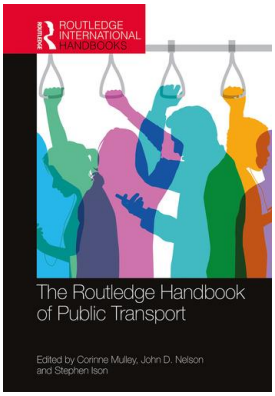

The Routledge Handbook of Public Transport

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Bus – from workhorse to thoroughbred

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BUS – FROM WORKHORSE TO THOROUGHBRED

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Introduction

Buses form an integral part of the urban fabric of cities, able to provide connectivity and access to distributed suburban areas, connecting people, employment and services to central commercial districts. They offer short-term flexibility as cities grow or change, given that fixed-route public transport (metro, light rail, tram) cannot change their routes without further investment and long-term planning. Where buses can develop significant mode share, cities benefit by requiring less space to accommodate the motor vehicle (both moving and stationary), as buses can lead to a reduction of cars on the road, thus impacting traffic congestion and reducing emissions.

The chapter charts the history of how buses have evolved over the last half century as a public transport mode in cities – from emergence to decline and then resurgence. The United Kingdom is used as an example, mainly because its approach has been well documented in the peer-reviewed literature. In recent years, buses have found greater dominance through a number of critical enablers, such as higher-quality vehicles, technology that improves control and monitoring and service reliability, dedicated public transport road infrastructure and bus priority measures and the institutional and regulatory frameworks that improve accountability and performance as well as a greater focus on sound business models.

The structure of the chapter is as follows. It begins by providing the historical setting of the evolution of the local bus as a public transport mode in cities. The chapter continues by looking at how the bus as a mode of transport has developed around the world, becoming the backbone of public transport networks, with a particular focus on technology as an enabler. Consideration is given to emergence of the 'next generation' bus, sometimes manifested as buses with a high level of service (BHLS), particularly in Europe, and bus rapid transit (BRT) more globally. The chapter then presents an empirical discussion on how BRT has emerged in developing countries using Latin America as a case study, showing the importance of decision-making and design. The chapter concludes by including areas for further research.

Evolution of the bus as a public transport mode

Bus operations in the United Kingdom essentially evolved following the end of the First World War using demobilised soldiers with practical experience of driving and maintaining heavy

vehicles and a surplus of military vehicles available for purchase. Following rapid growth and the resulting public safety concerns over the next decade, the first Road Traffic Act 1930 in the United Kingdom was passed, which created the framework for regulation whereby Traffic Commissions issued licences for routes which provided protection for the incumbent operator from competition (Mulley, 1983). The 1930s resulted in the consolidation of small bus operators into larger territorial operations but still largely in private ownership (a few local authorities owned a bus fleet, many converted from tram operations). Up until the Second World War, bus services were profit-making organisations receiving no public subsidy. After the war, fulfilling the promise of the newly elected Labour Government, the 1947 Transport Act made provision for the nationalisation of all transport, which for the bus industry brought about the nationalisation of Thomas Tilling, one of the larger bus groups. This caused an uneven impact on bus ownership, with approximately 20% of the fleet coming under state control (Mulley, 1998).

During the 1950s and 1960s, buses were the mainstay of public transport, transporting passengers to and from the expanding suburbs, operating under licence that protected them from competition on their routes. A cross-subsidy between routes, and financial support from government kept fares, set by the licensing body, affordable. The fleet was either part of the nationalised group of services (which included Thomas Tilling and other, smaller operators) or a local government-owned fleet or private-sector operators (although the latter made up only around 10% of scheduled bus services) (Mulley, 1998).

The rapid growth of private car ownership from the late 1950s onwards resulted in a steady decline in bus ridership, which consequently increased the demand for public funds in order to maintain public transport service levels. Also impacting the efficiency of bus operations was the increase in traffic congestion as the investment in road infrastructure failed to keep pace with traffic demand. The convenience of car travel also led to suburban sprawl that became difficult to service efficiently with a public bus service. All these factors transpired against bus operations. More recently, however, the unsustainability of the private vehicle mode has become more evident, with buses now viewed to be uniquely positioned as a flexible, cost-effective and environmentally friendly means to attract back private motorists as part of a strategy to bring greater sustainability to our cities (Department of Transport, 2020), thus echoing the sentiments of 20 years previously (Department of the Environment, Transport and the Regions, 1999).

Institutional aspects: the impact of deregulation – the UK experience

Institutional aspects are critical to the performance of a passenger transport system, influencing investment, performance and behaviour. This section illustrates this by looking at the impact of deregulation and aftermath of bus reform in the United Kingdom through the Transport Act of 1985 under the neo-liberal policies of the Margaret Thatcher Conservative Government, which affected ownership and subsidy, with its impact varying across the United Kingdom and metropolitan areas (Beesley, 1989). This is contrasted with the reform of the sector in contracting in the capital, London, and full privatisation in the rest of the United Kingdom, which, as it matured with ongoing adjustments, has created a new era for the industry in the 21st century. This section concludes by briefly looking at developments outside the United Kingdom (see also Chapter 1).

