Urban developments as a challenge for funding mass transportation systems.

Lida Margarita María Durán Bernal

Civil Engineer
MSc. in Civil Engineering
Bogotá D.C., Colombia

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L.M.M. Durán
Bogotá D.C., Colombia

PRESENTATION: Civil Engineer from the National University of Colombia. Master in Civil Engineering from the Andes University with emphasis in construction projects management. I've worked on different jobs related to infrastructure construction. The most relevant projects are: Cycle path: Fontibón-Dorado-Uniandes (Bogotá D.C.); Road rehabilitation: Honda-Río Ermitaño between Puerto Boyacá and Honda (Colombia); Church construction: Parroquia Nuestra Señora de la Reconciliación (Bogotá D.C.); Management of different construction projects designed by Rogelio Salmona (Bogotá D.C.) (Rogelio Salmona is one of the most important Architects in Colombia. His designs are very relevant and they stand out for the use of concrete and brick like predominant materials).

For more than six years, I've worked for TRANSMILENIO S.A. (district entity that makes planning, management and control of the operation for Bogotá's mass transportation system, TransMilenio System). Here, I've worked in urban and infrastructure projects planning. My experience with this kind of projects has allowed me to have a vision about the importance of planning for the appropriate development of the cities in the world so I participated in IUP3-Training in 2007. A general description of developed work during that training is showed below:

Urban developments as a challenge for funding mass transportation systems. The case of TransMilenio in Bogotá.

L.M.M. Durán
Civil Engineer
MSc. in Civil Engineering
Bogotá D.C., Colombia

ABSTRACT: Transport is a necessary activity for the development of the economy. Due to congestion problems, pollution and costs, mass transport systems have acquired a great importance in several cities of the world. In the case of Bogotá, TransMilenio System makes part of a mobility strategy that has given very good results for the city. Nevertheless, commercial and housing developments that it brought along were not planned and the private sector has been the only one that benefitted of these investments. Nowadays, the city has difficulties to finance the maintenance of the infrastructure and long term expansion of TransMilenio. An opportunity to finance them is related to urban impacts planning with shared benefit between public and private sectors.

1 INTRODUCTION

Bogotá is a cosmopolitan city that remains in continuous growth and expansion and it is considered as one of the cities of the fastest growth, not only in Colombia but also in entire South America. The city has near seven (7) millions inhabits with different origins; the city is a fork of races, religions and cultures. Modern and high buildings contrast with houses of colonial architecture and preserved areas of civic recreation of the past. The mass transportation system, TransMilenio, makes part of the change for which the city passes through. At the moment, the System has 84 Kilometers of exclusive roads, belonging to the Phase I and II, 42 Kilometers respectively. TransMilenio System began the operation in December of 2000.

In Bogotá, implementation of mass transportation system brought related changes in the land use. For example, in zones around the exclusives roads ("trunks"), big commercial developments took place; the bus routes created new corridors of parkland that provide public space where children and adults play sports and old people promenade. However, these changes were not planned before the implementation of the BRT system. Urban and regional planning serves to formulate public politics that help to finance projects in the cities. With an appropriate planning, urban changes in Bogotá could have been used to finance construction of everything or part of the infrastructure system. Today, city need resources for maintenance to build infrastructure, but commercial and housing developments generated benefits for people in private sector but they didn't generate benefits for district government.

This project intends to present the general information corresponding to different mass transportation in the world, particularly BRT systems, to analyze the case of TransMilenio System and its urban impacts and to propose a general methodology to use the urban impacts for funding mass transportation systems in the world.

2 BACKGROUND AND CONCEPTS

2.1 *Background*

In the world, there are different mass transportation systems. Each one of them has their own history and development (Jiménez, 2006). For example, BRT (Bus Rapid Transit) is a public transit mode that uses buses to provide a quality of service similar to light rail. BRT combines the flexibility and low cost of bus service with the comfort, efficiency, cost-effectiveness and versatility of light rail transit (LRT). BRT can be considered as a hybrid transit service falling between traditional rail and bus modes. Cities in developing countries have struggled with the problem of how to upgrade and improve existing transit services at a low cost. Developing countries with high transit-dependent populations and limited financial resources have increasingly attempted the use of BRT systems because of their low costs and relatively fast implementation times (Leal, 2003).

The influence of mass transportation systems in urban areas depends upon the type of system and their dimensions, countries, cities, land use along the corridor and many different factors. Implementation of one mass transportation system can be simpler in a city with a planned growth than in a city with unplanned growth like cities in developing countries. Mass transportation system affects all urban components. It has impacts on cities housing, trade, industry, infrastructure and mobility.

