

Bus Rapid Transit: TransMilenio

Bogotá, Colombia 

Bogotá's sustainable mass urban transport system

TransMilenio is Bogotá's sustainable mass urban transport system based on a Bus Rapid Transit (BRT) scheme. The objective of the project is to establish a safe, efficient, rapid, comfortable and effective modern mass transit system that ensures high levels of passenger transportation [9]. TransMilenio is the BRT with the highest passenger capacity worldwide, becoming the main symbol of the city, transforming its physical infrastructure, and also influencing land use, productivity, road fatalities, crime rates and health issues [14].

Country/ City Profile

| | | Country | City |
|---|---|--|---|
|  | Population (2014) | 48.93 million [1] | 8 million (city) [2] 10.7 million (metropolitan) [4] |
| | Land area (km ²) | 1.109 million | 1,587 (city) 4,321 (metropolitan) |
| | GDP per capita (2014, current international \$, at purchasing power parity) | 13,046 [15] | n/a (city) 17,497 (metropolitan) [4] |
| | Region | South America | Inland (4°36'N, 74°5'W) |
| City's physical geography | Location | <ul style="list-style-type: none"> ✓ In the center of the country, in the eastern part of the Andes Mountains (occasional seismic activity) ✓ Set in a mountainous plateau area with a great variety of climates, soil types, water bodies and natural formations ✓ Placed between mountains that act as a natural barrier, the city is restrained from humidity flow = it influences rain regimes [7] ✓ Relatively high altitude (2,640m) = lower atmospheric oxygen levels | |
| | Climate | <ul style="list-style-type: none"> ✓ Subtropical highland climate zone (average temperatures: 15-20°C) = varied and unpredictable weather [5] ✓ 799 mm of average annual rainfall, two rain seasons, one from March to May, and one from September to November | |

Initiating context

Bogotá's previous traditional public transportation system was dangerous, underused and offered poor quality service. It consisted of 15,000 buses owned and operated by 66 private companies. The system was inefficient, the bus fleet was old and required large amounts of fuel and operated at low average speeds; there were no designated bus stops, and trips were paid in cash on the bus. Moreover, there were almost 50,000 taxis operating in the city by private companies. Public transport was more utilized by low income communities, while taxis and private cars were more widespread among high income groups [8]. In the past two decades, the city had significant growth in private car ownership, causing high accident rates, long commuting times and severe air pollution [13]. The city presents a clear spatial segregation and unequal access to transport modes, the low-income groups living in the periphery while the high income people live close to the centers of activity [14].

Project description

The change was brought by TransMilenio, a Bus Rapid Transit system located within the metropolitan area of the city of Bogotá, Colombia. The project started in 2000, and it has now become a model for the country, region and the world. The project is a public-private partnership (PPP), in which responsibilities are distributed between the public sector (in charge of the investment in the infrastructure - stations, terminals, segregated lanes etc.) and the private sector (responsible for the investments of the bus fleet, ticket selling and validating system and for the operation of the trunk and feeder services) [9]. The overall public transport structure is composed of three main

networks: TransMilenio (BRT), the integrated public transport system (SITP) and traditional bus services. The city authorities are in the process of integrating these systems [8].

Bogotá's BRT is based on high-capacity buses operating on dedicated bus lanes on trunk routes, being supplied with passengers by feeder buses (which connect residential areas to BRT bus stops). From the initial 41km of bus lanes (in 2000) to the expansion to 207km (2015), the system has become the largest in the world [8]. The buses are managed by private concessionaires under the supervision of the local transport authority. In 2011, nearly 1.6 million daily trips (about 25% of all transit trips in Bogotá) were taken on BRT buses, the capacity steadily increasing from 700,000 passengers per day (2003) to 1,672,000 passengers by 2011, reaching an average of 200,000 passengers during rush hour [11]. The BRT system has provided the foundation for Bogotá's Mobility Plan (2006) and also to Colombia's sustainable transport framework - National Urban Transport Program (NUTP) [13].

Implementation process

TransMilenio is implemented gradually in different phases, the first one being completed in 2000, and its initial 41km costed 213 million US\$. Phase 2 finished in 2006¹, adding other 43km to the network, followed by phase 3 and 4 (under construction) [10, 13]. In 2006, the project became the world's first mass transit project registered with the UNFCCC for Clean Development Mechanisms (CDM) credits, generating significant carbon revenue through the sale of voluntary and certified emission reductions (VERs and CERs) between 2006-2012 [9].

Projects implementation details

| | | |
|-------------------------------------|---|--|
| Financing | Funding comes from the national and district government, and the total investments for all phases are estimated to 4,091,989 million pesos (around 2.2 billion US\$). The national government of Colombia covers 64% of the total investment costs of the project (through a national decree ²), while the remaining 36% are covered by the District of Bogotá. Due to the sharply increased costs for phase 1 of the project (the cost per kilometer overrun by 80%), the investment costs for phase 2 are far higher than anticipated (an overrun of 125 million US\$ 2000). The District became dependent on alternative income sources to cover a portion of this deficit. In 2002, new additional financial resources were secured by opting for the CDM registration to sale GHG emission reductions in the global market. On the other hand, operational costs of the TransMilenio are covered with fare collection [8]. | |
| Features of TransMilenio [9] | <ul style="list-style-type: none"> ✓ Exclusive right-of lanes ✓ Rapid boarding and alighting ✓ Transfer between lanes ✓ Pre-board fare collection and verification ✓ Enclosed stations ✓ Clear route maps ✓ Real-time information displays ✓ Automatic vehicle location technology ✓ Modal integration at stations ✓ Clean vehicle technologies ✓ Marketing and customer service | Involved stakeholders Current project participants <ul style="list-style-type: none"> ✓ TransMilenio S.A. ✓ Corporación Andina de Fomento - CAF ✓ The Netherlands' Ministry of Infrastructure and the Environment (IenM) |

