Office of Evaluation and Oversight

Comparative Case Studies of Three IDB-supported Urban Transport Projects

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Bus rapid transit (BRT) systems have become an increasingly popular approach to addressing mobility and environmental problems in urban areas in Latin America and around the world. In line with this trend, the IDB's support for BRT projects as well as other urban transport in Latin America and the Caribbean has grown rapidly in recent years: the annual lending volume for the urban transport sector grew by 36% from 2005 to 2012, to account for more than 20% of the transport sector lending portfolio. BRT systems represented roughly half of all IDB mass transit projects. These projects typically aim to increase overall mobility while also reducing negative externalities such as traffic accidents and emissions of local and global pollutants; in addition, they often seek to improve mobility and access to jobs, goods, and services for the poor. This evaluation presents lessons learned from OVE's in-depth comparative case studies of three IDB-funded BRT projects –in Lima, Cali, and Montevideo– and makes suggestions to inform future IDB support for urban transport projects.

Lima's system garnered the highest travel-time savings and corridor-level emissions reductions of the three cases. Cali's system also provided several benefits, including substantial travel-time savings for trips along the trunk lines and had a much wider impact on emissions reductions in the city because of its ambitious scale and more successful bus scrapping program. In addition, important improvements to public spaces were part of both the Cali and Lima projects. In Montevideo, because of poor design and corridor choice, as well as a lack of institutional and bus sector reforms, the system realized few if any mobility or environmental objectives; however, passengers benefited from improved sidewalks, a new electronic fare card system, integrated tariffs, and a system enabling passengers to access information on the best route combination from any origin to any destination in the city. Although all three projects had explicit or implicit objectives of improving mobility for the poor, little or no diagnosis of mobility needs of the poor was conducted by the client or the IDB to inform their design. In Lima and Cali the poor are using the traditional bus service at higher rates than the BRT system, citing a lack of service coverage, slow service, and long lines as barriers. This was not measured in Montevideo. The projects generated some positive land use developments; however, none incorporated a transit-oriented development (TOD) strategy in their design. Although TOD strategies would have required a high degree of inter-institutional coordination and management of complex factors, if incorporated they could have not only supported the project's objectives of improving mobility and increasing transit ridership, but served as a potential source of additional revenue to the system through land value capture mechanisms.

OVE makes several suggestions for future IDB support for such projects: (1) offer increased support and technical assistance for the necessary reforms (PPPs, fleet modernization, institutional frameworks, station design, among others) to support BRT infrastructure and garner strong political buy-in of key stakeholders for such reforms early on; (2) deepen the diagnosis of mobility needs of the poor to inform project design; (3) support LAC governments in considering subsidization of BRT system operational costs and innovative financing mechanisms; (4) incorporate TOD planning around BRT stations, and (5) integrate other innovative, demand responsive public transit modes as complements to BRT systems in lower demand corridors.

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This evaluation was prepared by a team led by Lynn Scholl and including Alejandro Guerrero, Oscar Quintanilla, Margareth Celse L'Hoste, and Patricia Sadeghi, under the general direction of Cheryl Gray. The background papers on the emissions impacts of the BRT projects were prepared by Magdalena Fandiño and Joanne Green with the Clean Air Institute (Lima and Cali cases) and Juan Pablo Bocarejo (Montevideo case). The team is grateful to Gerhard Menckhoff, who served as an expert peer reviewer and was part of the team during the mission to Montevideo. Daniel Oviedo and Juan Pablo Bocarejo provided inputs on the poverty analyses for the Lima and Cali cases. The poverty analysis for Lima was based upon excellent survey work by Grupo Limonta, Lima, Peru. The team is also thankful to Target Empirica for the social media analysis performed for the Cali case. The team is grateful to Cesar Bouillón for his guidance on the poverty analysis and to Alejandro Palomino for excellent data analysis and graphics support. Numerous colleagues gave very helpful feedback on earlier drafts of the report, including Cesar Bouillón, Jose Claudio Linhares Pires, Hector Valdes Conroy, Michelle Fryer, Agustina Schijman, Saleema Vellani, David Suarez, Juan Manuel Puerta, and Roland Michelitsch. The team sincerely thanks numerous government officials and members of civil society in Lima (Peru), Cali and Bogota (Colombia), and Montevideo (Uruguay). Our gratitude also goes to IDB Transport Division staff who provided very valuable information and support to the case studies, including Esteban Diaz, Elias Rubinstein, Andrés Pereyra, Miroslava Nevo, Ana Maria Pinto Ayala, Rafael Acevedo, and Rafael Capristán.

