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Transportation For Transformation: A Case for Bus Rapid Transit for Smart Cities in India

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Abstract

The paper makes a detailed analysis of the Bus Rapid Transit System and its immense opportunity for India. BRTS is increasingly being adopted as a preferred model for designing cities, neighbourhoods, and urban expansions, as well as revitalizing older and deteriorated areas in many parts of the world. It is a cost-effective transport infrastructure investment that can usher Transit-Oriented Development for sustainable urbanisation. The paper highlights successful case studies to draw lessons for India. We also outline the challenges faced due to disjoint land use planning and transportation planning in India. In this context, BRTS presents significant opportunities to make India's urbanization process efficient, inclusive, sustainable and financially viable. In this line, the paper suggests a coordinated transport land-use integration framework for urban development, strategizing on the BRTS.

Keywords: Bus Rapid Transit System, Transit-Oriented Development, land use planning, transportation planning, urbanisation.

JEL Code: R42, R41, H54, R0

1. Introduction

The growing dominance of private vehicles, inadequate funding for public transportation, and the adoption of spatial planning strategies that encourage scattered, automobile-dependent growth have been major contributors to urban transport challenges across many nations. Efforts to create more liveable and sustainable cities led to the rise of a new urban design movement known as 'New Urbanism' in North America and Western Europe during the 1970s and 1980s. This movement was later complemented by the concept of 'Smart Growth', an integrated approach to urban planning and transportation. A central feature of Smart Growth, Transit-Oriented Development (TOD), emphasizes focusing growth around transit hubs or along transit corridors. Although TOD originated in developed countries to address issues like urban sprawl, suburbanization, and environmental decline, its principles are highly relevant for rapidly urbanizing nations such as India

Indian cities face challenges such as unplanned expansion, inefficient boundary extensions, uneven development patterns, and inadequate infrastructure quality. These issues are largely attributed to restrictive Floor Space Index (FSI) regulations in central urban areas, weak coordination between land use and transport planning, and prolonged underinvestment in public transportation systems. The trends in urbanisation, metropolitanisation and

motorization; the numbers, densities, population composition and income distribution structures in cities; failure of master planning model that is excessively concentrated on detailed land use and neglected public transport; concerns of energy security and sustainability; and need for innovative mechanisms to finance urban infrastructure, especially transportation to facilitate economic growth suggest that Indian cities must adopt TOD as a core strategy of planned urban development. TOD offers an elegant way to restructure existing cities, undertake urban renewal, and promote satellite towns or new towns on industrial growth and freight corridors.

TOD promotes compact, high-density, mixed-use development located within a short walking or cycling distance—generally around one kilometre—from a transit station. Centered on a transit hub, it enhances accessibility to public transportation, encouraging residents to opt for walking, cycling, and using transit services instead of relying on private vehicles. TOD is energy and environment friendly. By strategically concentrating development and linking public transport with land use planning, TOD counters urban sprawl, fosters agglomeration benefits, and reduces the negative impacts of congestion. This approach often boosts property values, highlighting the advantages residents and businesses gain from varied transportation choices, along with savings on automobile and parking expenses. TOD also presents a coherent model of financing transit and development together by utilizing the unearned benefits or value increases received by land and property owners due to transit development and supportive land use policies. It promotes value capture, creation, and recycling. The importance of TOD in the Indian context derives from the compulsion to transition from car-dependent growth towards a planned urban development model driven by public transportation that is centered on peoples' needs.

National Urban Transport Policy of India has stressed on the importance of public transport – the heart of TOD. Public transportation includes mass rapid transit (MRT), para-transit services, and personalized public transport. MRT systems—whether rail or road-based, including city buses—form the core of urban mobility, as they are capable of moving large numbers of passengers while utilizing minimal space. However, Bus Rapid Transit System (BRTS) plays a crucial role in a city's public transit network. It is of immense use to the working poor. It serves the low-income categories by connecting them to opportunities, which they otherwise would be deprived of. Large Indian cities are are highly conducive to BRTS in view of their concentrated pattern of development, economic densities and income patterns. A BRTS requires comparatively less investment than a rail based MRTS and is thus, of extreme importance in the early stages of transition towards a Transit Oriented Development framework. This paper explores the possibility of implementing a BRT framework for the smart cities in India. It looks at the various challenges and draws lessons from successful national and international practices. The paper is organised as follows: Section 2 provides a case for BRTS. Section 3 illustrates successful international practices and draws lessons for implementation in India. Section 4 highlights the existing BRT networks in India. Section 5 presents the way forward and the ways to implement a BRTS in Indian cities. Section 6 concludes.

