Frequency and Connectivity – Key Drivers of Reform in Urban Public Transport Provision

Professor David Hensher, Director, Institute of Transport and Logistics Studies (ITLS), University of Sydney

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Abstract

The selection of appropriate public transport investments that will maximize the likelihood of delivering the levels of service required to provide a serious alternative to the automobile is high on the agenda's of many metropolitan governments. Mindful of budget constraints, it is crucial to ensure that such investments offer the greatest value for money. This paper promotes the view that integrated multi-modal systems that provide frequency and connectivity in a network based (as distinct from corridor-alone based) framework offer the best way forward. This will require serious consideration of a mix of public transport investments in which buses as feeder services and BRT as trunk services can offer a greater coverage and frequency than traditional forms of rail, even at capacity levels often claimed the domain of rail.

Introduction

Cities continue to grow for a whole host of reasons, resulting in levels of traffic congestion that have rarely been observed in the past. The "predict and provide" approach, so common with urban transport planning, which typically recommends more road building alone, is not going to have a positive long term impact in delivering sustainable city performance that is close to securing economic efficiency and distributive justice objectives. There are many other ways of supporting these objectives, one of which is improved public transport. Public transport alone, however, cannot be the solution, despite what many believers would like, but it is an important component of the overall plan for a sustainable future. Public transport, however is very much multi-modal and should not be seen as a single mode solution as is so often the case with many ideologues. This paper takes a strategic look at what are sensible ways of working to embody improved public transport into the complex workings of a city.

The Appeal of Bus-based Public Transport

Public transport investment is being touted as a key springboard for a sustainable future, especially in large metropolitan areas with growing populations. Whether such investment will turn the tide away from automobility is a big question; however regardless of the likely outcome, any commitment to improved public transport has a growing number of options to pursue. Although variations in rail systems typically loom dominant in many strategic statements on urban reform (Sislak 2000, Edwards and Mackett 1996), ranging from heavy rail through to metro rail and light rail, there is a growing interest worldwide in ways of making better use of the bus as a primary means of public transport, and not limited as a service that feeds a rail network (Hensher 1999, 2007; Canadian Urban Transit Association 2004, Federal Transit Administration 2004, Callaghan and Vincent 2007)[1].

In establishing a role for public transport, it should be enshrined in the motto of delivering 'frequency, connectivity and visibility' that is value for money as defined in terms of net social benefit per dollar outlaid. Connectivity refers to the provision of services that offer door-to-door services with minimum delay and almost seamless interchanges. Visibility is predominantly 'knowing where the mode is going from and going to, and when'.

There are many ways in which bus transport can be developed as part of an integrated network-based public transport system (Hensher 2007a), typified by the best practice bus rapid transit (BRT) systems in South America such as Curitiba in Brazil and TransMilenio in Bogota, Colombia (Menckhoff 2005). Bus Rapid Transit is "…a high-quality bus based transit system that delivers fast, comfortable, and cost-effective urban mobility through the provision of segregated right-of-way infrastructure, rapid and frequent operations, and excellence in marketing and customer service. BRT essentially emulates the performance and amenity characteristics of a modern rail-based transit system but at a fraction of the cost. A BRT system will typically cost four to 20 times less than a light rail transit (LRT) system and 10 to100 times less than a metro system." (Wright and Hook 2007, 11).

Recent research by Callaghan and Vincent (2007) shows the appeal of BRT in Los Angeles when comparing the Orange line BRT with the Pasadena, California Gold Line light rail (LRT), both of which connect to the Red Line subway and have similar service patterns and length. The BRT is performing considerably better than the LRT. The latter costs considerably more and carries fewer riders. Capital costs per average weekday boarding for the BRT line is $US16,722 in contrast to $US45,762 for the LRT line; cost per revenue service hours for BRT and LRT are respectively $US243.18 and $US552.54; and cost per passenger mile are respectively $US0.54 and $US1.08. These are impressive evidence of the value for money from BRT compared, in this instance, to an LRT system. Metro rail and heavy rail would be even more unattractive within the service capacity range studied. Cain *et al.* (2007) review the lessons that can be learnt from the most successful BRT system in Bogota, Columbia, the TransMilenio, and its applicability to the USA. The most important findings relate to connectivity and network integrity, reinforcing the view that it is all about networks and not corridors per se. They suggest that BRT is capable of playing a role in the achievement of a wide set of objectives such as sustainable accessibility and urban renewal when implemented as part of a holistic

