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TOWARDS A NEW PARADIGM FOR URBAN PUBLIC TRANSPORT: THE TRANSMILENIO CASE

The process of urbanization in Latin America presents new challenges for urban transport systems insofar as one of the priorities is to provide proper mobility for the increasing and complex interaction of communities.

This edition of the Bulletin, prepared by Irma Chaparro, presents a summary of the recent study entitled ***Evaluación del impacto socio-económico del transporte urbano en la ciudad de Bogotá. El caso del sistema masivo de transporte, Transmilenio***, LC/L 1786-P, October 2002, which considers the socioeconomic impact of the Transmilenio system in Bogotá. This system is part of an integrated transport strategy promoted by the District Authority over the period 1998-2001 and is an avant-garde solution to the difficult problem of transport in the city.

For further information, contact Irma Chaparro, ichaparr@netcolombia.com or trans@eclac.cl.

Background

The National Plan for Development of Colombia 1994-1998 contemplated a long-term sectoral strategy geared towards institutional and infrastructural issues, which resulted in a joint initiative by the Government and the Capital District of Bogotá. According to this plan, the *Integrated Public Transport System* would have consisted of a combination of integrated transport networks namely the metro (the rigid component) and main line buses (the flexible component). Following various assessments, it became clear that the investment in the infrastructure would be very costly; the bulk of the investment was to be charged against the district budget; there was limited capacity for institutional management; integrating the metro with buses proved problematic and there was low

coverage of demand (amounting to as little as 11%, in the case of the fixed component). All the above meant that such a system was not practicable.

This strategy laid the foundations, however, for the implementation of the Transmilenio project, which was based exclusively on the flexible bus component.

Mass transport using high capacity buses has been promoted in various Latin American cities, such as Curitiba, where it has been an integral part of an urban development model which has emerged over a long period. A system has been developed in Quito to meet the existing net demand. Bogotá has been working on the System since 1998 as part of a sustainable urban development process which contemplates: (i) improving road infrastructure; (ii) strengthening traffic management; and (iii) constructing bicycle routes within the vehicular road network, which connect with parks and avenues.

Concept of the Transmilenio System

Transmilenio is an urban mass transit system that includes high-capacity articulated buses operated by franchise holders and monitored by satellite. The buses run in separate, exclusive lanes along main corridors and link up with a system of feeder routes operated by medium-capacity buses. The system has stations with raised platforms and automatic doors that synchronize with the bus doors and the flat rate allows users access to both the main line service and the feeder service.

The components of the system are the infrastructure, the routes and the institutional and transport business management as can be seen in figure (1).

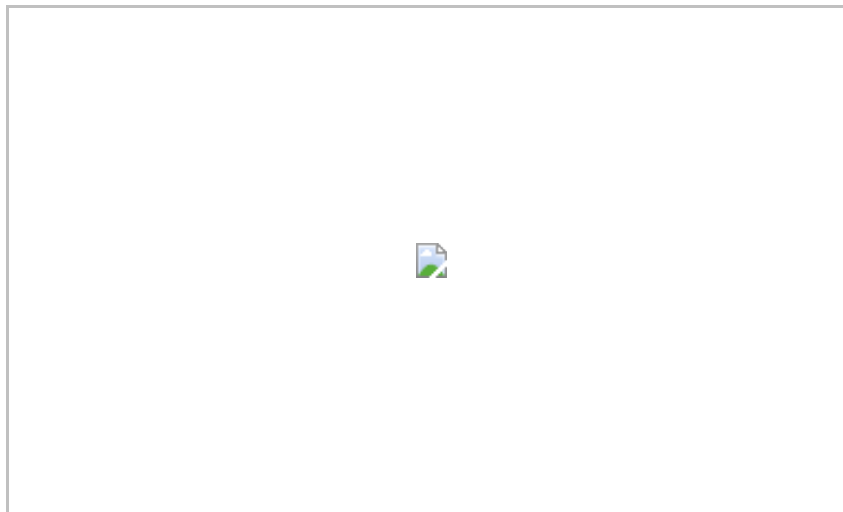
The road infrastructure is installed and maintained by the District. The high-capacity, new technology articulated buses run separately on mixed use lanes which are also used by other vehicles. There are three types of station: conventional stations, which have covered areas and through which users can enter the system and; intermediary stations, which allow transfers between urban feeder and main line buses; and terminals or header stations which are located at the extremes of the main corridors, where the user can also transfer to inter-city services. All of these stations have bridges and pedestrian walkways, which provide proper access to the system and ticket offices where cards can be purchased. The Centralized Control Centre constantly monitors the operation of the services and the number of passengers entering the system. The buses have global positioning systems, a computer that programmes the route and a reporting unit which enables the vehicle to transmit information. Thus, they can keep in touch with vehicles and stations and can receive service instructions and operational adjustments. The routes have local and express services that use exclusive corridors with the circuit beginning and ending at the terminals. Local services stop at all stations along the route offering flexibility to the passengers. Express buses stop only at stations in areas of high concentration and demand. In addition, there are feeder routes that cover service areas for the system using medium capacity buses, which run along the conventional road network.

