



10

Bus Rapid Transit Project, Bogotá, Colombia

PROJECT SUMMARY

Colombia, like many Latin American countries, has experienced a dramatic population increase in urban centres due to economic and social factors. Bogotá, the capital, has absorbed a large portion of those people who have migrated from the rural areas. The population shift created major challenges for Bogotá, including, in the transportation sector, heavy congestion of roadways due to the use of private vehicles and the need for a cost-effective means of transportation for the urban poor. Prior to the introduction of TransMilenio, Bogotá's public transportation system was inefficient and underused.

The Mayor's Office in Bogotá proposed the bus rapid transit (BRT) system in order to alleviate congestion and provide an efficient and cost-effective means of transportation. Through strong leadership from the Mayor's Office, the new public transportation system became operational in a short amount of time. In 1999, TransMilenio S.A. was created, with representation from several public agencies, to manage the system and the public-private partnership (PPP) that has created a thriving urban bus rapid transit system.

Under the TransMilenio partnership, the public sector is responsible for the system's infrastructure and the oversight of the BRT system, while the private sector is in charge of the

system's operations and maintenance. TransMilenio S.A. oversees the design, planning and monitoring of the system while managing the other entities involved in the system's operation. The Institute of Urban Development (Instituto de Desarrollo Urbano, or IDU) was placed in charge of building and maintaining the infrastructure necessary to operate the BRT system. Private corporations operate and maintain the buses and perform ticketing and fare collection. The public entities are not reimbursed for their investment in the system since funding is received through taxes, loans and grants. The private entities recover their investments and maintain operations through the collection of fares paid by passengers and therefore bear the demand risk for the project.

Both national and local stakeholders were involved in the planning and implementation of the BRT under TransMilenio S.A. Those people with the most experience, government officials and bus operators from the old public transportation system, all provided input into the design and planning of the new BRT system. Open lines of communication allowed concerns to be voiced and resolved so that major road-blocks to the new public transportation system could be avoided. All of the partners who received contracts to operate in TransMilenio were selected by TransMilenio S.A. through an open and competitive bidding process. The first phase of implementation was completed in 2002 and the system is currently under expansion so that more

residents of Bogotá can use the public transportation system.

PROJECT OBJECTIVES

Decades of armed conflict in Colombia displaced a large number of people from rural to urban areas. As a result, today almost 75 per cent of Colombians live in cities and it is now estimated that two-thirds of the Colombian population living below the poverty line is located in urban areas. Bogotá, the capital, has a population of 6.5 million, or roughly 15 per cent of the country's total population. Providing efficient and affordable transportation for residents became a major challenge for Bogotá's administrative officers, especially since the city continues to grow by 2.5 per cent annually. A transport system able to provide efficient mobility and accessibility for all inhabitants in a city is a powerful tool to promote economic growth, alleviate poverty and achieve social and political integration while improving environmental conditions and triggering upgrading of public space.

Traditionally, Bogotá's transportation infrastructure favoured the use of private vehicles. Ninety-five per cent of the road network was used by 850,000 private vehicles, which only transported about 19 per cent of Bogotá's population. Public transportation in Bogotá was described as low quality, with low operating speed, resulting in excessive travel times, high levels of congestion, high accident rates and elevated levels of air

and noise pollution. The majority of the buses were more than 14 years old, with a bus occupancy rate averaging around 50 per cent. In general, buses did not have comfortable seats, ventilation or security. There were no defined bus stops; therefore, buses picked up and dropped off passengers at any location along the route. The low quality of the system provided little motivation for car owners to switch to public transportation.

Heavy reliance on private vehicles coupled with ill-maintained buses produced many damaging effects. The city of Bogotá emitted pollution levels of 750,000 tons of atmospheric pollutants per year generated by traffic and noise levels above 90 decibels on major streets. Air pollution was a serious issue because of Bogotá's high altitude and the lack of pollution control. In addition, 52,764 accidents were reported and 1,174 fatalities were recorded the year before TransMilenio was introduced.

Mayor Enrique Peñalosa proposed the TransMilenio BRT system as a key element to his "mobility strategy". This strategy sought to reduce the use of private vehicles, prioritize the use of public transportation and promote non-motorized transportation. The inspiration for Bogotá's BRT came from the all-bus network transit system implemented in Curitiba, Brazil. The mission of a BRT system is to combine the flexibility and low implementation cost of bus service with the comfort, efficiency, cost-effectiveness, versatility and effective land use of light rail transit. Bogotá's administrators chose the

BRT system because of its low cost (approximately one third of a light rail transit project) and its relatively short implementation time.