TransMilenio is a Bus Rapid Transit System. The TransMilenio System is part of a structural change of the transport systems in Bogotá. This System experience is a proposal for change in terms of urban mobility by means of a bus-based mass passenger transportation system. It is based on two general objectives: improving citizen's quality of life, and bettering the city's productivity.

With the implementation of this System, important achievements were possible: reducing traveling times by 32%, and gas emissions by 40% in the city air (over 2,109 public-service vehicles were scrapped); making zones around the trunk roads ("troncales") safer, and decreasing accident rates by 90% in the corridors where the system operates. Bogotá's experience is seen as a model from which other cities and towns in Latin America can benefit to improve their public transportation conditions.

The System's nominee company is TRANSMILENIO S.A. The entity has a sound staff structure, and its purpose is focused on service planning, management and control of the system operation. Its administrative and functioning processes are financed with 4% of the collection money obtained from trip selling and secondary activities such as advertisement at stations along the system. TRANSMILENIO S.A. developed a project to evaluate the urban impacts along the phase 1 corridors. The project was based on information that was obtained different moments. Today, TransMilenio System does not have a project to

evaluate the urban impacts along phase 2 corridors which are completed, and there isn't any project provision to evaluate the urban impacts along the phase 3 corridors as was the case for the design stage. However, TRANSMILENIO S.A. took information about of corridors during design stage.

2.2 *Concepts*

Transport is the movement of people or goods from one place to another. Transport includes all the means and infrastructures implied in that movement, reception services, delivery, and manipulation of such goods (Rezk, 2007). Transport, as any other productive activity, is part of the economy (Girardotti, 2003).

Transport and communication roads have a great significance in the development of a region and a country. Few elements of the economy have as much influence in the human existence as the transport system. Economic growth, well-being, social structure, geographical expansion, relationships with the external world and specialization of the productive efforts are influenced by the development of transport. Our daily displacement to working place, business centers in the cities, and certainly trips to the surrounding areas are possible thanks to existent means of transport (Martínez, 2003).

Transport is an important part of the history, and it constitutes a central element for progress of different civilizations and cultures. Operation of the transport is carried out in roadways that are fundamental spaces of the urban structure. Transport and alternatives for urban mobility generate direct impacts on the urban structure, the landscape and they are related to the environmental quality of the cities and consequently to the quality of the citizens' life (Martínez, 2003).

Concentration of population in big cities or big metropolitan areas has supposed the necessity of efficient mass transports for the development of daily life of people. Also, growth of the congestion, mainly in the cities, has increased the levels of pollution and accidents, making necessary to build alternative systems of urban transportation.
Next the main concepts for the development of this project are presented:

2.2.1 *Public Transportation*

"Public transportation services", and "public transportation purposes" mean the movement of people and goods by publicly or privately owned water vehicle, bus, railroad car, rapid transit vehicle, taxicab, or other conveyance which provides general or special service to the public, but not including school buses or charter or sightseeing service (Michigan, 2007).

2.2.2 *Mass Transportation Systems*

"Mass transportation systems" means all plants, equipment, work instrumentalities, and real and personal property and rights, used or useful for transportation of passengers for hire, except taxicabs and airport limousines (Michigan, 2007).

2.2.3 *Bus Rapid Transit (BRT)*

"BRT is a public transit mode that uses buses to provide a light rail quality of service. BRT combines the flexibility and low cost of bus service with the comfort, efficiency, cost-effectiveness and versatility of LRT. BRT can operate with exclusive rights of way, quieter and cleaner vehicles, rapid off-board fare collection, correct and attractive infrastructure and short times. The cost of a BRT project can be about one-third the cost of a LRT project. BRT can be considered as a hybrid transit service falling between traditional rail and bus modes.

Picture 1 shows TransMilenio System. The BRT implemented in Bogotá, Colombia.

Picture 1. BRT of Bogotá D.C., Colombia.
Source: TRANSMILENIO S.A., 2006

A BRT system includes the following characteristics:

- Exclusive right of way
- Rapid boarding and alighting
- Clean, secure, and comfortable stations and terminals
- Fast and efficient fare collection, including fare less zones, collection at stations or on board vehicles.
- Effective regulations for bus operators
- Use of Intelligent Transportation Systems
- Transit priority at signalized intersections
- Integration with other modes of transportation
- Adequate marketing
- Good customer service

When these characteristics are met, a BRT system can be considered to be as versatile, flexible and comfortable as LRT systems" (Leal, 2003).

2.2.4 *BRT's in the world*

BRT's history resides in a variety of previous efforts to improve the transit experience for the customer. The first wide-scale development of the BRT concept using bus technology occurred in Curitiba (Brazil) in 1974 (Wright, 2004).