2. Case for Bus Rapid Transit System (BRTS)

The major challenges to urban mobility in India include rising travel demand, rapid vehicular growth, a surge in private vehicle ownership, and a steady decline in public transport usage. These issues are compounded by severe traffic congestion, deteriorating urban air quality, increased risks to pedestrians and cyclists evidenced by growing accident rates, poor coordination between transport and land use planning, fragmented institutional frameworks, and persistent underinvestment in transport infrastructure. They are closely connected to patterns of urbanization, economic activity concentration, income distribution within cities, and the pace of motorization

India's current urban planning framework has largely marginalized public transport while failing to effectively manage land use density and transport networks. Unfortunately, land use and transportation planning have been carried out separately rather than in coordination. Most cities have had land use planners but lacked dedicated transport planners. Consequently, they have been unable to leverage agglomeration benefits and network effects to integrate transport with land use, promote local economic growth, reduce congestion and pollution, and mobilize funds for urban public transportation. The models of New Urbanism, Smart Growth and TOD have not been harnessed by Indian cities. These paradigms advocate building higher densities around transit stations to promote walkable and inclusive neighbourhoods that reduce the need for trips.

Of late, some recognition has been accorded to transit in shaping the city form and sustainable urban living. While, a lot of emphasis has been laid on metros and rail-based development, BRT has been completely neglected. But the fact remains that, bus services are an integral part of a TOD framework as it also connects people and places of lower density to the city centre. BRT can function both as a supportive addition and an alternative to metro or rail-based developments. There is a huge scope of planning mid-density development along bus corridors. Conventional buses and BRT networks are often underestimated and considered inferior to rail services in terms of efficiency, connectivity and accessibility. However, BRT can play a big role in promoting a compact and mixed-use urban development.

One of the most attractive features of BRT is its flexibility. Bus routes can be easily altered to accommodate population of mid-density or low-density regions. Buses are also cost-effective in the sense that, the same bus which operates in low or mid-density regions can also serve high density corridors if required and vice-versa. BRT is of particular importance to Tier-2 cities which are undergoing expansion. Although at present, such cities do not possess the optimum density required for rail-based TOD, the population is projected to grow at a rapid rate in future. A planned BRT network paired with mid-density housing can usher in city externalities and pave the path for sustainable urban development in such places. This holds extreme significance because future growth of not only population but also economic outputs is likely to occur in intermediate size cities (Glaeser and Josh-Ghani, 2012).

Various studies have recognised that BRT plays a very important part in city transformation. Boisjoly et al. (2018) suggest that investments in bus services specifically can mitigate the decline in transit ridership and even sustain and increase it. Ovido et. al. (2019) study the impact of BRT investment on reducing spatial and social inequalities by creating

accessibility for Lima, Peru. They find that BRT line leads to significant reduction in travel times. The relation between BRT and residential property values within walking distance to Bogota's BRT is studied by Ramon Munoz-Raskin (2010) using a city-wide econometric hedonic analysis. He finds that in relation to proximity, there are value premiums in the housing market. Rafael H.M. Pereira (2019) estimated the impact of TransBrazil BRT project on employment accessibility for different income groups. He finds that the full implementation of the project shall benefit 58 percent of the city dwellers. It will also lead to, on an average, 11 percent enhanced job accessibility, with greater accessibility for lower income groups with greater access to opportunities and hence reduction in inequalities. Mulley and Tsai (2016) find that the residential property values within 400m of BRT stops have marginally higher sales price than properties outside the BRT lines. Myung-Jin Jun (2012) used an urban simulation model to investigate redistributive effects of Seoul's BRT on property values and development patterns. He finds that with BRT, there is enhanced development density in city centres. Also, the highest property value gains occur in Central Business District (CBD). Land price premiums of 5 to 10 percent have been recorded for residences within 300 meters of BRT stops within few years of BRT improvements in Seoul (Cervero and Kang 2011). Land-price capitalization benefits of BRT investments have also be reported in Los Angeles (Cervero, 2004), Brisbane (Levinson et al., 2002), Bogotá (Rodriquez and Targa, 2004; Rodriquez and Mojica, 2009; Munoz-Raskin, 2010), Pittsburgh (Perk and Catala, 2009) and Seoul (Cervero and Kang, 2011). Mobilizing local resources is crucial, as investments in BRT tend to translate into higher land and property values. This creates a compelling rationale for adopting value capture financing.