The catalyst for UK deregulation was the escalating subsidy required by bus operators in the 1970s, particularly the larger, publicly owned regional subsidiaries of the National Bus Company (which had been formed from those operations nationalised under the 1947 Act

but also the larger British Electric Traction company, which surprisingly offered its operations for sale in 1967). Deregulation offered any bus operator the opportunity to run any route they wished as a commercial route without subsidy, subject to safety standards being achieved. This competition on routes was permitted for the first time since the Road Traffic Act 1930 had become law.

The government-owned National Bus Company's subsidiary companies which operated nation-wide local services were also privatised, to promote greater efficiency and to prevent unfair market competition. Local authorities were allowed to facilitate tenders for non-commercial but 'socially necessary' services, such as evening or Sunday services. However, the consequence of deregulation was that it broke a critical link between operators and local governments (including metropolitan areas), who were unable to cross-subsidise revenue from profitable routes to support the wider network, including loss-making services (Jeffrey, 2019). It resulted in buses being run by private companies, where service levels were decided by the operator but without any effective regulation from local authorities. Perhaps more importantly, then, since cities did not directly bear the financial burden for any inefficiencies (for example, with buses stuck in traffic), there was less incentive to invest in bus-related infrastructure such as bus priority schemes (Jeffrey, 2019).

Bus companies fought, via on-the-road competition, to gain market share, and unfair competition, for example, in Oxford and Darlington, sometimes required the intervention of the competition authorities to address unsafe or unscrupulous practices and predatory pricing through abuse of a locally dominant position (Stanley, 2020), which resulted in five bus companies – Arriva, First Group, Go-Ahead Group, National Express and Stagecoach Group (by now also active in the rail sector) – dominating 70% of the market by 2012 (Coach & Bus Week, 2012). These companies now have significant autonomy, deciding which buses to run and when and what fares to charge for the services they run without subsidy.

It is evident that deregulation has had variable impact (White, 1997). In some metropolitan areas where there is strong demand, services have become frequent, as operators meet passenger demand without subsidy and can be profitable. Some localities experienced bus wars, resulting in a private monopoly operator being able to exploit profitable opportunities, while in other areas, the impact has been more negative, not on account of privatisation itself but as a result of the laissez-faire approach, lack of network management and absence of local control and co-ordination. This has led to a decline in bus patronage. In the immediate aftermath of deregulation, the upheaval in the route network impacted demand, as routes changed frequently, operators entered and left specific markets and little information was posted at stops (Savage, 1993, p. 11). This is in stark contrast to London, which did not have economic deregulation imposed but instead was reformed to use a franchise model (this is discussed in more detail in the following).

However, over time, institutional reform in the United Kingdom has matured, bringing opportunities for local governments to be more involved in the provision of bus services. Outside London, the most recent legislation, the Bus Services Act 2017 (BSA), allows enhanced partnership schemes (EPSs), a non-compulsory agreement between willing operators and local government which widens the powers of the local government to support bus services (e.g. using car parking charges and enforcement to contribute to bus-oriented services). However, if supported by 75% of local bus services, it becomes compulsory for all operators, with the local government becoming the new Traffic Commissioner. In addition, 'metro mayors' have the power to introduce quality incentive contracts (QICs) as used in London or the long-established quality bus partnerships, which are voluntary and locally developed to suit local

needs (Davison & Knowles, 2006). Under QICs, on-the-road competition is suspended, with mayors specifying the bus service for the area – the routes, fares, frequencies and quality of bus services – which are put out to competitive tender on a gross contract basis.

In London, prior to 1985, bus services were publicly operated, which internalised both the costs and demand risks of bus services, providing poor quality of service, and absorbed ever increasing amounts of subsidy. In 1985 and later in 1996, privatisation aimed to change the ownership of public bus operators and introduce competition through a tendering process to reduce public subsidies and transfer risk and opportunity to the private sector, with the expectation of improved operational efficiency and service quality. In 1985, these contracts were a gross-cost contract which transferred only the operational risk to the contractor, with the demand risk remaining with London Transport. During 1994 and 1995, the 13 public subsidiary firms were privatised, while London Transport retained the function of planning routes and setting the fare structures.

Due to an increasing subsidy burden, between 1996 and 1998, net-cost contracts were introduced where the operating and demand risks were assigned to the bus operator, who would keep the fare revenue. The idea was that shifting the demand risk to operators would create the incentive to build revenue through increasing the quality of the service provided. Competition was managed with negotiated terms to allow investments to be recouped. But the net-cost contracts scheme did not produce the expected results, as operators, perceiving a greater risk, focused on cost-cutting rather than improving quality to attract new users. This provided the impetus for the establishment of Transport for London (TfL), created in 2000, and the introduction of gross cost contracts labelled 'quality incentive contracts'.