The mid-1970s also saw a limited number of BRT applications being developed in other cities of North and South America. While not as sophisticated as the Curitiba system, variations on the concept were developed in Sao Paulo, Brazil (1975); Arlington, USA (1975); Goiania, Brazil (1976); Porto Alegre, Brazil (1977); and Pittsburgh, United States (1977). The Sao Paulo BRT system is currently the largest in the world with 250 kilometers of exclusive lanes serving 3.2 million passenger trips each day (Wright, 2004).

Despite Curitiba's success and relative fame within the transport planning profession, the overall replication of the BRT concept was actually somewhat slow to gain momentum elsewhere. It was only in the late 1990s that BRT's profile became more widely known. Visits by technical and political teams from Bogotá (Colombia) and Los Angeles (United States) to Curitiba served to launch BRT efforts in those cities. In 1996, Quito (Ecuador) opened a BRT system using electric trolley-bus technology, and the city has since expanded the system with clean diesel technology (Wright, 2004).

However, it was the effort in Bogotá with TransMilenio system that has particularly transformed BRT's perception around the world. Bogotá provided proof that BRT was capable of delivering high-capacity performance for the world's megacities. Today, with both Bogotá and Curitiba acting as catalytic examples, the number of cities with built BRT systems or with systems under development is quite significant (Wright, 2004).

In 1998, the United States was embarked on a national BRT programme that includes 17 cities. Higher-quality bus systems are already in place in Chicago, Honolulu, Los Angeles, Miami, Orlando, Philadelphia, Pittsburgh, and Seattle. Likewise, other OECD nations such as Australia, Canada, France, Germany, Japan, and the United Kingdom have seen the potential for BRT as a high-quality but low-cost mass transit option. The transfer of BRT technology from Latin America to OECD nations has made BRT one of the most notable examples of technology transfer from the developing south to the developed north (Wright, 2004).

Picture 2 shows TransJakarta System. The BRT implemented in Jakarta, Indonesia.

Picture 2. BRT of Jakarta, Indonesia.
Source: TRANSMILENIO S.A., 2007

Table 1 shows a summary of cities in the world with high-quality bus systems in operation and Table 2 shows a summary of cities in the world with high-quality bus systems in the design or construction phase:

Region	**Cities with a high-quality bus system in operation (some form of exclusive bus way)**
África	Abidjan, Cotê d'Ivoire; Saint-Denis, Reunion (France)
Asia	Ankara, Turkey; Istanbul, Turkey; Jakarta, Indonesia; Kunming, China; Nagoya, Japan; Taipei; Taiwan
Europe	Bescançon, France; Bradford, UK; Claremont Ferrand, France; Dijon, France; Eindhoven, The Netherlands; Essen, Germany; Grenoble, France; Ipswich, UK; Leeds, UK; Limoges, France; Lyon, France; Montpellier, France; Nancy, France; Rennes, France; Rouen, France; Runcorn, UK; Strasbourg, France; West Sussex, UK
Latin América	Belo Horizonte, Brazil; Bogotá, Colombia; Pereira, Colombia; Campinas, Brazil; Curitiba, Brazil; Goiania, Brazil; León, México; Porto Alegre, Brazil; Port of Spain, Trinidad; Quito, Ecuador; Recife, Brazil; Sao Paulo, Brazil
North America	Alameda and Contra Country, USA; Boston, USA; Chicago, USA; Honolulu, USA; Las Vegas, USA; Los Angeles, USA; Miami, USA; Ottawa, Canada; Orlando, USA; Philadelphia, USA; Pittsburgh, USA; Seattle, USA; Vancouver, Canada
Oceanía	Adelaide, Australia; Brisbane, Australia; Sydney, Australia

Table 1: High-quality bus systems in operation.
Source: Wright, 2004

Region	**Cities with a high-quality bus system in the design or construction phase**
África	Accra, Ghana; Cape Town, South Africa; Dakar, Senegal; Dar es Salaam, Tanzania
Asia	Bangalore, India; Beijing, China; Chengdu, China; Dhaka, Bangladesh; Delhi, India; Hangzhou, China; Shejiazhuang, China
Europe	Annecy, France; Brest, France; Caen, France; Cambridge, UK; Coventry, UK; Luton, UK; Maubeuge, France; Nice, France; La Rochelle, France; Toulon, France