[1] Discussions with Raymond Lam, Singapore's Minister of Transport, have been useful in highlighting this position.

package of integrated strategies. Importantly it is the commitment to a *network* of BRT routes (and not a corridor view of planning per se), which gives a metropolitan area the opportunity to enhance the accessibility and urban renewal benefits from corridor level to metropolitan wide level. The relatively low capital costs have made this possible in many countries (see Hensher and Golob 2008) within a relatively short time frame (up to 5 years often). Whether this is a transition strategy to other forms of public transport or an end in itself should be determined by how the market responds. It is not uncommon to see BRT promoted as a transition to light rail, metro and even heavy rail (e.g. in Brisbane and Pittsburgh), partly to get something started within constrained budgets, but to also appease anti-bus groups who see public transport as singularly rail. What is encouraging is that the success of many of the BRT systems has resulted in its expansion without the need to go to a rail 'solution'. Carrying capacities of BRT (see Figure 1) are increasing all the time and moving the case solely for rail off of many agendas.

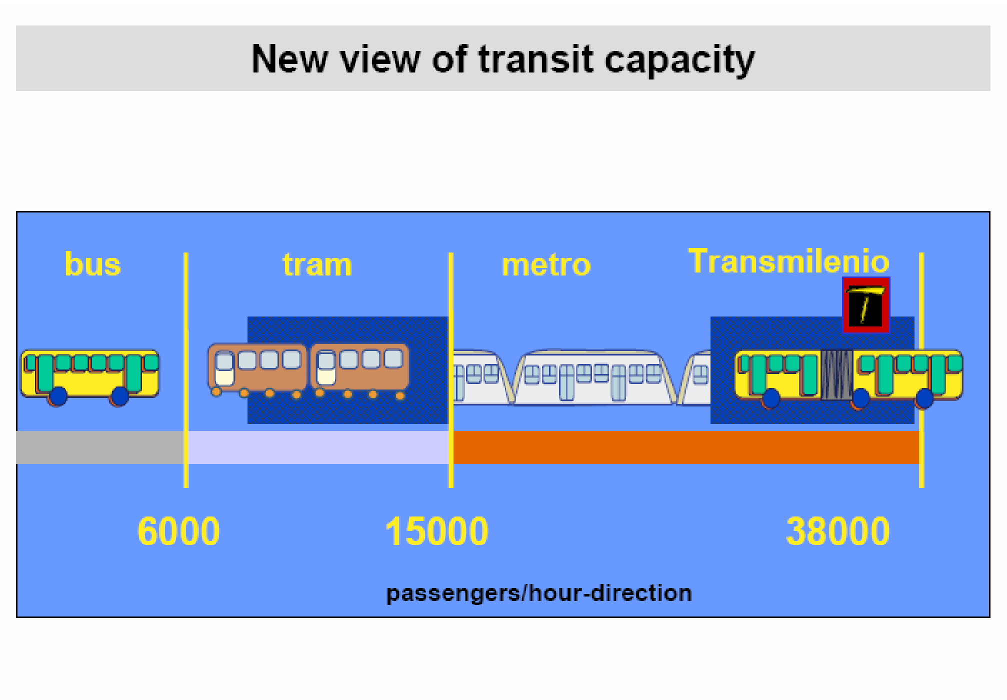

Figure 1 The changing capacity capability of the modes

What is especially pertinent in the commentary above, however, is the recognition that the so-called natural evolution from a bus in mixed traffic through to heavy rail in terms of passenger capacity per hour (seating and standing) is no longer strictly valid. BRT systems such as the TransMilenio have shown that a BRT system can, if appropriately configured, carry more passengers per hour than many rail systems. The main trunk corridor in Bogota has peak maximum ridership[2] of 35,000 trips per hour[3] one way with three minute maximum peak headways (five minute off-peak headways) with buses spaced much closer together much of the peak, average station dwell time of 25 seconds,

[2] For 35,000 passengers with a load of 160, there would need to be 219 buses in the peak hour, or almost four buses each minute.
[3] With recent claims of up to 45,000 trips per hour.

with articulated buses having a carrying capacity of 160 passengers and off-vehicle smartcard fare payment. Curitiba, the forerunner to Bogota, has a peak maximum ridership of 20,000 trips per hour one way. This compares to the busiest rail line in Sydney, for example, of 14,000 trips per hour one way. In general Hidalgo (2005, 5) states "There is range, between 20,000 and 40,000 passengers/hour per direction, in which Metros and HBRT[4] are able to provide similar capacity. Nevertheless, there are large differences in initial costs: US$5-20 million per kilometre for HBRT, US$30-160 million per kilometre for Metros".

