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

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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 agendas 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 framework offer the best way forward. A mix of public transport investments with buses as feeder services and bus rapid transit (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, typically recommends more road building. This, however, does not contribute in the long term to 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.

This paper takes a strategic look at what are sensible ways to embody improved public transport into the complex workings of a city.

Public transport investment is being touted as a key springboard for a sustainable future, especially in large metropolitan areas with growing populations. 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. Hence, any commitment to improve public transport has a growing number of options to pursue. Although enhancement in rail systems typically loom dominant in many strategic statements on urban reform (Sislak 2000; Edwards and Mackett 1996), ranging from heavy rail to metro rail and light rail, there is a growing interest worldwide in 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; Callaghan and Vincent 2007).

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 in terms of net social benefit per dollar outlaid. Connectivity refers to the provision of door-to-door services with minimum delay and almost seamless interchanges. Visibility is predominantly knowing where the mode is coming 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). The BRT systems in South America such as that in Curitiba, Brazil and TransMilenio in Bogota, Colombia (Menckhoff 2005) are good examples. BRT 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 excellent 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).

The Appeal of Bus Rapid Transit Systems

Achieving connectivity and value for money

Recent research by Callaghan and Vincent (2007) shows the appeal of BRT when comparing the Orange Line BRT in Los Angeles with the Gold Line LRT in Pasadena, California, 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 is US$16,722 in contrast to US$45,762 for the LRT; cost per revenue service hour for BRT and LRT are respectively US$243.18 and US$552.54; and cost per passenger mile are respectively US$0.54 and US$1.08. These are impressive evidence that a BRT system offers better value for money than an LRT system. Metro 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 - the TransMilenio - in Bogota, Columbia, and its applicability to the United States. 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 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 provides the opportunity to enhance the accessibility and urban renewal benefits from corridor level to metropolitan-wide level. The relatively low capital costs have made a network of BRT routes possible within a relatively short time frame (often within 5 years), with examples such as Brisbane, Philadelphia, and Bogota (see Hensher and Golob 2008).

BRT, as a high capacity public transport solution for major corridors, forms the centrepiece for a fully integrated network of bus-based services. The connectivity deep into the network's outer fringes is established through a hierarchy of feeder and trunk routes, with almost seamless transfer points. While it is true that this can allow for light rail and heavy rail, the hourly capacity needs in many jurisdictions are such that rail is unnecessary given it higher capital costs (and lower value for money) and greater lifecycle maintenance and operating costs. The fully integrated and connected bus hierarchy can be modified for little cost as markets change, making it very adaptable to the preservation of connectivity relevant to patronage throughout the network.

Increasing capacity through high frequency

Whether BRT is part of 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). This is 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 are increasing all the time and moving the case solely for rail off many agendas (see Figure 1).