Region	Cities with a high-quality bus system in the design or construction phase
Latin América	Barranquilla, Colombia; Bucaramanga, Colombia; Cali, Colombia; Cartagena, Colombia; Soacha, Colombia; Medellín, Colombia; Cuenca, Ecuador; Guatemala City, Guatemala; Guayaquil, Ecuador; Lima, Perú; Mexico City, México; Panamá City, Panamá; Puebla, Mexico; San Juan, Puerto Rico; San Jose, Costa Rica; SanSalvador, El Salvador
North America	Albany, USA; Charlotte, USA; Cleveland, USA; Eugene, USA; Hartford, USA; Louisville, USA; Montgomery County, USA; Reno, USA; Salt Lake City, USA; San Francisco, USA; Toronto, Canada
Oceanía	Auckland, New Zealand; Perth, Australia

Table 2: High-quality bus systems in design or construction.
Source: Wright, 2004

3 THE CASE OF TRANSMILENIO IN BOGOTÁ

3.1 *Bogotá, capital of Colombia*

Colombia is the second-most populous country in South America with 42.1 million inhabitants as of 2005 (DANE, 2005) and can be considered a middle-income country. Bogotá is home to slightly more than 20% of Colombia's urban population, and it is the largest city in the country with an estimated population of 6.78 million in 2005 (DANE, 2005). It is a very compact city with an average population density of 230 persons per hectare (Suárez, 2005). Currently, Bogotá represents approximately 30% of Colombia's Gross National Product (GNP) and it is increasingly becoming a more service-sector-oriented city (Hidalgo, 2004).

During the twentieth century, Bogotá experienced accelerated urbanization and industrialization processes. During this time, the built part of the capital grew close to 300 times, and its population multiplied by 60 (IDU, 2006).

The city's urban structure had been growing through the savannah at a fairly slow rhythm until the 50's decade. Since then, the development has been characterized by an expansion towards the periphery, guided by the construction of residential neighborhoods far from the traditional historic center and connected to it by the principal network of roads (IDU, 2006).

Every year, 220 illegally urbanized hectares emerge in average, and it is estimated that close to 50% of urbanized property in the city has been developed illegally. So, part of Bogotá's urban form is a result of the logic behind the construction of the principal road network (IDU, 2006).

As is common in Latin American cities, Bogotá has notable income segregation. The city is classified into six different strata, named from 1 to 6, according to similar social and economic characteristics (Hidalgo, 2004).

The consequences of Colombia's social and political degradation are notable. In Bogotá, 49.6% of the population lives below the poverty line (El Tiempo, 2005). For many of the poor, it is extremely difficult to afford a home with even minimum standards, including land tenure or to have appropriate access to basic services such as sanitation, education, health facilities or --as is the concern of this study—transportation (Munoz-Raskin, 2007).

During the last 25 years, the Colombian government has discussed the need for a new transportation system in Bogotá. Possibilities such as a LRT were considered. However, LRT was never implemented because of the high cost and the protests made by private companies that operated the existing public transportation system (Leal, 2003).

In 1998, Bogotá initiated a mobility strategy in order to overcome its transportation problems. Since 1998 the city has implemented some strategies to reduce congestion such as a reduction of 40% of the automobiles used during the peak hours through plate number restrictions, implementation of a bikeway network, pedestrian walkways, and the creation of the TransMilenio BRT system (Leal, 2003).

3.2 *TransMilenio System Infrastructure*

TransMilenio was created in order to reduce accidents, shorten travel times, reduce pollution, and provide accessibility for young, elderly, and people with disabilities and to provide affordable, high quality and advanced transportation technology. The fare collection and operation systems are controlled by the private sector. A new transit authority, TRANSMILENIO S.A., was created in October 1999 in order to manage, control and plan the system. TRANSMILENIO S.A. is supported by 3% of the fare revenues and other activities, such as commercial advertising (Hidalgo and Sandoval, 2001).

Financial resources for the implementation of the BRT system came from a fuel tax, local revenues, a credit from the World Bank and grants by the national government. Resources were planned to fund the BRT infrastructure until 2006 with a possible extension to 2016. The phase I of the project was designed and constructed by local and international firms. It took about eighteen months to finish the studies and develop detailed plans for the system. Examples of BRT systems in other Latin Countries, such as Quito (Ecuador), Curitiba, Sao Paulo, and Goiania (Brazil), helped to identify important elements for the planning and design of the system (Leal, 2003).

From the beginning of the BRT implementation the private transportation operators that provided transit service in Bogotá were involved in the planning process. Operators of the old system were offered the opportunity to be the operators of the new system. This strategy was implemented by showing them the opportunities and advantages of their participation. The operators' experience was recognized and valued as a key aspect for the success of the new BRT. By involving the operators of the system as part of TransMilenio, the protests against and work stoppages for the service were avoided. Every time that a new

TransMilenio bus was put in service, some old buses had to leave the system. The newer buses are used as feeder buses to take passenger from remote locations to the TransMilenio system (Leal, 2003).