Wright and Hook (2007) have compiled details of many BRT systems to document the inherent advantages (and disadvantages) of many of the systems in terms of cost and performance. With a focus on delivering a cost efficient and service effective transport system, there are opportunities today to evaluate mixtures of bus and rail systems that can service the full spectrum of capacity requirements and patronage demands (Cornwell and Cracknell1990, Hidalgo 2005, Transit Cooperative Research Program 2007).

It is not unreasonable to assume that the two primary transport indicators that attract the attention of governments and the media in particular when debating public transport options are infrastructure costs (Figure 2) and patronage levels (Figure 3) (see Hensher and Golob 2008). The infrastructure costs in $US2006m per kilometre in Figure 1 vary from a high of $53.2m per kilometre in Boston to a low of $0.35m per kilometre in Taipei. The significant size of the various ranges indicates the local nature of costing. Additionally, the range depends upon the individual features sought within each system (e.g., quality of stations, separation from traffic). We recognise that such univariate comparisons are somewhat limiting and must be interpreted in the context of input cost differences across nations. However, what is surprising is that the variation does not systematically vary by country or continent, given an initial expectation that input costs might be greater in developed economies. For example, the seventh most expensive BRT is in Sao Paulo with the 12th in Bogota, both in Latin America. Although the least cost set are typically in Asia and Latin America, Taipei is a relatively prosperous city with GDP per capita of $US29,500, which compares favourably with Sydney ($US33,000) and Tokyo ($US35,000). Bogota is $US9,000 per capita.

Peak ridership for 26 systems, for which we have data, shows four South American systems (Transmilenio in Bogota, Sao Paulo, Porto Alegre, and Curitiba) with 20,000 passengers per hour per direction, which then declines to 12,000 (Seoul), with the majority of systems in the 2,000 to 8,000 passengers per hour per direction.

[4] Hidalgo (2005) refers to high level BRT as HBRT.

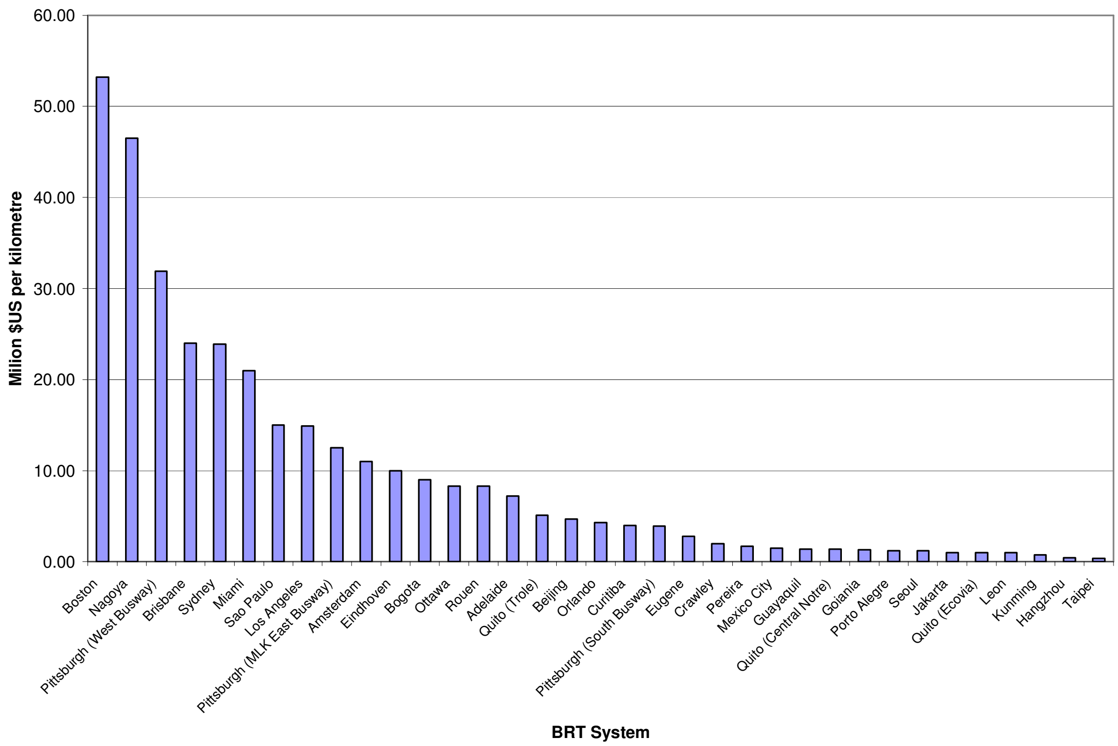

Figure 2 Total infrastructure costs per kilometre ($USm2006)