The establishment of TfL fundamentally changed the organisation and functioning of public transport in London, as it became the integrated body responsible for the transport system (network manager and infrastructure planning). It is a statutory body created by the Greater London Authority (GLA) Act 1999. Its primary role is to implement the mayor of London's transport strategy and to manage transport services across the capital, contracting services to the bus operator (public or private). With the re-introduction of gross-cost contracts (which pays the operator a given sum for a specified service for a given period, with all revenue collected being returned to TfL), it takes a significant level of revenue risk, setting service levels and fares. The more recent success of London's transport can largely be attributed to the presence of TfL as the network manager.

The London experience, with a strong network manager and operating by franchises, is diametrically opposed to the rest of the United Kingdom, where in the early stages, privatised services lacked network management. Elsewhere in the developed world, at the time the previous reforms were occurring in the United Kingdom, public transport was also faring badly in terms of competition with the private car. New Zealand followed the UK example with deregulation but has since modified its regulatory framework to be less market dependent. Other jurisdictions in mainland Europe and Scandinavia followed the London model by introducing more competition for the market rather than on-the-road competition as with deregulation. Those countries belonging to the European Union needed to demonstrate more arm's-length treatment of public transport contracts, and in some cases, this has led to private operators entering the bus market alongside those operators owned by the public sector (see also Chapter 1 for how contracts were devised and developed). In developing countries, public transport did not compete with the private car in the same way and there have been various iterations of institutional change over this time period, with a much higher proportion of informal transport (see also Chapter 18).

How technology has paved the way to enhancing the service offering

The previous section has shown that there have been significant changes in the institutional framework which governs how buses can operate since the bus 'came of age' following the First World War. This section turns to the bus itself and looks at how improvements in technology have underpinned the development of the bus mode from its inception to today's modern vehicle in a modern environment. Technology has played a critical role in the development of the 'next generation' bus, sometimes manifested as BHLS and as bus rapid transit – both are discussed in the following.

Buses generally provide good area coverage, being able to penetrate communities where people live, with the flexibility to adjust service levels relatively quickly as demand changes (see also Chapter 32). However, while flexibility is a positive, it is also a drawback if potential riders are uncertain or confused about the network (as opposed to, say, a fixed track mode), if they lack information and find timetables difficult to read or if unpredictable services cause excess waiting time. Dodgson and Preston (1991) observed that some of the decline in UK bus patronage was not due to the commonly understood issue of fares or frequency but because of uncertainty associated with constantly changing services.

There are numerous examples of technology applications to improve the overall quality of the bus 'environment'. Guided busways were popular in the 1980s, notably in Essen (opened in 1980, 12 km) and Adelaide (opened in 1986, 12 km), but have largely failed to become widespread, partly because they didn't embody the image of rail that developers have sought. Guidance technologies deployed have been either kerb, magnetic or optical. A more recent development is the graduation of quality bus services into the domain of optically guided trackless trams which have rubber wheels and run on streets (such as in Rouen, France; Castellón, Spain and Las Vegas in the United States). These systems, however, often have significantly modified vehicles in size and dimensions compared to buses (Wong, 2018).

The term BHLS was popularised by a European-funded COST Action (Finn et al., 2011). BHLS typically combine bus priority measures with quality enhancements such as route branding, real-time passenger information and integrated ticketing. There are a number of BHLS schemes in Britain which include guided busway sections, for example, in Cambridge (at 25 km now the world's longest guided busway) and Greater Manchester. Some of the services have proved ephemeral, with the Edinburgh Fastlink guided busway having been replaced by the new tram service. The Vantage service in Greater Manchester opened in April 2016 and includes a 4.5-mile guided busway (at the west end of the route), new bus lanes and other bus priority measures. The project generated controversy since the guided busway section uses a disused rail alignment, and there was strong lobbying for a rail link to be reinstated instead. The guideway itself is owned and operated by the Regional Transport Authority (Transport for Greater Manchester) and the service provider is FirstGroup. The contract specification included service frequency, extended operating hours (04:00–24:00), real-time passenger information and smart ticketing. The Fastlink service arguably incorporates the features of a thoroughbred bus service (and might be regarded as BRT-Lite, discussed subsequently) and is also conditioned by the regulatory framework in which it operates; this emphasises the importance of institutional frameworks, as discussed earlier.