In April 2000, four different firms created by local transportation operators associated with international investors received the contract concession to provide and operate 470 new articulated buses. Ninety-six percent of the private operators that provided transit service acquired stock in the four firms that were awarded the contracts. This shows the success of the program to include former transit operators in the TransMilenio operation. The fare collection was awarded to a local firm supported by an experienced fare collection system provider. The control system was awarded to a Spanish firm (Hidalgo and Sandoval, 2001).

The phase I infrastructure was constructed by local contractors under the supervision of the Institute of Urban Development (Instituto de Desarrollo Urbano, IDU). Their duties were to develop: 35 km of exclusive lanes and complementary lanes, 4 terminals, 4 parking and maintenance yards, 58 stations, 17 pedestrian overpasses, plazas, sidewalks. On December 18 of 2000, TransMilenio started operation (TRANSMILENIO S.A.).

Exclusive lanes are located in the center lanes of the main avenues of the city. These exclusive lanes are physically isolated from the mixed traffic lanes, private vehicles, trucks, and taxis. TransMilenio requires a gradual implementation. The caused effects while constructions of exclusive lanes are really strong for the city and its inhabitants. Due that, it is impossible to build more than 40 km at the same time. TransMilenio Master Plan includes 22 exclusive lanes or main lanes in a 15 year period covering 388.9 km.

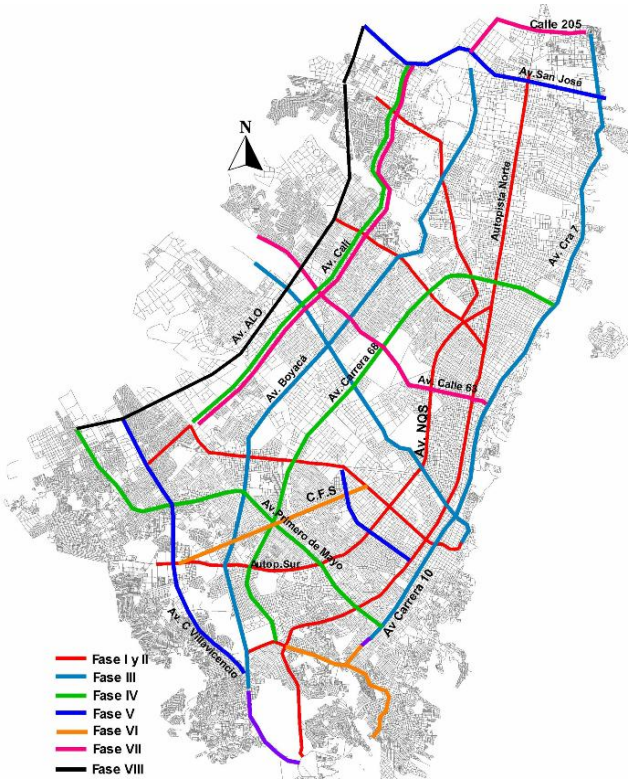

Figure 1. TransMilenio Master Plan, 2003

Figure 1 shows different phases of exclusive lanes that were planned until 2016 (TransMilenio Master Plan, 2003).

Today, TransMilenio System has 84 km of exclusive lanes and complementary lanes, 7 terminals, 7 parking and maintenance yards, 114 stations, 73 feeder services and several pedestrian overpasses, plazas and sidewalks. The phase I and phase II of the system are completed. Phase III is on construction.

3.3 *Funding Colombian Mass Transportation Systems*

TransMilenio is the most important infrastructure project in Bogotá in the last years. This Bus Rapid Transit System (BRTS) has brought several benefits to the city. The infrastructure of the project is provided by the public sector. The Nation contributes 66% of the total cost of the project and the city the remaining. The private sector is in charge of the operation of the system, without any public subsidy (Mendoza, 2005).

In spite of the fact that TransMilenio Master Plan includes 8 phases and 388 km, nowadays, Bogotá only has money to build the phase III infrastructure. The City has difficulties to finance the construction and maintenance of mass transportation system infrastructure. In order to ensure the completion of the TransMilenio Master Plan and give additional financial sustainability for the expansion of the system, new resources should be found.

Although no specific studies have been carried out, it seems that TransMilenio positively affects land values. The Bogotá's Association of realtors' analysis, a study about the rent prices around TransMilenio's infrastructure and the fact that commercial developers consider that locating near to it is beneficial for their businesses, suggest likewise (Mendoza, 2005).