Most of the transit projects, especially BRT frameworks fail to influence the city development pattern or densify areas because they are merely viewed as mobility investments disjoint from city planning tools. Cervero and Dai (2014) argue that BRT is not viewed as a city-shaping investment because engineering, cost-minimization perspectives generally wins over urban-planning and development-maximization perspectives. Additionally, considering BRT as a myopic solution to transit issues prevents it from augmenting land development, compact and mixed-use urban form. If planned and implemented properly BRT can address not only transit requirements but also act against sprawl, congestion and pollution. The next section illustrates some successful BRT practices.

3. Learning from International Practices

BRT is increasingly being recognized worldwide as a favourable model for planning cities, neighbourhoods, and urban expansions, as well as for revitalizing older and deteriorated urban areas. This section highlights several successful international BRT examples that offer valuable insights for Indian cities in integrating transportation with land use planning.

Curitiba

The BRT model of Curitiba, Brazil is one of the guiding models in the world. The buses run as frequent as in every 2 minutes. The well-designed stations are not only attractive but also very convenient for users. The system is characterised by dedicated lanes, which eliminates the constraints of traffic signals and congestion, pre-boarding fare collection system, quick

loading and unloading of passengers expedite the movement. The town plan of Curitiba adopted a transport-land use integration model. It encouraged commercial growth along the main transit corridors connected to the city centre. The main network comprised of five major routes connected to the city centre like spokes in a wheel. Minibuses connected the residential neighbourhoods to the main network. The city centre-imposed restrictions on vehicular movements and developed pedestrian streets. The BRTS is used by about 70 percent of the working commuters. This has resulted in congestion-free roads and reduced degree of pollution.

Bogota

The capital of Colombia, Bogota, has been internationally acclaimed for its efforts to strengthen economic efficiency by focusing on transit. The major initiatives to its credit are the TransMilenio BRT and Metrovivienda program, which is a social housing measure linked to transit. Initial stages of the system aimed to construct 388 kilometers of BRT in 22 corridors in the city, to be carried out in five phases between 1998 and 2016 (Suzuki et al. 2013). In order to facilitate more extensive use, the BRTS adopted a trunk-feeder model. This system consists of trunks or dedicated lanes for high speed buses and feeder networks which connect the urban periphery to the trunks. The trunks are physically separated from the city traffic. One of most striking features of the BRTS in Bogota is the provision of affordable housing and transit as a "bundled good". This provides the poor with easy access to work place as well as a decent place to live.

Ottawa

Ottawa, Canada, opted for a BRTS in order to decrease the dependency on personal vehicles. The BRT network of Ottawa is an excellent example of transport-land use integration. Most of the offices are concentrated in the city centre which is frequently served by the buses. Free parking has been stopped and parking has also been downsized in order to discourage the use of private vehicles. Stations have been designed close to major employment or shopping centres and well-integrated with residential, commercial and public institutions so as to increase transit ridership. Stations are equipped with comfortable waiting zones, vending zones, adequate lighting and information display systems. In order to provide services frequently and reliable, the BRTS has introduced various innovative features including 'bus-only' lanes and priority signalling. To ensure first and last mile connectivity, convenient inter-change routes and transfer to local routes have been designed. There are provisions of daily or monthly passes for easy ticketing. With effective planning and implementation the BRTS of Ottawa has yielded, transportation, environmental and developmental benefits.

4. BRTS in India

Although BRTS offers India considerable potential to enhance its urbanization by making it more efficient, inclusive, sustainable, and financially sustainable, only a limited number of successful BRT projects have been implemented so far. Some of the successful BRTS networks are discussed below:

Ahmedabad: Janmarg

The city of Ahmedabad is expected to grow to 1000 sq. kms from its present level of 440 sq. kms by 2035. The population is projected to grow to 11 million over the same period. Urbanisation of such magnitude can be made sustainable only with proper planning and implementation of a transport-land use integration framework. Recognising this fact, in order to increase its physical, social and economic accessibility, the city opted for:

- A Bus Rapid Transit System (BRTS) to cater to major mobility needs of the city.
- A regular bus system to support BRTS.
- Decentralised Regional Bus & Rail Terminal.
- Integrate various transport modes, i.e., BRT with other regional and urban transport systems, with bicycles and pedestrian facilities.
- Coordinate land use and transportation planning by promoting higher Floor Space Index (FSI) along BRT corridors to enhance development synergy.