Recent contributions covering the development of BRT worldwide are reported in Munoz and Paget-Seekins (2016) and Ferbrache (2019). BRT is widely considered a cost-effective solution for cities that are experiencing overwhelming motorisation, traffic congestion and a deteriorating quality of life. However, experience shows that 'jumping on the BRT bandwagon' is

fraught with risk, as planners often follow international examples without a proper understanding or analysis of the basic levers that underpin success or awareness of the risks and unintended consequences. For BRT, one size definitely does not fit all, and it is imperative that cities design BRT with clear objectives within the context and culture of the city while being acutely aware of its political and social dimensions. BRT has in some cases been used to initiate wider transport sector reform, such as bus operator and route rationalisation, and to introduce a new business model for bus operation. The concept of BRT-Lite has also gained some traction (Cervero, 2013) with the term being used where there is some form of priority but not fully segregated busways and bus shelters instead of stations. Lagos is a notable example.

BRT is not simply about faster bus services. BRT has altered user perceptions of bus services by influencing the key determinants of user travel choice with a higher level of system capacity; clearly identified corridors; better information and improved efficiency, safety and reliability. Route maps that resemble a 'metro' map make it easy for passengers to conceptualise the system and be more confident in wayfinding.

Evidence suggests that if BRT is able to attract passengers due to travel time savings, cities can reap the benefits of being able to mitigate traffic congestion or growth in private vehicle use. This is especially pronounced in developing cities where motorcycles are increasingly predominant as roads become congested. For the bus industry, it is expected that a more sustainable business will be implemented for the BRT and for operators providing essential complementary bus services. In fact, BRT is often used to lead sector reform by rationalising bus operators and routes (also necessary to properly support BRT). However, caution should be exercised not to burden BRT with too large a reform task (World Bank, 2020). These aspects are explored in a case study of BRT in Latin America which follows this section.

It has been argued that technology can be the saviour of bus systems by improving planning and management to make buses more reliable and safer, with a greater focus on user needs and developing a 'travel product' to attract users, including, more recently, the advent of digital technologies (such as journey planning and Mobility as a Service (MaaS); see also Chapter 3).

At a fundamental level, automatic vehicle location (AVL) – commonly being provided via GPS-based bus-tracking – enables 'real-time' information and control, which provide management information to intervene in case of operational incidents and the recording of travel data to inform service planning. It also provides passenger information such as 'next-bus' schedule advice. AVL is also applied in bus priority systems such as the Public Transport Information and Priority System (PTIPS) in Sydney, which manages buses through intersections on green wave signalling.

Digital apps and journey planners have more recently entered the market, particularly for urban areas, with options such as OneBusAway (USA), Citymapper (UK), Transit App (Canada), NextThere (Australia) and Moovit (Israel) providing real-time platforms (Mulley et al., 2019). However, in the United Kingdom, which had in place a centrally funded comprehensive national journey planner system, open data and private players have created their own apps, causing a level of fragmentation and some loss in terms of the customer experience. There is also widespread interest in the role of social media platforms such as Twitter in enabling public transport operators to establish a dialogue with their customers, especially in times of disruption (Gault et al., 2019).

E-ticketing and smart ticketing are used to secure revenues and can easily manage more complex fare policies but are also useful in managing fare policy as a price mechanism to incentivise travel and create value (exploit willingness to pay), as well as being able to target user subsidies more efficiently. Interestingly, the technology is not new, with a plastic card containing a microchip having been first patented in Germany in 1968. The value of smart

ticketing can be shown through its use in providing better integration between travel modes such as 'through-ticketing' to encourage seamless travel (see also Chapters 33 and 36). Latest-generation technology 'Ride-apps' combine functions of service information, trip planning and payment (linked directly to the service provider) to make travel easier and to optimise travel choices. Bus systems will benefit by use of the latest user-friendly payment technologies such as mobile phone payment and electronic proof of purchase to reduce the transaction costs of separate ticketing medium.

Electronic surveillance at bus stations/stops and also on-bus allows better control and monitoring, with on-board vehicle diagnostics able to inform of mechanical issues to prevent breakdowns and safety alarms (linked to Control Centre) and deliver better security for both drivers and passengers.

MaaS technology is a further step, in that it bundles multiple transport modes into the journey planning and payment systems (Hensher et al., 2020). For public transport, this would have a profound effect on improving passenger information, accessibility and first/last mile access and allowing easy payment within a single platform. This contributes greatly to making public transport more user friendly and customer focused, addressing the difficulties that public transport networks have in getting trip information to passengers and requiring them to decide how to use it.

