickets (Auckland Regional Transport Authority, 2010e). Under the MAXX brand, and now the Auckland Transport website journey planner appears to provide a coordinated public transport system, but this appearance is not confirmed by passenger experience.

Despite this transferrable fare being in place, the North Shore suburban bus network is not in fact being used as a feeder. The survey data shows that between one and nine passengers transfer from the suburban buses to the BRT in any one morning peak period from 7a.m. - 9a.m. During this two hour period, most of these services feed four buses to the BRT. Very few passengers are therefore, using the suburban buses for transfer purposes. Despite this, the BRT buses are consistently full meaning that this bus line is not attracting passengers because it is part of a quality public transport network but rather because it is a quality bus line in and of itself.

Discussion and Conclusion

The previous section applied four principles of network planning (straight line structure, frequency, transfers and fares) to the analysis of service quality offered by the BRT in Auckland.

The analysis shows that peak hours commuters are the focus of many planning documents. This being emphasised in the BRT – a straight line public transport service designed to specifically target peak period travellers from Northern Auckland heading into the CBD. The BRT epitomises the definition of a straight line structure. The direct travel path offered plays a key role in its success, with the line being one of the most highly patronised public transport lines in the city. Due to BRT success, the major bus lines were redesigned to follow a simple, straight line structure, resulting eventually in increased patronage levels. There have also been some recent attempts to redesign cross town bus lines to increase use by shoppers outside peak time. This shows that there is a demand for simple and direct routes, not only during peak hours, but also in off-peak hours. However, these bus lines operate in isolation rather than being designed to form part of a simple, and straight-line based network.

Frequencies significantly influence BRT use, and can be developed to meet either existing patronage levels (Carey and Crawford 2007; Ceder 2007) or desired patronage levels (Mees 2010; Stone et al. 2012; Nielson 2005). Generally, customers demand high frequency BRT services and this can be facilitated by a pulse-timetabling system designed to time services in such a way that main line and the feeder services all arrive at and depart from a destination at the same time (ibid). However, public transport frequencies in Auckland are generally very poor. Within the entire network, only three high frequency lines; the BRT and the two b.lines were found, with no pulse-timetabling occurring throughout the rest of the network. The BRT and two b.lines offer reliable and frequent all day services to passengers during the week and are therefore highly patronised. This demonstrates that people utilise high frequency public transport lines when they are offered. However, these lines offer much lower frequencies at weekends and during the evening. Although frequencies can be reduced during off-peak hours, the service must remain regular and coordinated with the wider network to remain effective. This does not happen due to the absence of pulse timetabling which can eliminate or significantly reduce waits experienced by passengers. When a pulse timetable is not provided the network does not operate as a single entity. Instead, the BRT operates in isolation, attracting customers based on the quality of the individual line's performance and the availability of park and ride facilities, with the surrounding bus network being poorly patronised. There is no reason why the BRT passengers and new passengers would not utilise a local bus network, if a quality system was provided.

Transfer is a key element in the provision of a successful BRT network (Guo & Wilson 2011; Shrivastava, et al., 2007). The quality of transfer points and timely transfers influence people's willingness to transfer between services (Lo et al. 2003; Mees 2000, 2010; Mees et al. 2010; Stone et al. 2012; Nielson, 2005). The Auckland public transport network however, has not been designed to accommodate transfer; in fact it has been designed to avoid transfers wherever possible. However, the BRT offers high frequency and world class stations as transfer points (see Figure 3) but the surrounding bus network does not meet frequency standards and straight line principles (see Figure 2). These buses are infrequent and uncoordinated. This means that passengers using them to transfer will find transferring time consuming and inconvenient – particularly when transferring onto a suburban bus from the BRT. The fieldwork shows that few passengers are transferring between lines. This is largely due to the different buses operating in isolation from one another – even competing in many instances. Chowdhury and Ceder (2013) argue that although the BRT stations provide information integration and integrated physical connection of transfer, improved network, fare and ticketing integration and integrated timed-transfer are also needed. The document review shows that little attention is being given to facilitating transfers in BRT. The focus is on the development and expansion of park and ride facilities as transfer points. This shows that public transport trips remain dependent on private vehicles and the availability of car parking. This strategy might reduce CBD congestion but only shifts that congestion to the park and ride facilities in the suburbs. Clearly, this approach does not promote the utilisation of the wider public transport network. The current approach means that each public transport line is utilised according to its own strengths rather than on the accumulated strength of the wider integrated network.