Due to positive impacts of TransMilenio Colombia's Government decided to invest in similar projects for seven cities of the country. All of them share the same principles (Mendoza, 2005):

- National Government assume among 40% to 70% of the debt service for building infrastructure of the project. Municipalities cover the rest.
- Private sector participation relates to buses supplies, operation and fare collection system. In addition, private sector participates in the investment of infrastructure, in order to reduce public funding.
- The systems must be auto sustainable. That means operation will not receive any kind of subsidies.

These principles present different cities in Colombia already with difficulties in terms of getting the private sector to participate in the investments for infrastructure.
Problems related to mass transportation planning are the main cause. Those problems are as listed below:

- Lack of adequate knowledge about the different mass transportation systems in the world, their characteristics, their implementation and their impacts in cities where they have been implemented.
- Lack of adequate knowledge about the changes that implementation of mass transportation systems generate in land use and urban development.
- Lack of adequate knowledge about tools to distribute the economic costs and benefits that are generated by changes in the land use and urban development after the implementation of mass transportation systems.

3.4 *Urban Impacts*

Transit and transportation systems have a major impact on the shape and quality of urban life. A new transit system will wield a considerable influence over the physical form of a city. This impact occurs both directly through the transit infrastructure as well as indirectly through the development that occurs around the transit corridor as a result. In the long term the system will even influence where people decide to live (Wright, 2004).

Transportation facilities improve the accessibility for households and businesses, generating increments on its land values. Usually public transport facilities (transit) are provided by the public sector, which by definition is in charge of assuring that function. However, this is not an easy task and, when requiring large amounts of money, it may constrain public intervention. Therefore, there is a necessity of looking for new and inventive funding options. The private sector may play an important role to do so (Mendoza, 2005).

The impacts may also be transferred to other sectors, different to the transport market. In that sense one of the most important indirect benefits of transport infrastructure is the fact that houses and commercial activities will be located in more accessible areas, and therefore the land values increase (Hayashi, 1989). The precedent means that land values may rise, because of the perceived improvement of the ease of reaching amenities from a certain location (Targa, 2003). Other activities initially located in other areas, may be attracted to the "improved location", resulting in land value increments. However, sometimes land values can also diminish because of a transport investment (Offermans, 2003).

Proximity to stations have a positive effect on rent, because of higher demand; in consequence land developers would like to build high density properties, to make a more intensive use of land and receive a higher profit from it (Benjamin & Sirmans, 1996). Public transport projects generate increments in land value for residents, retailers and businesses. However, some authors argue that the benefits are higher for commercial and office properties; in consequence, there is a stronger capitalizing benefit for those uses (Cervero & Duncan, 2001).

In the case of Bogotá, with implementation of mass transportation system, important achievements were possible: reducing traveling times by 32%, and gas emissions by 40% in the city air (over 2,109 public-service vehicles were scrapped); making zones around the trunk roads ("troncales") safer, and decreasing accident rates by 90% in the corridors where

the system operates. Bogotá's experience is seen as a model from which other cities and towns in Latin America can benefit to improve their public transportation conditions (TRANSMILENIO S.A.).

Additionally, implementation of TransMilenio brought about related changes in the land use. For example, in zones around the exclusives roads ("trunks"), big commercial developments took place; the bus routes created new corridors of parkland that provide public space, where children and adults play sports and old people promenade.

Pictures 3 to 4 show some different urban developments generated by TransMilenio System implementation (TRANSMILENIO S.A.):

Picture 4. Commercial development close to TM.
Source: TRANSMILENIO S.A., 2007

Picture 3. Housing development near to TM.
Source: TRANSMILENIO S.A., 2007

4 INTEGRATED URBAN PLANNING

"Urban development is a complex process. It involves housing and technical systems for water supply, sanitation and storm water drainage, energy, telecommunications and transports - all with high investment costs. Schools, clinics and other social services have to be developed; parks and recreation areas must be provided. Building regulations to guarantee public safety, hygiene and environmental protection have to be established and enforced and all development must take future expansion into account.

Many, often conflicting, interests are involved. Private and public interest, environmental concerns, the protection of cultural heritage and other aspect should all be considered. The economic consequences of infrastructure investments and other development initiatives are considerable since they create business opportunities, raise the cost of land and have an impact on rents and property values.

There are many stakeholders and some are more powerful than others. The majority of the population, the urban poor, is not powerful at all. They, as well as other interested parties, may easily be excluded from planning and decision procedures.

Urban development is therefore a difficult political and technical issue, which requires democratic governance and management guided by professionalism and a vision of social, economic and environmental sustainability. In reality, the planning capacity of most local authorities in developing countries is very limited. Unfortunately, it is also fragmented" (Tannerfeldt & Ljung, 2006).