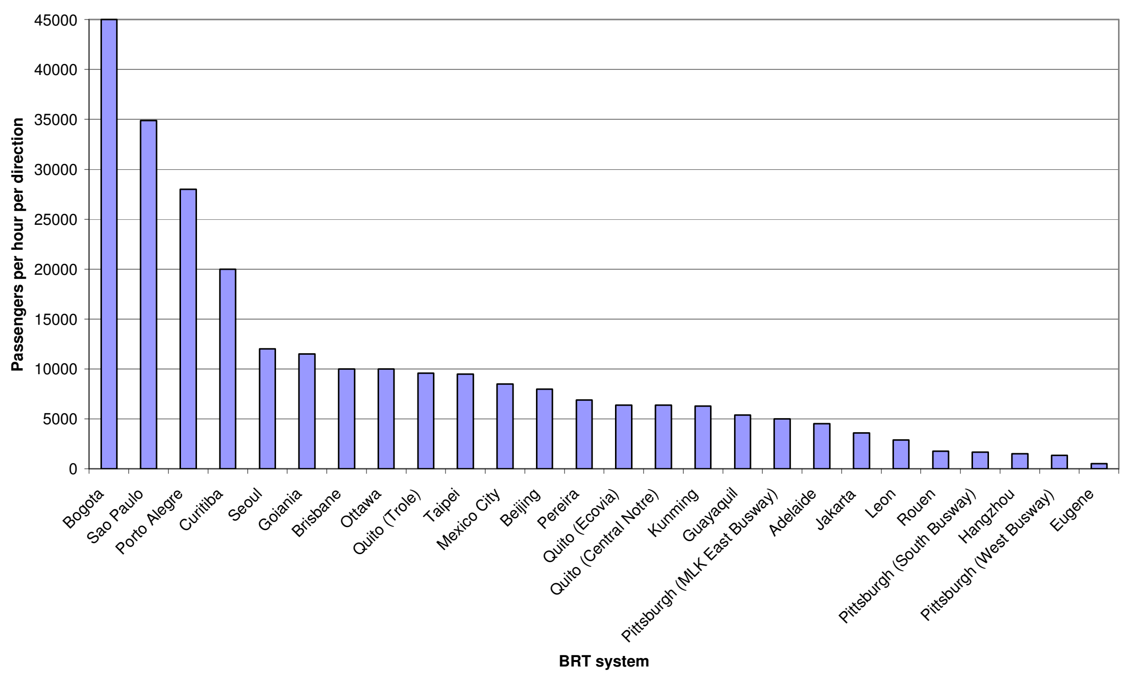

Figure 3 Peak ridership (2006)

A careful assessment of these figures shows a significant amount of variation in the specifications of each system. Clearly a preferred scenario would support high commercial speeds, no operating subsidies (unless they are optimal in an economic welfare sense), low flow buses with at level boarding, totally dedicated corridors with no interference from other modes (which is an attractive feature of railways), smart card off-vehicle fare payment, seamless model interchange (where it occurs), and minimum access and egress time. There is no one system that comes closest to fulfilling all these conditions. The Australian and US systems deliver the highest commercial speeds, the Latin American systems are least dependent on operational subsidies, the Latin American and European systems dominate the provision of at-level boarding and alighting, the Latin American systems have been most effective in eliminating the need for signal priority or grade separation at intersections, and the Latin American, Asian, and French BRT systems have committed to pre-board fare collection and fare verification. Modal integration at stations is strongest in Australia, Europe, and USA. Finally, the majority of BRT systems have stations spaced apart on average 500 metres, although this increases to over 1.5 kms for Australian and USA systems including one in China and in Holland.

Concluding

This paper reinforces the need to have a broad view on candidate public transport systems, designed to deliver network-based frequency and connectivity, that is compliant with value for money objectives. It is essential to stop thinking modes and to think outcomes and only then consider the role of specific modes which are a means to an end and not an end per se. The emotional debate on bus vs. rail has become somewhat counter-productive; it is time to focus on the real objective of providing sustainable transport systems that are the most affordable for the job at hand.

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