Case study: Bus Rapid Transit in Latin America

This section explores issues around decision-making and design of BRT. The case study is primarily Latin American, but brief examples pointing to relevant learning experiences in other developing countries are included. High-profile BRT projects in Latin America have inspired an enthusiastic fraternity of BRT promoters. Based on early success stories, namely Curitiba (started in 1974 and improved during the 1990s) and Bogota (started in 1996), BRT has been promoted as:

> A high-quality bus-based transit system that delivers fast, comfortable, and cost-effective services at metro-level capacities. It does this through the provision of dedicated lanes, with busways and iconic stations typically aligned to the center of the road, off-board fare collection, and fast and frequent operations.
>
> Because BRT contains features similar to a light rail or metro system, it is much more reliable, convenient and faster than regular bus services. With the right features, BRT is able to avoid the causes of delay that typically slow regular bus services, like being stuck in traffic and queuing to pay on board.
>
> (Institute of Transportation and Development and Policy, n.d.)

Yet 20 years on, BRT in Latin America finds itself under scrutiny. Has it delivered on its expansive promises? Some cases have been less than successful; other cases needed time to adjust and resolve unforeseen impacts. How confident are cities now to embark on a BRT project? Elledge (2016) asks the question, "So if BRT is so great – if you can get all the benefits of a metro system at a fraction of the price – then why hadn't every city built one?"

Experience shows that notwithstanding the BRT 'sales pitch', BRT is not a 'silver bullet' solution for every city and corridor but offers a range of design options for both infrastructure and operations and should be approached as an integrated set of measures that can be applied according to the local conditions (World Bank, 2020). The remainder of this section explores some of the main BRT planning issues that cities may encounter when considering BRT. Some

'planning traps' are examined, and BRT is evaluated in terms of what it represents, the design objectives and suitability to context and factors that can determine its success. Furthermore, aside from infrastructure considerations, the institutional frameworks of governance, management and the business model and the matter of financial sustainability are also considered.

Design issues

Should BRT be qualified only as a high-capacity system typical of Latin American Countries' (LACs) systems – or are cities able to adapt its design principles, considering that many cities do not have the road space to accommodate a high-capacity system? While idealists will always argue for a pure BRT, a recent term, 'BRT creep', is now part of the discourse – alleging that 'design compromises' will cause cities to stray from the so-called 'proper' standards of a BRT.

Looking past the dogma of BRT design, the 'high-capacity' credentials of BRT require examination. Bogota's TransMilenio, a beacon of innovation, has taken BRT capacity to its design limits, which has caused serious operational challenges (Jara Moreno, 2012), and it has struggled to maintain quality, resulting in low user satisfaction. Evidenced by BRT systems worldwide, BRT corridor capacities are typically at around 10,000 passengers per hour per direction (phpd) (Velásquez et al., 2017) before operational bottlenecks such as berths at stations and intersections begin to impact efficiency and quality (World Bank, 2020). While there are notable exceptions, such as Bogotá and Guangzhou (carrying 27,000 and 40,000+ passengers phpd, respectively), these are outliers whose systems exhibit a much higher level of infrastructure than many cities will be able to afford or achieve, as they do not have the available road space to accommodate such infrastructure (Jara Moreno, 2012).

Implementation issues

While many BRT projects have transformed urban mobility in cities, in numerous cases, they have faced severe implementation and operational challenges. Exploring the reasons leads to three underlying assertions, as follows:

The first is that BRT implementation is complex, since it operates under political and economic imperatives and involves complex planning and design, adaptation to local conditions and extensive co-ordination of stakeholder engagement and institutional change, as well as project and financial risk management (World Bank, 2020).

The second is that BRT design, often laden with idealism, hype and over-promise, has not sufficiently understood the on-ground realities (or properly considered the applicability of the prescriptive standards) and as a result finds itself ill adapted to the local context. As evidence, consider the experience of Colombia's National Urban Transport Program (NUTP), where five medium Colombian cities: Pereira, Barranquilla, Cartagena, Bucaramanga and Medellín, adopted Bogota's BRT model but faced serious challenges of falling demand and financial uncertainty due to wrong planning assumptions (World Bank, 2020). Dar es Salaam, Tanzania, a city that emulated the LAC BRT model most comprehensively, has faced difficult implementation challenges in operational performance and contractual arrangements, largely by not properly managing the 'software' elements of the system, with lack of institutional readiness, uncertainty surrounding the business model and risk assignment and an unclear plan on how to incorporate the displaced Dala Dala minibus sector (World Bank, 2020).

Third, idealism overwhelmed pragmatism, resulting in BRT not fitting the local context. While it can be observed in some cases, that design compromises have diluted BRT benefits, such as in Delhi, where inadequate implementation and an inappropriate design resulted in the

system being terminated (CityLab, 2016), evidence bears out that failures in BRT are also due to optimistically trying to replicate overseas success without due care and consideration of the local situation. In the argument that BRT suffers compromise largely due to political expediency or a poor understanding of design elements, it should be emphasised that BRT by its very nature has a political dimension. Ardila Gómez (2004) highlights the value of BRT's flexibility to allow meaningful stakeholder engagement in planning, and that flexibility allows political imperatives to be accommodated to make the system more relevant compared to metro rail alternatives.