Institutional management entails actions relating to the functioning, development and execution of the Transmilenio project and is divided up among the Urban Development Institute, the Ministry of Public Works of the District, the Ministry for Transit and Transport of Bogotá and the company, Transmilenio S.A, a small high-capacity entity.

Private enterprises have a crucial role to play. Various companies were awarded leases

through open bidding. This was the case with the trunk and feeder bus operators, the fare collection company and the trust company responsible for administering the resources. The bus companies are responsible for purchasing the rolling stock, hiring the necessary manpower for driving and maintenance and for overhauling the parking bays. The fare collection company provides the fare infrastructure and is responsible for handling the funds.

Figure 1:CONCEPTUAL DESIGN FOR THE TRANSMILENIO SYSTEM



Total system evaluation

A very rigorous preliminary evaluation focused on two fundamental points: the impact of the project and State participation. In the first case, attention was paid to the physical-spatial, technical and economic, socio-environmental and fiscal-financial issues. In the second, the resource aspect is fundamental: the plan is for the project to be executed gradually and therefore the Government provides 65.7% of the infrastructure resources, while the District contributes 34.3% through the surtax on petrol. For its disbursement, a profile of payments was established consistent with technical execution and development, the capacity to pay and legal provisions.

The Transmilenio System versus the first metro line. The implementation of the Transmilenio system proves that affordably priced mass transit systems are feasible. Existing road space is used to transport volumes of passengers comparable to those that can be conveyed by metro, but at a fraction of the cost and without major sacrifices in terms of speed. For a lower investment, a much higher proportion of the urban transport market can be served.

Comparing Transmilenio and the first metro line, it was observed that the net present value is significantly higher with the introduction of Transmilenio. The cost-benefit relationship is approximately twice as high (depending on the discount rate used) in relative terms. The internal rate of return is much higher and of the order of 60.9%. (See table 1).

Table 1:ECONOMIC EVALUATION INDICATORS

(Economic prices in millions of dollars)

System	Transmilenio system	The cost of infrastructure of the total Transmilenio system was set at US\$ 1.97 billion. It is projected
Metro-First Subway		

	Line	
	Discount rate 7%	
Net present value US\$	494	1.637
Cost/benefit ratio %	1.2.	2.30
	Discount rate 10%	
Net present value US\$	120	1.220
Cost/benefit ratio %	1.06	2.16
	Discount rate 12%	
Net present value US\$	-53	1.010
Cost/benefit ratio %	0.97	2.07

Source: Document National Council for Economic and Social Policy (CONPES), 3093.

determined demand and supply. Demand modelling was developed using a set of simulation programmes and basing the scale of the services on the average for the period of maximum load during morning peak periods from 6.30 a.m. to 8.30 a.m.. The modelling results were checked through the origin-destination surveys for interception in public transport vehicles, which, supplemented with bus frequency information, occupancy level and boarding and exiting of passengers, will make it possible to estimate the demand for Transmilenio services.

Implementation and description of phase one

The first phase consisted of three main corridors including four intermediate stops and 51 conventional stops covering 38 kilometres. At each one of the terminals, connections can be made with the feeder routes, whose itineraries range from two to ten kilometres with stops located every 200 or 500 metres. For the three main routes that make up the first phase of the project, three local and eight express services are operated together with a total of 27 feeder routes. Annexed to the system are inter-city routes that provide services to the terminals, relieving congestion in the city centre.

A procedure referred to as "fleet renewal" was established, which involved withdrawing 2.7 buses from traditional public transport for each articulated bus incorporated in the system. The age of the vehicle and technical conditions of the operation were the criteria for withdrawal, the idea being to eliminate the oversupply of transport and to reduce pollution levels. The rate of renewal is expected to be stepped up in the future.

The current fare is set at US\$ 0.35 and the maximum capacity per hour and direction on critical segments is 21,000 passengers.

Linkage of companies in benefits by operation

that the entire project will take place over 15 years in 4 phases constructing 24 trunk roads and gradually incorporating 4,474 buses into the system at an estimated cost of US\$ 895 million and payment equipment to the tune of 73.5 million. The total investment will be US\$ 2,936 million in 2000 dollars (estimated costs using social prices) and will service 80% of the market. The first metro line would have required an investment of US\$ 3.04 billion in 1998 dollars and would have covered 11% of the market.

The feasibility study entrusted to a specialized consultant with wide experience characterized the existing public transport system and

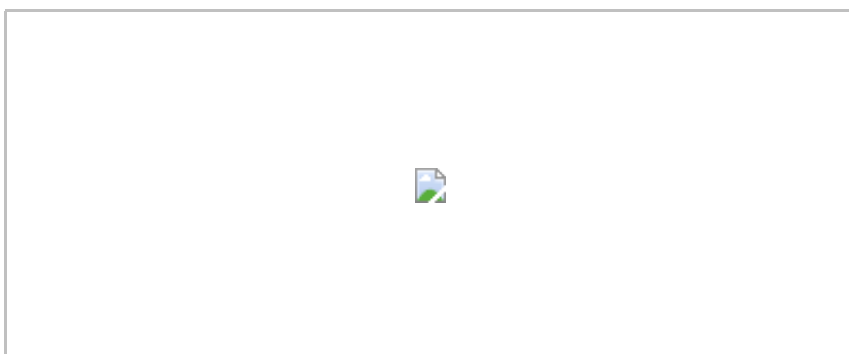
The payments received by main-route operators are given in bus-kilometres in accordance with operating service instructions handed down by Transmilenio S.A. The companies that operate the feeder routes receive payment based on the number of passengers transported. The fare collection company receives approximately 10% per ticket sold. Transmilenio S.A. receives 3% and the trust company receives 0.0387% of total payments.