Public transport networks should operate using an integrated and transfer-friendly ticketing system (Mees 2000, 2010; Mees et al., 2010; Nielson, 2005). This means the adoption of a zonal fare system where passengers pay according to the total distance travelled. This is because public transport needs to be looked at as a single entity and not a series of individual components (ibid). The research shows that Auckland has primarily adopted a zonal fare system, but the public transport system also charges passengers for individual trips and transferrable fares are not readily accessible across the entire system. The BRT and buses operated by any particular company generally offer their own transferrable ticketing using a time-based system. These differences within the wider network make fare structures complicated and difficult to understand for users. The document analysis show that the implementation of a single transferrable fare gained significant attention from transport planners and a HOP smart card was recently issued which is the first step towards providing a single integrated ticketing system for the city.

Auckland public transport is operated by several private companies and therefore lacks cross-subsidisation. Auckland Council and Auckland Transport do not pool and then re-distribute all public transport revenues and subsidies. Currently, subsidies are based primarily on patronage levels rather than performance standards. Managing subsidies in this manner encourages operators to provide long and elaborated routes that access as many key destinations as possible. These routes often travel on similar paths, access the same key points and cluster on high-demand corridors. Routes therefore are purposefully designed to attract as many passengers as possible but this does not result in successful public transport. When operators are paid subsidies based purely on performance targets such as punctuality and reliability of arrival and departure times, there is an incentive to provide a high quality public transport network, as the focus is no longer on increasing patronage and competing against other transport operators. By pooling and re-distributing revenues and subsidies in this way, Auckland Council would be paying operators according to the quality of the services offered and not on the number of passengers using their services.

The discussion clearly shows that complex route structures, and uncoordinated bus services and fare structures create passenger confusion and deter public transport system use. However, the BRT counters this trend due to its line structure, frequency, speed, simplicity and reliability it is well patronised (2.3 million boardings per year in 2012 or 6500 per day). However, these figures are much lower than Vancouver's express, trunk bus services (called the B-Line) which carry 20-30,000 passengers per day (Mees et al. 2010). This service replaced a large number of low-frequency suburban routes with a feeder network connecting to the B - Lines at specially designed interchange stations. With Auckland BRT, the surrounding bus services are not designed as frequent, coordinated feeder routes despite the presence of high quality bus stations. There is an opportunity to increase patronage by learning from the success of the Vancouver B - Line rather than expanding the park and ride facilities.

This research investigates short-term approaches to improve the existing BRT system in Auckland including line structure, frequency, transfer and fare structures. The research finds a meandering, radial line pattern to exist apart from the straight line route of the BRT. The BRT line structure is simple and straight, high in frequency, has world class bus stations, and offers a transferrable fare to connect to the wider north Auckland bus network. When compared to the rest of Auckland, the BRT experiences high patronage levels with the potential for further increases. It therefore shows the potential for short-term network planning factors to improve city public transport.

The main lesson learned is the importance of adopting network planning principles in the design of BRT services. This involves: 1) designing BRT lines to create a simple and straight line network, as already started in Auckland 2) providing more high frequency corridors and utilising pulse-timetabling techniques for low frequency corridors 3) designing BRT services to facilitate planned transfers to and from feeder buses 4) fully developing integrated fares in such a way that transferrable tickets can be used on the BRT and its feeder services, and 5) benefiting from 'network effects' in the short-term rather than focusing on new public transport infrastructure and technology.

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