Given such a realistic evaluation of a few examples, a robust evaluation of BRT must start with a fundamental question of what overall 'success' means for a BRT (within a city context) and how to define its success in terms of whether it achieved its aims.

Clear objectives and agreed-upon design principles

The starting point must be a set of clear objectives adopted by the city on what BRT is expected to achieve, which in a broader sense implies that BRT planning needs to be in alignment with the city's transport and mobility objectives. Such an approach will not simply help establish the design guidelines for a BRT but also engages the city in a greater sense of ownership.

In BRT promotion and literature, much has been made of the necessity of a 'political champion' or 'political will' to drive the project, but evidence (such as Hanoi BRT) showed that implementation problems (despite adequate political will) were born out of poor planning and lack of confidence in the project (World Bank, 2020). This emphasises the importance of decision-makers to understand the 'why', 'what' and 'how' of the project to build confidence and help them make timely and supportive decisions.

Bus rapid transit infrastructure

The promotion of BRT has typically been heavily focused on infrastructure and so-called 'international best practice', as promoted by the Institute of Transportation and Development and Policy, which has developed its 'BRT Standards' to guide infrastructure design, certifying BRT corridors as gold, silver, bronze or basic as an internationally recognised standard for 'best practice' BRT. While such a standard can be instructive and a useful general reference, it should not be taken as a rule book or prescriptive standard. Fundamentally, each city should design its BRT in accordance with the city's objectives and its local operating and physical environments.

As an example, Lagos, Nigeria, planned for a BRT system that was readily deliverable and affordable in the local context, with immediate benefits in terms of bus run times, convenience and timesaving with pragmatic solutions while retaining as many of the most desirable BRT characteristics as possible. It delivered a quality bus system (in effect BRT-Lite) which was cost efficient and now carries around 200,000 passengers per day. Such adaptation has delivered a system adapted to context and is not a 'design compromise' in the sense that it has not met the required 'standards'.

As the Lagos example shows, BRT infrastructure can be low-cost infrastructure that offers operational enhancements (sometimes with lower capacity), to more high-capacity systems offering benefits of "high speed and level of reliability of rail transit, but at a significantly lower cost" (Deng & Nelson, 2011, p. 75). In reality, and as evidenced in many cities where BRT line capacity has a maximum at around 10,000 passengers phpd, BRT may be better described as occupying the middle ground between urban rail and traditional bus systems (Cervero, 2013). However, BRT design decisions should not be categorised as a system type; design should be

adaptive to the complex local systems in which cities operate – balancing the interplay with other road-based transport modes and users, institutional structures, technology applications, and the political situation (World Bank, 2020).

Institutional framework to implement and operate bus rapid transit

While infrastructure is the most apparent representation of BRT operation in a city, its real success in both implementation and operation is the institutional framework, being the system 'software' of governance, management and the business model.

Critical to successful BRT development is the institutional capacity to manage the project. Cities need to be careful in developing new institutions to manage BRT implementation, as they may not be able to mobilise quickly enough or build sufficient capacity in time to manage a large infrastructure project together with a large sector reform (bus contracts and route rationalisation). It may be better to harness or facilitate existing co-ordinating mechanisms to implement BRT, such as establishing a steering committee with the key players, to take the strategic planning and co-ordination role and give the implementation responsibilities to capable organisations with the proven skills and capacity (World Bank, 2020).

In BRT planning, there are two distinct levels of institutional responsibility to consider: one at *co-ordinating level* mentioned previously, to steer the project at a political level and manage cross-jurisdictional issues, and the other at a *service delivery level*, such as a BRT agency managing the BRT network (the business). Experience in Ghana showed that the newly established Greater Accra Passenger Transport Executive (GAPTE) as 'regulator' was not equipped to manage financial responsibilities, resulting in the system facing financial hardship. Regulators should manage the 'risk-takers' and do not take business risk themselves (World Bank, 2020).

On the other hand, a BRT agency is not a regulator – its role is to manage and take a share of the business risk. Where agencies do take substantial (revenue/passenger) risk, they have greater control by having a stake in the result. Such agencies also need to be robust and mindful of the risk/power relationship with the private-sector operators, as this will govern its level of control over operator performance and behaviour.

The business model and financial sustainability of bus rapid transit

Public transport planning is usually centred around supply-side policies, tariff levels, public subsidy, social service and operator performance, often with scant attention paid to the business model – yet the business model will spell success or failure of any BRT project.

A commercial 'business model' defines how the enterprise will make money, but in the context of public transport, it could more likely mean reducing subsidy dependency, managing affordability and ensuring financial sustainability. A demand-driven 'business-like' approach is necessary, aiming for financial sustainability through customer service (building revenue/ridership), efficient operations (and delivering an efficient travel product) and control of costs. Ridership and financial performance become the gauge of success, being the business 'case' underpinning financial sustainability. Such an approach is the antithesis of a supply-side subsidy dependent operation, where reliance on subsidy often takes away focus on customer satisfaction and the orientation of management towards serving its clients' needs.