The main objective of TransMilenio is to create a cost-effective transportation system that will improve the quality of life and increase urban productivity in Bogotá. The BRT system aims to achieve this objective by improving the efficiency and safety of public urban passenger transport services, providing reliable accessibility to the poor, enhancing private-sector involvement in service provision, reducing air pollution and greenhouse gas emissions and by being the impetus for a comprehensive urban development process.

Following the implementation of the BRT system, TransMilenio users are now saving, on average, 223 hours annually. Surveys show that 83 per cent of the users perceive the increase in speed as the main reason to use TransMilenio. Nine per cent of TransMilenio users have converted from commuting by private automobile to the new public transportation system. TransMilenio is also highly socially sustainable, consistently polling public approval ratings of over 90 per cent, making it the most popular public project in Bogotá. Since the introduction of the BRT system, air pollutants within Bogotá decreased by 40 per cent and there was an observed reduction of 92 per cent in fatalities, 75 per cent in injuries and 79 per cent in collisions. Additionally, robberies at transit stops were reduced by 47 per cent.

PROJECT DESCRIPTION

PARTNERS

Design, planning and investment in the infrastructure are carried out by public institutions such as the Bogotá Mayor's Office, the Fund for Education and Road Safety of the Secretary of Transit and Transportation (Fondo de Educación y Seguridad Vial, or FONDATT), IDU, the District Institute of Culture and Tourism (Instituto Distrital de Cultura y Turismo, or IDCT), the Secretary for Transportation and Traffic, the Department of Planning, the Secretary of Finance and Metrovivienda.

The operation of TransMilenio is performed by private entities. Each private company was selected through an open and competitive bidding process. Four trunk-line operators run the local and express services on the main highways. There are seven feeder bus operators who run services from rural areas to the main highways. Fare collection and the installation of validation equipment are carried out by a private partner, and the control centre was installed and customized by a private firm.

IMPLEMENTATION ENVIRONMENT – LEGISLATIVE AND ADMINISTRATIVE

The largest change in Bogotá's public transportation system occurred in the operations of the service. Prior to TransMilenio, municipal authorities granted permits to private enterprises, allowing them to operate given routes. These companies did not own the buses

that they operated; instead, they rented the vehicles from bus companies at a fixed daily price. The bus owners, looking to maximize profits, were lax on maintenance and renovation of the vehicles, which raised operational costs and increased contaminants and noise. In order to pay rent and make a profit, the companies providing transportation services would hire more buses than necessary, believing that the more buses they ran, the higher the profits that they would generate. Between 1993 and 1997, the demand for bus service increased only 27 per cent, but the supply increased 72 per cent. This resulted in an oversupply of about 50 per cent of the seats necessary to meet demand.

Additionally, profit was directly proportional to the number of passengers that the companies served. This led to "la guerra del centavo", which translates as "the war of the cent". The war of the cent refers to the aggressive actions taken by drivers in order to pick up the maximum number of potential passengers. This produced unnecessary competition along oversupplied routes. The competition for passengers also led to unsafe driving practices that endangered all commuters on the road. Fare collection was performed by the driver, which produced many of the distractions that ended in accidents. In addition, tasking the driver with multiple duties increased the travel time, making the service less attractive to the public.

The Bogotá BRT system opened on 18 December 2000. The project went from a

well-defined but very general idea to initial operation in only 36 months. Rapid implementation was possible because of strong political will and guidance, adequate financial support for infrastructure development, the work of a committed and enthusiastic technical team and the participation of a sector of the traditional transport industry. In an effort to acclimate passengers to the new system, TransMilenio ran free of charge from 18 December 2000 to 6 January 2001.



Figures 1 and 2 |
Before and after
the BRT system.



The system is run without any operational subsidies, yet the performance capacity is comparable to that of heavy rail transit systems (metro and regional rail) at a fraction of their capital cost. TransMilenio can achieve capacities of 45,000 passengers per hour commuting in one direction. Maximum daily demand now approaches 1 million passengers (figs. 1 and 2). The fare charged by the TransMilenio System amounts to approximately \$0.50, which is only 6 per cent higher than the average fare charged

by transportation services in other Colombian cities that offer less efficient and lower-quality services.

TransMilenio brought centralized control to Bogotá's public transportation system along with the ability to implement organized plans that respond to the market's demand. The system comprises three divisions: regulators, managers and operators. The regulators of the system are the Ministry of Transport, which is in charge of national policies and plans, and the Municipality of Bogotá, especially the transit and transport secretariat.