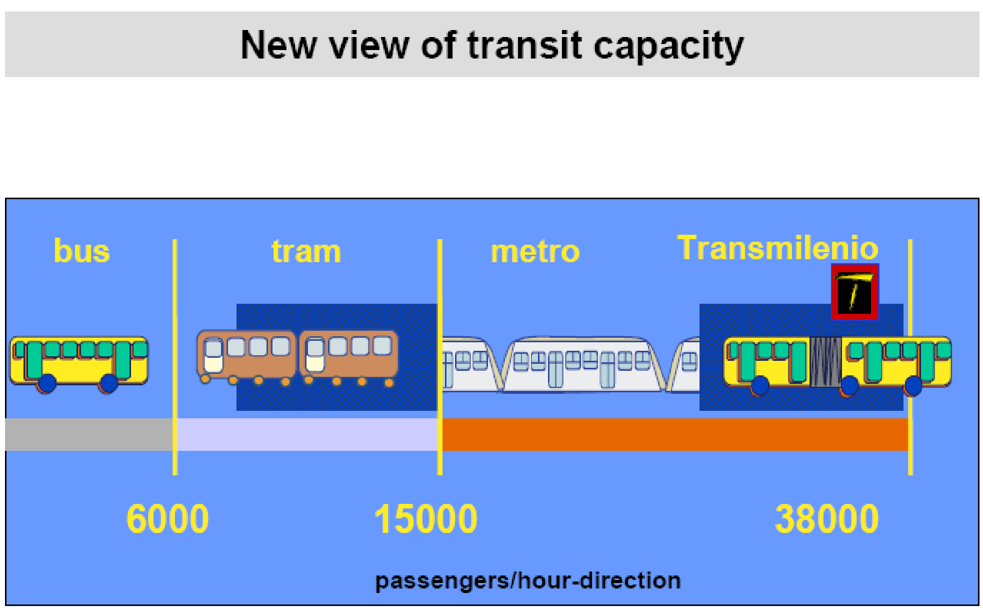

Figure 1 The changing capacity of the modes

The so-called natural evolution from a bus in mixed traffic 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 maximum peak ridership[1] of 35,000 passengers per hour per direction[2] with maximum peak headways of three minutes (five minute off-peak headways), average station dwell time of 25 seconds, with articulated buses having a carrying capacity of 160 passengers and off-vehicle smartcard fare payment. Curitiba, the forerunner to Bogota, has a maximum peak ridership of 20,000 passengers per hour per direction. This compares to the busiest rail line in Sydney, for example, of 14,000 passengers per hour per direction. In general Hidalgo (2005) states “There is a range, between 20,000 and 40,000 passengers per hour per direction, in which Metros and HBRT[3] 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”.

Figure 2 shows the peak ridership for 26 systems for which data is available. The four South American systems in Bogota, Sao Paulo, Porto Alegre and Curitiba have peak ridership of 20,000 or more passengers per hour per direction. This declines to 12,000 for Seoul, with the majority of systems in the range of 2,000 to 8,000 passengers per hour per direction.

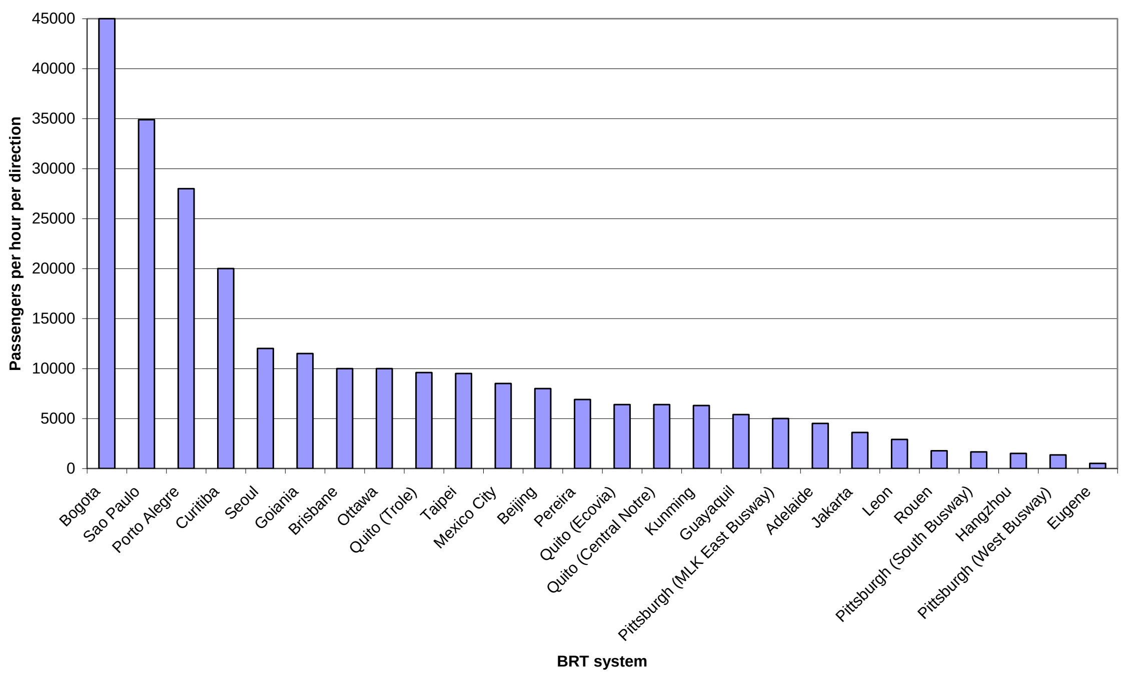

Figure 2 Peak ridership of BRT systems (2006)