As stated, in the case of Bogotá, TransMilenio project brought changes in land use, land values, among others, however those changes were not planned before the implementation of the BRT system. With an appropriate planning, urban changes in Bogotá could have been used to finance construction of everything or part of system infrastructure. Today, city need resources for maintenance of built infrastructure, but commercial and housing developments generated benefits for the private sector but they didn't generate benefits for district government.

Nowadays, the authorities in Bogotá have conscience about the opportunities that the development of the TransMilenio infrastructure has. However Bogotá lacks the leadership to impel urban projects related to the phase III of TransMilenio System. The Urban Renewal Company (Empresa de Renovación Urbana – ERU) together with some other local companies has identified different urban renewal projects for the phase III, like Central Station. This entails a big station in downtown of the city, in which TransMilenio System will be commercial integrated. Nonetheless, the use of those possibilities depends on political decisions. May be in the near future we will get to develop some of those projects.

4.1.1 *Cadastral Information*

Actualized cadaster information is basic for the methodology success. The base for taxing is good cadastral information, in order to be able to estimate increments due to improved infrastructure and to have a negotiation tool (Mendoza, 2005). Nonetheless, actualized cadastral information is also significant in the context of generating public-private partnerships.

The potential of the tools that this article describes in the following sections are connected to the formation and updating of the cadastral information system and to the knowledge of the current land market. Bogotá have the cadastral information, but it is important that the other cities in Colombia continue the actualization of their cadaster systems.

One of the most important problems in the application of the methodology in other cities of Colombia is the lack of actualized cadaster information.

4.1.2 *Tools for funding mass transportation systems*

"Since the investment required for the provision of transit is usually very large and most of the time financing of infrastructure and operation through fare collection is insufficient, other sources of funds must be found. Subsidies, grants, new taxes, public-private partnerships for the provision of the infrastructure (by the public) and the operation (by the private) are some of the examples of additional funds. However, other options, based on the economic principle that the beneficiaries must pay for the service (or infrastructure), exist. One of those is value capture" (Mendoza, 2005).

"When referring to transit projects, value capture is a set of mechanisms by which the agency responsible for the development of an urban transport infrastructure recoups (at least) part of the increments in value in the real property generated by that infrastructure, in order to fund that investment" (Mendoza, 2005).

Table 3 summarizes the different mechanisms, according to the source of revenues and if is mandatory or not.

	Voluntary contribution		**Mandatory contribution**		
Capture from developers	**Joint Development**	Benefit Sharing	**Governmental Intervention**	Administrative guidance	
		Concession leases		Development charges	
		Connection fees		Development rights	Certificates of building potential rights
		Land leases and air-rights development			Transfer of development rights
		Developer contribution			Density bonusing
					Land swaps
				Municipal land disposal	Land readjustment
					Land banking
					Land assembly
Capture from the community				Assessment districts	
				Impact fees	
				Tax incrementing	
				Temporary rate increase	
				Split-rate property tax	
Capture from within	Superdeveloper				

Table 3: Value capture options for funding transit projects.
Source: Mendoza, 2005, based on Offermans, 2003.

Some options are focused on the generation of public-private partnerships with (residential and/or commercial) developers, either from a voluntary and mandatory basis. These are defined as value capture from the developers. These options are intended to have a particular partner, reducing the costs of collection and generating a secure source of funds. It requires commitment from the public and private parties, setting clear common objectives and drawing up an agreed strategy (Mendoza, 2005).

The second group corresponds to capturing value from all the community benefited. The most important point here is to delimit that community, in order to charge each particular

owner. These options require ability from the public agencies to convince and demonstrate the individual economic benefits that the new infrastructure will bring in order to receive and earmark the revenues in time (Mendoza, 2005).

The final group requires big companies in capacity to build the complexes. The owner of the public infrastructure becomes (also) the owner of commercial or residential developments, from which revenues are generated to fund the non-profitable part of the project. Large managerial capacity is compulsory from the agencies in charge. Political intervention is desired to be relegated into a second level within these organizations (Mendoza, 2005).

4.1.3 *Business structure*

Business structure depends on the tool selected. TRANSMILENIO S.A. focuses mostly on the operational and contracting aspects of managing the BRT system. The organization is also involved in planning and financial aspects of the system, but in coordination with other agencies. Specifically, the city's Institute for Urban Development (IDU) holds the responsibility for delivering the system's infrastructure.