Managers include TransMilenio S.A. and IDU. Under the authority of the Mayor's Office, TransMilenio S.A. was incorporated in October 1999 as a dedicated agency. This transit authority plans, manages and controls the BRT system. IDU supervises the construction and maintenance of the infrastructure, which includes bus lanes, terminals, parking and maintenance yards as well as pedestrian overpasses, plazas and sidewalks. Both entities form part of the municipality of Bogotá.

The introduction of TransMilenio brought organization to the operations of Bogotá's public transportation system. TransMilenio's operation has three components: bus operators, fare collection and a control centre. TransMilenio S.A. implemented a competitive bidding process for bus operators by issuing public Requests for Proposals (RFPs). Awards are based on a point system that takes into account the bidders' experience in public transport in Bogotá, their

financial capacity, their economic bid for the ten-year concession contracts to be executed with the city and the buses' environmental specifications, among other factors. Under the supervision of TransMilenio S.A., the trunk lines are operated by four companies that are consortia of local transportation companies, associated with national and international investors that own the buses and hire drivers and maintenance personnel. Ninety-six per cent of the private operators that provided transit service prior to TransMilenio acquired stock in the four firms that were awarded the contracts.

FINANCIAL AGREEMENT

TransMilenio is a PPP in which the public sector is responsible for the investment to develop the required infrastructure while the private sector is responsible for the investment in the bus fleet, the ticket selling and validating system and the operation of the trunk and feeder services.

The cost of the infrastructure for the project was \$5.3 million per kilometre. The initial public investment into the infrastructure totalled \$213 million. The public-sector financial resources for the implementation of the BRT system came from a fuel tax (46 per cent), local revenues (28 per cent), a credit from the World Bank (6 per cent) and grants from the national government (20 per cent). Half of the 25-per cent gasoline tax levied in Bogotá is used for the continued expansion of TransMilenio. Tariffs collected in the TransMilenio system cover only operational costs; the public-sector-financed component is not repaid.

Development of the system will continue until 2016, with a predicted total investment of \$1.97 billion.

The private sector maintains its operations through fare collection. No public subsidies were provided to fund equipment acquisition or operation. TransMilenio is designed to recover 100 per cent of its operational costs through passenger fares. Given that it is privately operated, any increase in revenue from expanded ridership goes directly to the operators. Likewise, if costs increase while demand declines, the private operators are required to cover the risks and losses.

CONTRACT PROVISIONS

IDU is in charge of constructing and maintaining the infrastructure associated with the BRT system. TransMilenio S.A. supervises the operations of the system, including awarding contracts to the private-sector operators. In order to ensure continual funding to monitor and maintain the control system, TransMilenio S.A. receives 4 per cent of the system's revenues.

Fares collected by the private concession holder are deposited in a trust fund on a daily basis. Monies are distributed weekly to the system's agents in accordance with the provisions of their respective contracts. The compensation for trunk-line operators is based on the kilometres served by each bus, plus or minus bonuses or penalties to incentivize service quality. Trunk-line operators can receive up to 65 per cent of the collected revenues. The compensation for feeder

line operators and the fare collector is based on the number of passengers served. Feeder-line operators can receive up to 20 per cent of the fares collected, while the fare collection operator can receive up to 10 per cent. One per cent of revenues is deposited into an administrative fund.

As TransMilenio has grown, the contract provisions for new bus operators have been expanded. Given that the system has already demonstrated its profit-generating possibilities to the private sector, coupled with the continued need to include displaced bus owners and to dispose of obsolete buses, modifications were made to the contract. An increased responsibility to cover cleaning and safety of the new stations has been assigned to trunk line operators. The new contracts call for incentives to include owners of one or two buses as shareholders of the trunk-line operator companies, with a minimum of 10 per cent of the shares. Finally, a requirement was implemented to scrap at least six obsolete buses to introduce each new articulated bus (two buses connected in the middle by a flexible tube).

IMPLEMENTATION METRICS

The goals of the TransMilenio system are to transform Bogotá's public transportation system in order to improve citizens' quality of life and increase the city's productivity. By 2015, the system will have resources in place to move more than 80 per cent of the city's population. The project is pursuing five major reforms in order to achieve these goals.

The system developed new infrastructure consisting of dedicated lanes, large-capacity buses and elevated bus stations that allow pre-board ticketing and fast boarding. The initial phase of the project included 40 kilometres of dedicated bus ways. The long-term plan envisions a total of 388 kilometres of exclusive lanes. The articulated buses that run on the dedicated lanes have a capacity of 160 passengers and are built with clean diesel engines that comply with Euro II environmental standards. Smaller feeder buses, with a maximum capacity of 80 passengers, were also integrated into the system. Seven feeder zones with 309 kilometres of feeder routes within 74 neighbourhoods were established to move passengers from remote areas to the main BRT system. Elevated bus stations allow the young, elderly and disabled to easily board and alight from the buses. TransMilenio uses a prepaid method of payment (off-board fare collection). The passenger pays the fare upon entry to the system by purchasing a contactless smart card at the ticket office located at the entrance of each station. The smart card can be for one or multiple trips. Access turnstiles (fig. 3) are located at the entrances and exits of the stations to validate and register the number of passengers using the system. The fare collector financed the acquisition and installation of the smart cards and validation system and provides information services to users of the system.