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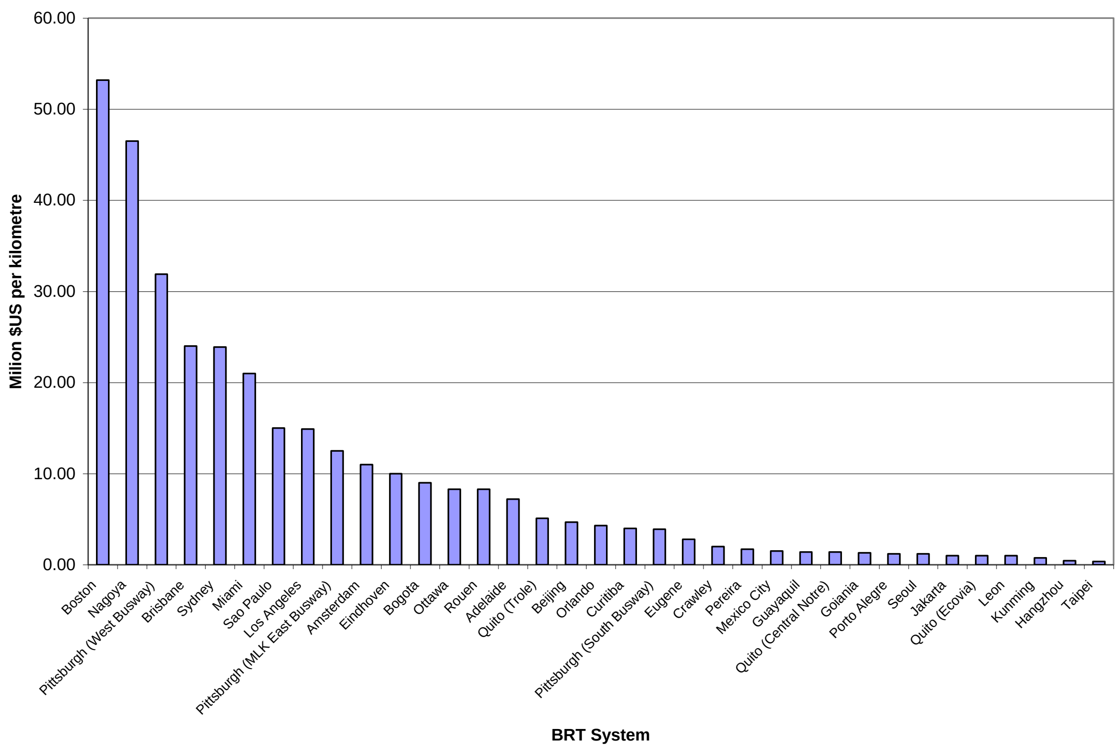
[1] For 35,000 passengers with a load of 160, there would need to be 219 buses in the peak hour, or almost four buses each minute.

[2] With recent claims of up to 45,000 passengers per hour.

[3] Hidalgo (2005) refers to high level BRT as HBRT, operating on its own right-of-way with high quality interchanges, integrated smart card fare payment and efficient throughput of passengers alighting and boarding at bus stations.

Infrastructure Costs of BRT Systems

Infrastructure cost is one of the key indicators considered by governments and the media when debating public transport investment options. The figure below shows that the infrastructure costs for BRT systems can vary from a high of US$53.2m per kilometre in Boston to a low of US$0.35m per kilometre in Taipei. The significant range indicates the local nature of costing. In addition, the range depends upon the individual features sought within each system, e.g. quality of stations, separation from traffic. While such univariate comparisons are somewhat limiting and must be interpreted in the context of input cost differences across nations, what is surprising is that the variation does not systematically vary by country or continent, contrary to 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 costly systems are typically in Asia and Latin America, Taipei is a relatively prosperous city with GDP per capita of US$29,500, which compares favourably with Sydney (US$33,000) and Tokyo (US$35,000). Bogota, in comparison, has a GDP per capita of US$9,000.



Total infrastructure costs per kilometer for BRT systems (2006 US$m)

The Preferred BRT Scenario

There is a significant amount of variation in the specifications of the different BRT systems. 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, dedicated corridors with no interference from other modes, smart card off-vehicle fare payment, seamless modal interchange, and minimum access and egress time.

There is no one system that comes close to fulfilling all these conditions. The Australian and US systems deliver the highest commercial speeds, the Latin American systems are least dependent on operating 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 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 500 metres apart on average, although this increases to over 1.5 kilometres for Australian and US systems including one in China and in Holland.

Wright and Hook (2007) have compiled details of many BRT systems to document the inherent advantages and disadvantages 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 Cracknell 1990; Hidalgo 2005; Transit Cooperative Research Program 2007).

Conclusion

This paper reinforces the need to have a broad view on candidate public transport systems, designed to deliver network-based frequency and connectivity, while complying with value for money objectives. It is essential to stop thinking in terms of modes alone, but to think in terms of 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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