Bogotá require improving the coordination between local agencies in order to get better results in the infrastructure development. Generation of public-private partnerships is an important tool for funding mass transportation systems, but Colombia has problems with the contracts yet. It's necessary to get a good business structure in order to distribute risks, benefits and charges.

5 CURRENT SITUATION

Bogotá, as Capital District and pioneer in the development of Colombian Transportation Systems, is actually going through a big transformation because it is working in the organizational and start-up process of a new integrated public transportation system (SITP). Structural component of this new system will have TransMilenio and TRANSMILENIO S.A. is the company in charge of managing, planning and controlling it. Main object of this project is to create a public transportation network with the next characteristics: it will cover the entire City, will be articulated, will be organized, will have easy access, and will allow mobilizing all citizens with greater quality standards. It is providing for integration of different public transportation modes, through special infrastructure as fixed stops, terminals, etc.; through integrated fare; through only one option of payment; through technology to control the whole System, users' information and fare collect; and through a better routes and services offer.

District authorities, based on previous experiences, have seen the necessity to involve transport and infrastructure facilities as garages, repair shops, modal interchangers and terminals inside of urban and territorial planning of the City regarding the next aspects:

- Pieces of land which will be selected to locate some of the transport and infrastructure facilities have to be according with land uses regulations; and with activities defined in City Territorial Planning Plan (POT) and different instruments that regulate it (Zonal Planning Plans –POZ-, Zonal Planning Units –UPZ- and others).

- The City defined planning instruments for urban establishing and land reservation to those facilities. These facilities are called "Implantation and regularization Plans".

- Planning of established and operation of each one of those facilities have to include identification of effects in urban environment (urban structure, land availability, complementary uses, road infrastructure, public space, public services and others). So, it has to propose mitigation measures to those impacts. The City has made changes and has complemented urban regulations in order to make easier the establishing and operation of transport and infrastructure facilities.

  Mitigations have to include territorial actions and shared manage with private contributions in order to get related services implementation, which have to respect urban preexistences and land calling.

- Projects have to be developed considering articulation between transportation systems, urban planning and land uses as a strategy to consolidate territorial organization and to create and capture taxes and to provide incentives to private-public participations (PPP).

- Projects have to include definition of land areas required for each kind of facilities to get an optimal operation and identification of necessary zones to future expansion of the network and of each facility.
- Projects have to include identification of manage schemes which make possible private contributions to develop them.

Briefly, projects of transportation and infrastructure facilities have to be involved in a systematic vision or network vision that allow its complementarity, optimization and articulation, in order to get an efficient land utilization and economies of scale. Facilities can´t be seen as an isolated project regarding location, scale and specifications.

This way, District authorities are looking forward location and establishing of facilities be an urban opportunity that help to consolidate territorial planning through articulation and coordination between land uses, increases in values (include collection for the City), private-public participations (PPP) and environmental and social aspects, with transportation systems.

Based on described premises, Bogotá has been working in different processes as the next showed:

- Terminals or Main Stations (SITP)
- Stops (SITP)
- Central Station (Phase III – TransMilenio System)
- North Satellite Terminal (Terminal of Short distance Intercity Buses)
- "El Pedregal" Intermediate Station - Carrera 7 por Calle 100 (Phase III – TransMilenio System)
- "1ª de Mayo" Intermediate Station (Phase III – TransMilenio System)
- Modal Interchangers Network

6 RECOMMENDATIONS

- Although, Bogotá and TRANSMILENIO S.A. got good results with the implementation of TransMilenio; they must continue improving the planning process looking for better integration with land use and other transport modes.
- Bogotá require improving the institutional coordination in order to exploit some opportunities that have been identified. Leadership and political decisions are necessary.
- It's important that the other cities in Colombia continue the actualization of their cadaster systems. Application of tools for funding mass transportation systems depends on that information.
- It's important that Colombia and its cities continue exploring integration opportunities and tools for funding mass transportation systems. The application of these depends on each one.

7 CONCLUSIONS

- Bogotá has one of the most famous BRT's in Latin America. TransMilenio brought many positive changes to the city. Nonetheless, it is necessary to find additional funds for maintenance and further development.
- Integrated Urban Planning is the best mechanism to achieve sustainability. It's very important that local governments integrate land use planning with public transport strategies and different policies, plans and programs for the cities.
- There are several tools for funding mass transportation systems. The application of those depends on the situation in each city. Taxing and private-public partnerships are good options to get additional funds for maintenance and further development of transport systems. Integration between different transport modes provides good opportunities to use some of those tools.
- The public transport infrastructure is a responsibility of the government (Mendoza, 2005), but transit projects generate revenues in different markets. The improved accessibility is capitalized through increasing land values (Cervero & Duncan, 2001).

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