The BRTS in Ahmedabad, "Janmarg", was developed under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). It has innovatively designed a "fully pedestrian and transit only" section at few locations. A one-way bus lane has been designed to combat congestion in narrow regions. Further, there are proposals of developing high density corridors along the BRTS route. The FSI was increased along the BRTS corridor in order to densify the city. This would not only increase transit ridership but also ensure that the project is financially viable.

Pimpri-Chinchwad BRTS

Being an industrial hub in the close proximity of Pune, Pimpri-Chinchwad is expected to grow rapidly in near future. A bus rapid transit system was proposed to be an ideal public transportation system in the region considering the current and future traffic. Pimpri-Chinchwad Municipal Corporation (PCMC) has planned to develop a 130 km BRTS. Dedicated BRT lanes, trunk-feeder system, median stations, platform boarding, pre-board e-ticketing, improved passenger information system and pedestrian friendly infrastructures are some of the characteristics features of the BRTS in Pimpri-Chinchwad. The major components of the model are:

- Construction of two new road-cum-BRT corridors (19 km)
- On two previously built BRT corridors, passenger access to BRT stations, such as over- and underpasses and improved at-grade crossings
- GPS system to control BRT operation
- Three bus terminals to serve the previously built BRT corridors
- Technical assistance studies such as Monitoring & Evaluation, Access Plan to BRTS by NMT & Pedestrians, Parking Policy & Master Plan for PCMC area and Promotion & Outreach Program and capacity building.

PCMC prompted the formulation of Urban Street Design Guidelines for the region. Increasing accessibility of cyclists and pedestrians, safety and comfort of users and environmental protection were important characteristics of the guidelines.

5. BRTS: Implementation, Financing and Way Forward

The public transport systems in developing countries like India, have generally been found to be lacking on all fronts – planning, operational and financial. In particular, the financing and execution challenges of public transit and BRTS are major issues. The successful implementation of BRTS in India requires establishing a well-defined institutional framework combined with transparent financing mechanisms. Given the significant planning and investment demands of BRTS, a strong, comprehensive institutional structure must be developed at the central, state, and local levels of government. Special focus is needed on the design, execution, and enforcement of pricing and regulatory policies. Effective coordination among the multiple agencies involved across different governance levels is essential to avoid conflicts and delays in implementation.

Ensuring safety, convenience and comfort will make BRT attractive for the users. Updated time-tables and route maps must be made available to users. Mobile applications reflecting tracking systems and on-board real time information systems must be developed. A pre-paid ticketing system or off-board fare collection will be convenient both for the users as well as the operators. Buses should either run on dedicated lanes or should be subjected to priority at traffic signals. This would prevent traffic jams and also save time by improving the speed of commuting. Frequency of buses should be such that users have to wait for a maximum of 10 minutes during peak hours and 15 minutes during off-peak hours. A pedestrian friendly approach with wider footpaths needs to be adopted for making walking safer and convenient. Platform-level boarding should be provided because it not only facilitates easier boarding and leaving but also expedites the whole process. In order to make the waiting period comfortable and safe, waiting halls must be developed at boarding stations. Good lighting, CCTV cameras and provision of basic necessities must be ensured at these waiting halls. The special needs of the differently abled commuters must also be catered to by developing ramps. Transit stations should be planned and placed at appropriate distance so that they are neither too closely placed nor too far apart. A holistic approach is required to move riders frequently, quickly and reliably

It is important to keep in mind that BRT is not just a mobility enhancing instrument but can also serve as a city development investment. For this to be realised, BRT must be developed in conjunction with city densification attempts, as a transport- land use integration strategy. Development needs to be densified around BRT stations. Allowing for higher Floor Area Ratio (FAR) could be a step in this direction. 500 m around the boarding stations can be considered as the ‘influence zones’ and mixed use should be encouraged in these areas by reserving spaces for residential, commercial, recreation and official purposes. This should be coupled with restrictive parking policy including shared and paid parking. Such a set-up can reduce the use of personal vehicles in daily activities which is travelling for work, shopping and recreation; making the BRTS compact and sustainable. A people-centric approach needs to be followed to balance the requirements of users belonging to different categories and groups, by discussing and seeking suggestions from community stakeholders, professional planners and environmental activists. Government should ensure the provision of low cost; affordable housing units close to the BRT stations. Low-income households spend the most on housing and transit. Thus, an integrated transit and affordable housing programme will be highly beneficial for such groups. It is important to boost employment opportunities close to

BRT station areas, as this encourages more people to choose public transportation, thereby increasing transit ridership and leveraging further social benefits.