Main phases of project development [9]:

| Phase | Trunk routes and projected distance | Projected completion date |
|-----------------------------------|--|---------------------------|
| Phase 1 | Calle 80 (10.1km), Caracas (21.8km), Autonorte (10.3km) | 2000 |
| Phase 2 | Americas (13.0km), NQS (19.3km), Suba (10 km) | 2003-2006 |
| Phase 3 | Calle 26 (13.9km), Carreras 10 and 7 (22.5km), Av. Boyca (26.6km) | 2007-2009 |
| Phase 4 | Avenida 68 (25.7km), Calle 13 (7.1km), Av. Ciudad de Cali (14.7km), Av. 1 de Mayo (12.3km) | 2011-2015 |
| Total phases 1-4: 207.3 km | | |

¹ Phase 2 of the BRT system is included in the "Plan de Ordenamiento Territorial (POT)" of the Ministry of Environment of Colombia [10]

² The share 36% District and 64% National Government is based on an agreement between the District and the National government of financial obligations towards TRANSMILENIO 2004 to 2011 showing a total sum of 1,837,383 million Pesos (pesos of 2003) with 1,183,678 million (64%) from the national government and 653,705 million (36%) from the District. This corresponds basically to the distribution established originally for all phases in the official planning document Conpes 3093 where a share of the National Government of 66% was projected.

Results

TransMilenio is the first BRT system in Colombia, being so successful that it is considered as model-case for a modern mass urban transit system and is being replicated by various cities world-wide. The system decreased the average travel time by 32%, increased property values along the main line by 15-20%, enhanced tax revenues, created jobs, and improved the health and safety of the community [13]. TransMilenio helped stimulate support for the national plan to expand BRT systems to eight other cities in Colombia. Through impressive leadership, strategic institutional coordination and innovative financing models that included funding from public, private, and international institutions, Colombia was able to expand Bus Rapid Transit systems across the country [9].

Technology deployed [9]

| | | | |
|-----------------------|---|---------------------------|---|
| Infrastructure | <ul style="list-style-type: none"> ✓ Dedicated bus lanes ✓ Bus and integration stations ✓ Station-modular design with obstacle-free waiting areas and elevated level-access with a high platform ✓ Access-ramps for mobility-impaired passengers ✓ Bicycle parking and storage facilities ✓ Trunk and feeder routes (integrated transport system) | Transit Management | <ul style="list-style-type: none"> ✓ An operational fleet center manages bus dispatch, informs passengers, produces reports and maintains records ✓ Efficient bus fleet management through optimization of load factors and coordination scheduling of services ✓ GPS-linked busses provide real time information and potential transit problems |
| Bus Technology | <ul style="list-style-type: none"> ✓ Euro2 (compulsory since model-year 2001), Euro 3, 4, 5 standard vehicles ✓ On trunk routes: new articulated and bi-articulated buses ✓ On feeder routes: maximum 12-year-old buses | Fare system | <ul style="list-style-type: none"> ✓ Pre-boarding ticketing (trunk busses) and On-board ticketing for feeder units ✓ Use of magnetic ticketing that streamlines the boarding process and optimizes operations ✓ Centralization of fare collection and management conceded to a private company |

Project benefits [9]

| | | | |
|---|--|---------------------------------|---|
| CO₂ emissions reduction (2013-2019) | <ul style="list-style-type: none"> ✓ 4,052,426 tCO_{2eq} (total estimated reduction) ✓ 578,918 tCO_{2eq} (annual average estimated reduction) | Socio-economic benefits | <ul style="list-style-type: none"> ✓ Improved social well-being (less time in congestion, less respiratory diseases, less noise pollution and fewer accidents per passenger transported) ✓ More than 1,500 temporary construction jobs created for unskilled workers ✓ Reduction of the economic cost of congestion |
| Environmental benefits | <ul style="list-style-type: none"> ✓ Less GHG and other air pollutant emissions (CO₂, PM and NO_x) achieved through more efficient transport system and new buses ✓ Reduction of around 7,000t particle matter (between 2006-2012) ✓ Reduction of more than 50,000t NO_x (2006-2012) ✓ Reduction of more than 800t SO₂ (2006-2012) ✓ Reduced noise pollution due to reduction of amount of vehicles | Overall project benefits | <ul style="list-style-type: none"> ✓ Improved efficiency: new and larger buses have improved fuel efficiency per passenger transported ✓ Mode switching: reduced transport times, increased safety, reliability and comfort can attract car or taxi users ✓ Load increase: the occupancy rate of vehicles can be increased due to a centralized managed organization dispatching vehicles ✓ Improved traffic fluidity |

Lessons learned

Bogotá's TransMilenio has led to the creation of a National Urban Transport Plan in Colombia, and the project has already been successfully replicated in cities like Pereira and Cali. TransMilenio was among the first green economy initiatives for urban renewal that has encouraged public investments in infrastructure for sustainable mobility. In a growing economy where individual motorized transport is growing, the implementation of a mass transit and non-motorized systems is essential in order to develop sustainability - an aspect which increases citizens' confidence in public entities, as has been proven in Bogotá [16].

Colombia's approach could be reproduced in other developing countries as they search for ways to address transportation and greenhouse gas challenges through development of BRT systems. Bogotá's process demonstrated how transportation and urban form can contribute to improving the level of civic engagement, creating a more efficient, equitable and sustainable city. The TransMilenio model can be successfully scaled down and adapted to metropolitan areas of less than 1 million inhabitants while the performance and economic viability of the bus system remains unaffected [13].

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