Yet an often-repeated statement is that 'all public transport requires subsidy', which more specifically relates to the affordability constraints relating to fare tariffs. This should, however, not imply the need for subsidy by default. In fact, the most critical factor on public transport funding (and in particular BRT) is that the city must decide on the level of service that it wishes

to provide for its citizens, what to charge and then how to pay for it. If there are constraints on public budgets to support a subsidy (as is the case in many developing cities), alternative forms of revenue should be investigated, such as car-parking charges as a source of cross-revenue to support public transport.

But for BRT generally, ridership is the key. As opposed to traditional bus services that can tailor services to demand to maintain occupancy levels and optimise fleet efficiency, BRT is in a unique and challenging position in that by sequestering road space for exclusive use, it must secure a significant mode share if it is to avoid criticism from motorists that the BRT underutilises road space and causes traffic congestion. The BRT in Bucaramanga, Colombia, lost political support because bus lanes were seen as mostly running empty (World Bank, 2020). Therefore, to justify exclusive use of a busway lane, BRT needs to provide a substantial service frequency to attract passengers, build market share and produce travel mode shift. Unfortunately, such service levels need to be funded during the period that demand builds up, and post-launch funding support needs to be considered.

Ridership on BRT cannot be taken for granted. It represents an explicit challenge facing BRT, and planners cannot assume that BRT is 'so good' that everyone will want to use it. In medium-sized Colombian cities, reforms associated with the introduction of BRT (namely reduction in kilometres operated and fleet size) caused an overall decrease in aggregate public transport ridership. Gomez-Lobo (2020) reports that in some cities, demand levels were a third of those projected prior to the reforms but also considers it probable the influx of informal taxi services, in particular mototaxis, caused some of this decline. However, it could also be argued that demand for mototaxis increased when passengers found BRT services, which had replaced traditional services, not so attractive.

Misjudging potential ridership is largely due to planning being influenced by excessive optimism of the BRT experience in Bogotá, with a view that traditional bus services suffered from 'excess supply', causing planners to be less attentive to the determinants of demand – the factors that influence a passenger's journey decision, such as service frequency/waiting time, walking distance, congestion inside the bus/seat availability, service quality, safety and travel time (Gomez-Lobo, 2020).

Planners also tend to be over-reliant on travel demand models which may not sufficiently factor in the behavioural attitudes that govern a 'journey decision' and also that models are often 'too coarse' for individual routes. The Asian Development Bank (2009), in charting a course for improved transport outcomes, concedes that "too often, transport plans stem from transport model black boxes and not from empirical evidence. Models have substituted for sound policy" (p. 1).

Another pitfall for planners in Colombia's medium cities was that they relied on modelled demand data and did not consider the feedback effect that the proposed operational plan would have on expected demand levels (Gomez-Lobo, 2020). This is an issue of practicality; passengers accustomed to bus oversupply, in some cases having the ability to negotiate fares or finding a seat on the bus, may not consider a BRT service superior. In many cases, BRT has displaced traditional services, creating inconvenience by increasing walking distance and transfers.

A better approach is to set ridership targets (bus occupancy) and use proactive policy and communication measures to create a shift from private modes of travel to BRT. This starts with setting an appropriate level of service frequency on the BRT (to justify its exclusive use) and providing a level of service to attract passengers. This approach was taken in Hanoi, as demand levels were uncertain, and the level of financial support was estimated gauged on various levels of bus occupancy post-launch (Word Bank, 2020).

Poor ridership will spell the failure of BRT; therefore, every design decision should be focused on 'winning the market'. Gomez-Lobo (2020) warns that lower-than-expected demand

on a new BRT system runs counter to the objective of promoting the use of public transport and will impact fare revenues, causing financial deficits, and result in a subsidy burden that will strain municipal budgets. To reduce these deficits, some lowering of supply levels (frequency and routes) to reduce operational costs will risk generating a downward spiral of lower quality of service that in turn lowers demand and income even further (Yepes et al., 2013).

Experience suggests that in most cases, a subsidy or some form of supplementary funding may be required. The early experience of Bogotá's TransMilenio BRT with a limited network and high efficiency allowed farebox revenues to cover its operational expenditure (OPEX) costs (Rodriguez et al., 2015). This has caused BRT to be promoted as not requiring subsidy. The logic was that the higher efficiency of BRT would eliminate the inefficiencies of traditional systems (oversupply of services) and would fund the additional costs of the new BRT systems. Based on this implicit (incorrect) assumption, when Colombia expanded BRT projects to medium-sized cities under the National Urban Transport Program, operational subsidies were not considered (Gomez-Lobo, 2020), but these systems, partly due to insufficient ridership, were soon in financial difficulty. The fundamental issue was that affordability constraints limited the ability of fare revenue alone to cover cost of operation. This problem was also evident in Bogotá's TransMilenio as the system expanded, where fare adjustment mechanisms caused fare levels to exceed the limits on affordability, causing public backlash. Other forms of supplementary funding were needed to support the systems. Following a change in legislation, Bogotá eventually funded a transport user subsidy to workers earning minimum wages.