The financing of BRTS must be considered within the wider context of funding urban transport systems and overall city development. Both economic and planning factors play crucial roles in shaping an effective financing strategy. Globally, various methods are used for financing public transport infrastructure, including BRTS. Some methods are furnished below:

- Equity, including public-private partnerships (PPP), special purpose vehicles, infrastructure debt funds, investment funds, infrastructure financing companies.
- Debt tools, including private debt, commercial bank debt, take-out financing, bond financing – infrastructure bonds, municipal bonds (revenue and general obligation), green bonds, etc. and federal and state infrastructure debt mechanisms.
- Credit assistance, including federal and state credit assistance and credit enhancement measures.
- Foreign Direct Investment and Foreign Portfolio Investment.
- Grant financing, combining central and state grants with local government resource mobilisation and using public funds to leverage market resources and PPP.
- Direct fees, including user fees, utility fees, benefit charges and congestion pricing.
- Using land as a resource - value capture and impact instruments such as land and property taxes, land value tax, land value increment tax, betterment levy, developer exactions, impact fees, special assessment districts, land readjustment, town planning scheme, joint development, land monetization including the lease and sale of land and air rights with enhanced Floor Space Index and value-enhancing land use changes in TOD zones, tax increment financing, etc.
- Bullet Bonds and Pooled Finance Fund Scheme.
- Emerging tools, including structured funds, land banks, redfields to greenfields, and a national infrastructure bank.

There is a need for the Government of India to address, in conjunction with State Government, key issues including establishing clear policies, developing a comprehensive financing strategy, creating a legal and regulatory framework for implementation, facilitating public-private partnerships (PPP), building institutional capacity, compiling a reliable database, and promoting research and development (R&D) to support the system's growth and efficiency. State governments need to support cities in establishing an organizational structure, enacting necessary legislation, and developing policies for resource generation. Additionally, a strong institutional framework is essential to ensure the integration of planning, financing and development of bus corridors, boarding points and transit areas. Rather than accelerating work by planning through a myopic lens, for political gain, it is important to integrate transit and land-use planning and appreciate that such developments take time. Some pilot projects can be carried out to address the issues of physical infrastructure along the BRT network including- electricity, water, sewage, solid waste management and rain-water harvesting structures. Proper planning and implementation will

ensure that BRT succeeds not only in commuting people but also achieves city densification with ecological, social and economic viability.

6. Conclusion

Sustainable mobility plays a crucial role in fostering inclusive and environmentally responsible economic growth. It significantly contributes to poverty alleviation and equitable prosperity in Indian cities. To maximize the benefits, especially in metropolitan areas, India's cities need a comprehensive integration of urban transport and land use planning systems. This integration helps leverage the relationship between urban structure and functions, enhances connectivity, and improves overall city efficiency. BRTS is a key guide in this direction. However, BRTS in most cities suffers from a lack of planning and financing as well as implementation capacity.

There is widespread uncertainty regarding the allocation of implementation responsibilities among the various central, state, and local government agencies. Demand for urban transport in India is expected to double by 2030, hence, there is an urgent need to develop strategies to manage such demands without constraining growth and adversely impacting the quality of environment to urban dwellers. Further, regulatory reforms are essential to form a dedicated bus transport authority which is responsible for planning, provisioning and maintaining services at affordable prices as well as maintaining bus services for economically challenged members of the society. Achieving successful BRTS in Indian cities requires establishing strong, integrated, and participatory institutions empowered by clear roles, legislative authority, financial autonomy, and professional expertise to improve urban accessibility effectively. Equally important are transparency, oversight, and accountability mechanisms to ensure these institutions serve the public interest responsibly.

It is essential to treat the urban transport sector as a unified system by aligning financing, pricing, regulation, and land use planning to ensure seamless integration and greater efficiency. It influences the spatial morphology and built form of cities. Property value enhancements along BRT corridors can be capitalised into funds for local governments. By properly utilizing these increments, adequate funds can be generated using the principles of benefit taxation. BRTS holds significant importance because it tends to be heavily utilized in areas with high concentrations of economic activities and is particularly favoured by lower-income and economically disadvantaged populations. Thus, formulating and implementing a robust BRT framework is of critical importance to cities.

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