TransMilenio developed an integrated fare system that allows free transfers. Because the ticketing system is privately

operated and uses the technology of the smart card, multiple boarding from feeder services to trunk services (local or express) is permitted. This reduces dwell times, bus operating cost and travel times for passengers. Additionally, the use of fixed fares allows cross-subsidizing among passengers to occur. Passengers who travel a short distance subsidize those who travel a longer distance. This seems socially equitable because the poor normally live in residences farther from the city centre. Use of transfers saves riders approximately \$0.60 per day, which is equivalent to 14 per cent of the average daily income of a low-income passenger.

The project helped to improve the move of the bus management system from many small independent enterprises competing at bus-to-bus level to a consolidated structure with formal enterprises competing for concessions. This step brought safer, more efficient public transportation to Bogotá.

The centralized coordinating fleet control provides monitoring and communications to schedule services and real-time responses to contingencies. The satellite control centre enables continual supervision of the operation of the buses. Weight sensors in the bus suspension are used to prevent overload. Each bus has a Global Positioning System receiver to report the bus location, a computer that contains the schedule, a tracking communication system that shares information with the control centre and the police, and a transponder that sends the information to receivers at the entrances and

exits of every station. This communication system makes it possible to adjust the schedule and identify possible new routes into the system.

Finally, TransMilenio instituted a "scrappage programme" to reduce the existing fleet of outdated, high-polluting buses. By disposing of over 9,000 buses, TransMilenio will retire more than one third of all conventional buses and reduce the risk of a declining efficiency (load factor) in the remaining system.

COMMENTARY

METHODS FOR OVERCOMING IMPEDIMENTS

From the beginning of the BRT implementation, the private transportation operators that used to provide transit service in Bogotá, were involved in the planning process. Keeping the operators of the old system informed and allowing them to partake in TranMilenio planning helped to prevent possible protests and work stoppages. Finally, no operator was excluded from bidding for a position in the new system.

The city's strong leadership and buy-in allowed TranMilenio to develop into a working system in a short amount of time. The leadership mobilized the necessary funds to implement the system, adopted state-of-the-art technologies to run the system, established a good management company, developed a sound investment structure and created an efficient single-fare pricing system. The final

accomplishment enables most Colombians living in Bogotá to use the system.

KEY POINTS OF SUCCESS OR FAILURE

The success of TransMilenio was contingent upon many factors:

- ensuring that equity within the system remained a high priority;
- establishing coordination mechanisms and adequate institutional arrangements;
- allocating sufficient technical and financial resources to the preparation and execution of the project;
- including stakeholders in the process;
- thinking long-term but including specific short-term actions that have an immediate demonstrated effect;
- assuring financial sustainability by using measures that reinforce this principle even if they are unpopular (gas tax, use of general revenue, private-vehicle restrictions);
- providing adequate incentives for private-sector operation (performance-based contracts for defined periods and competitive tendering);
- connecting with existing road transport systems; and
- creating awareness of the system and its upgrades through information campaigns to gain public buy-in.

TransMilenio was just one aspect of a plan to decrease traffic congestion and alleviate pollution within Bogotá. To complement the system, 300 kilometres of paved cycleways were installed, 120 kilometres of roadways are closed to cars every Sunday, a licence plate registration system was established that bans 40 per cent of all private vehicles during peak times and Bogotá hosts the world's largest car-free-day event each year.

In order to expand the system, there are future barriers that must be overcome. In an effort to continuously improve the system's quality, there have been several enhancements in the contractual mechanisms and specifications of the infrastructure in the current plan for expansion. As a result, the cost per kilometre needed to extend the busways is significantly higher than anticipated, and the District of Bogotá must provide more funding for expansion than originally planned. It will be forced to identify alternative finance sources in order to continue with the project. Additionally, resistance to expansion of the current system has developed. Bus owners fear that they will lose income as more operators enter the system to meet the demands of the expanded network. Finally, the initial phase of TransMilenio affected only a limited part of the city: now legal challenges and proposed legislation have appeared to protect those parts of the city that do not contain TransMilenio infrastructure. A sustained effort from the local administration and national government is needed to adequately respond to these challenges.