Once the proceeds from the sale of cards have been received, the collections company hands them over to the trust company, which is responsible for administering them and making payments to various participating agents. Transmilenio S.A. makes the corresponding payment in keeping with the established mechanisms which ensures transparency. The payments to companies operating main line services are based on the number of bus-kilometres travelled unlike the traditional system where incentives are given for each paying passenger, which unleashed the “centavo war”.

Ex-post evaluation of the first phase

Deadlines and costs. Overoptimistic timeframes set for execution of the work meant that insufficient time was allocated for implementation of permanent designs, and for the award of contracts and construction projects.

Figure 2: Transmilenio system payment system



The delays were due to bureaucratic procedures with different District authorities. In addition, unforeseen infrastructure investments were incurred. The cost of investment including mixed lanes (that is, lanes used by private vehicles, trucks and taxis), amounted to US\$ 6,858, 199, while the cost per kilometre without including mixed lanes amounted to US\$ 5,041,271/km.

Source: Own production , on the basis of information supplied by Transmilenio S.A.

Estimated passengers versus actual passengers. In accordance with field information supplied by Transmilenio S.A., daily boardings were recorded and findings compared with estimates for the feasibility study for 420 vehicles (table 2). The result exceeds estimates by 63,947 trips per day, which signifies 15.98% more demand gained through implementation of the system. The actual passenger demand of 464,133 persons corresponds to aggregate data per trunk road and feeder roads, which represent 327, 249 and 133, 884 passengers respectively per day.

Table 2

Estimated number of daily passengers versus recorded passengers

(Partial operation of the first phase)

Estimated number of Actual number of

	passengers/day	passengers/day	Surplus	Percentage
Passengers boarding trunk and feeder lines	420 vehicles	420 vehicles		
	400.186	464.133	63.947	15,98

Source: Own production on the basis of information supplied by the consulting firm, Steer, Davies and Gleave, and Transmilenio S.A.

Current demand in main corridors with the first phase in full operation. The daily demand for passengers was audited and it was found that 760,000 persons were being transported per day using 490 articulated buses, exceeding the 660,000 passengers expected in this first phase and for whom a fleet of 475 units had been projected. The higher demand which had been anticipated called for the installation of 15 additional articulated buses, with the incorporation of 11 more contemplated by the end of 2002.

Benefits. Table 3 shows the savings in travel time for passengers, and in operating costs for the service as well as the reduction in the accident rate. The saving in travel time for users is the variable that shows the most benefits standing at 82.48% yielding a total value of US\$ 1,203 million. This variable shows the time of the bus journey, walking time and transfer time. The saving in operating costs as a result of the withdrawal of the 2.7 obsolete vehicles and their replacement by one articulated bus) stands at US\$ 252 million. Lastly, the benefits in terms of the lower accident rate are estimated at US\$ 3 million.

Table 3

Total benefits

Concept	In millions of 2001 United States dollars	Percentage
Benefits	1.458	100.00
Savings in travel time	1.203	82.48
Savings in operating costs	252	17.30
Accident rate	3	0.22

Source: Own preparation on the basis of information supplied by Transmilenio S.A.

Economic evaluation. If we deduct the costs from the benefits in this initial phase, we obtain a net present value of US\$ 944,730,000 using a discount rate of 12% over a 10 year period. The cost/benefit ratio is 2.84% and the internal rate of return is 60.34%, pointing to a highly favourable situation in the first phase, which is already in operation. If we look at the figures for net present value at a discount rate of 12% as shown in Tables 1 and 3, the first phase of operation alone covers 94% of the system's overall benefits.

Evaluation of the collection system

The electronic smart card system ensures operating efficiency, security of the money collected and minimization of fraud. Cards may be bought for one, two or ten trips. The service does have shortcomings at the sales level since the queues exceed the installed capacity and this generates considerable delays. The cards are not always read correctly and double checking causes congestion, especially at the exit. Some 80% of all cards sold are for one and two trips and 20% are for 10 trips.

Conclusions

Transmilenio is a fundamental contribution to optimizing public transport and quality of life.

In comparison with the metro, this system proves that a mass transit system at a more affordable cost is possible without sacrificing speed. With a modest investment, authorities can cater for a much larger volume of commuters.

Results show the high value that shorter travel time has for passengers even though waiting times may be longer than with the traditional system.

The prepayment smart card system should be improved, for example by installing card selling facilities at different points and by offering economic incentives for the purchase of multiple trip tickets.