Not to be overlooked as a financial performance issue is that the formalisation of traditional (unsubsidised) bus services through BRT adds costs of infrastructure and management and funds a higher standard of fleet maintenance, management and regulatory compliance, including with labour rules (and in some cases costs of compensating incumbent operators and infrastructure), which can overburden BRT with unsustainable costs. This emphasises the need to design BRT within the affordability constraints of the city.

Bus rapid transit operators contract and the assignment of risk

Another key determinant of success is the performance incentives and the assignment of risk in the business model/contract arrangements. The bus operator's contract defines the relationship between the authority/agency and the bus operator but also defines the power balance and the extent to which it can influence the behaviour of the players. In cases such as Dar es Salaam and Lagos, the private sector secured control of revenue and used it as a power advantage to exploit a profit opportunity (World Bank, 2020).

Contract design and management should therefore ensure robust capacity and a well-defined management role of the BRT agency that enables it to exercise control and authority over the system and be a capable partner in managing bus operator contracts; carefully assign roles, responsibilities and risks between the BRT agency and operators and avoid using standard model contracts – contracts must consider the capacity for risk management and the skill and experience of the players. Using 'BRT model contracts' as a blueprint for all situations regardless of conditions and context will not factor in local competencies, trust and culture and could result in unintended outcomes.

BRT operator contracts are usually described as either a net-cost contract where the operator carries the financial risk or a gross-cost contract which places revenue risk on the agency (city). But, for the gross-cost contract, there is little incentive for passenger growth (as it pays

the operators a fee for service), and the inclusion of penalties for performance lapses may create adversarial relationships and reduce co-operation. For the net-cost contract, the operator taking financial risk may result in them having a power advantage, meaning that the control of the agency is weakened. However, classifying contracts based on 'who takes all of the risk' is becoming outdated, and systems are increasingly using hybrid (shared risk) models. Hybrid models act to protect operators to some extent (by covering base costs) but maintain incentives to maintain quality and develop ridership. Due to risk being shared, it is useful to think of a hybrid contract as a partnership contract (World Bank, 2020). It is useful to note that if the operator carries any risk, they need to have some input to decisions that impact their risk exposure (such as level of service and fares) and be able to work with the agency to optimise services to reach mutual objectives.

Conclusions

The chapter has briefly charted the history of how buses have evolved over the last half-century as a public transport mode in cities – from emergence to decline and then resurgence. The critical enablers of this resurgence include an appreciation of the institutional and regulatory frameworks appropriate to a particular context, an attention to quality of infrastructure and service delivered and the appropriate use of enabling technology, all of which contribute to the creation of a thoroughbred bus service.

This chapter has covered some key areas of BRT planning using a case study from Latin America, but not to be overlooked is the essential role of BRT as part of an integrated public transport network. Sadly, the early enthusiastic advancement of BRT was too corridor focused and even considered traditional buses and the paratransit sector needing to be displaced by BRT. This sidelined an important partnership which could fill the gap as feeders to the BRT and to provide complementary services in lower-demand corridors and peri-urban areas. Integrated fares and reduction in transfer costs between feeders and the BRT can also improve the affordability of the system.

The task of BRT should be clearly focused on securing mode share (winning the market) and developing the advantages of BRT as part of an integrated set of measures within the urban mobility toolbox, with a flexible design approach suitable to local conditions and context. Most importantly, integration with complementary bus services and paratransit can provide first-last mile access and also design some pre-trunk services to operate on the busway while utilising technology apps to integrate feeder services into the system. For the future, planners must engage fully with the community to understand user needs and to identify the target markets.

Aside from BRT, the bus still has a major role to play in urban and rural areas where the density of demand is not sufficient to require BRT treatment. The bus remains flexible to provide service as cities grow or change, both in small and growing cities to those larger cities already with multi-modal networks.

The future of the bus, as part of the public transport network, has been significantly affected by the 2020 COVID-19 pandemic. Patronage declined dramatically as nations imposed lockdown on their citizens. As nations emerged from lockdown, the advice in a number of countries was to 'avoid public transport where possible', and so return to work has not seen a significant increase in bus patronage. Future research might previously have been identified as needing to explore more ways of increasing the bus's popularity with the travelling public, but post–COVID-19, it must be more concentrated on finding ways for public transport to survive, with the bus being a central part of that survival.

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