ABBREVIATIONS AND ACRONYMS

BRT	Bus rapid transit
CAF	Corporacion Andina de Fomento
CO_2	Carbon dioxide
CDM	Clean Development Mechanism
CNG	Compressed natural gas
COFIDE	Corporación Financiera de Desarrollo
GCI-9	Ninth General Capital Increase
GPS	Global positioning system
IEA	International Energy Agency
IDB	Inter-American Development Bank
ITS	Information technology software
IMM	Intendencia Municipal de Montevideo
ITDP	Institute for Transportation and Development Policy
LAC	Latin America and the Caribbean
MIO	Masivo Integrado de Occidente
NGO	Nongovernmental organization
OECD	Organisation for Economic Co-ordination and Development
OECD-DAC	Organisation for Economic Coordination and Development –Development Assistance Committee
OVE	Office of Evaluation and Oversight
PCR	Program Completion Report
$PM_{2.5}$	Particulate matter 2.5
PPHD	Passengers per direction per hour
PPP	Public-private partnership
SO_x	Sulfur oxides
TC	Technical cooperation
TOD	Transit-oriented development
WHO	World Health Organization

EXECUTIVE SUMMARY

High rates of urbanization and motorization, in combination with underinvestment in transport infrastructure and inadequate urban planning, have put enormous pressure on urban roadways in Latin America and the Caribbean (LAC), resulting high levels of congestion, air pollution, traffic accidents, and overall low mobility. In response, several LAC cities have begun to prioritize investments in public transit infrastructure over traditional approaches of widening and expanding roads and highways. Bus rapid transit (BRT) systems, designed to operate at capacities at or near those of metro systems, have grown rapidly as a lower-cost alternative to rail-based transit. These investments have typically been coupled with institutional and policy reforms aimed at re-regulating public transportation provision through a mix of centralized planning and public-private partnerships. They have been especially attractive to cash-constrained developing countries on the premise that their operational costs can be covered by fare revenues.

The urban transport portfolio of the Inter-American Development Bank (IDB, or the Bank) has risen alongside these trends –from just 17% of the transport portfolio in 2000-2004 to 33% in 2009-2013– with roughly half of the mass transit projects devoted to BRT systems. The Bank's support for BRT systems and for sustainable urban transport generally, is likely to become increasingly important in the coming decade because of several institutional strategies and commitments to support sustainable urban transport systems: the GCI-9 Agreement, the Sustainable Transport Action Plan, the Sustainable Cities Program, and the Rio+20 Commitments.

This evaluation, the first evaluation of IDB's support for such projects, seeks to inform such future urban transport operations. From among the 17 urban transport projects approved between 2000 and 2012, OVE chose to study three of the four cases of completed BRT systems funded by the Bank, those in Lima, Cali, and Montevideo. OVE used a mix of quantitative and qualitative evaluation methods to derive lessons learned from project design and implementation and assess the extent to which the projects were able to achieve key objectives –including (i) improving transit system performance, (ii) improving mobility and travel times, particularly for the poor, and (iii) reducing local and global pollution– and identify the factors that contributed to each project's successes and challenges.

Overall, the urban transport projects were highly relevant to the cities' mobility problems and resulted in several important and positive outcomes, including increased mobility and lower emissions in Cali and Lima; however, in Montevideo the suboptimal choice of corridors, designs flaws, and political economy issues that impeded planned reforms undermined the project's intended outcomes Cali's system sought to comprehensively reform nearly 100% of the urban transport system, while in Lima and Montevideo, single corridors were chosen. The success of Lima's system stood out, garnering the highest travel-time savings of the three cases. While Lima's system included feeders, it still lacks integration with other public transit modes in the city. Cali's system also provided substantial travel-time savings for trips along the trunk lines and had a much wider impact because of its ambitious scale. In addition, important improvements to public spaces in Cali in particular, but also to some extent in

Lima were made that benefited the populations. In Montevideo, because of a poor design and corridor choice, as well as a lack of bus sector reforms related to a combination of institutional, policy and political-economy issues, few if any mobility or environmental benefits were realized; however, passengers benefited from improved sidewalks, a new electronic fare card system, integrated tariffs, and an internet based information system enabling passengers to get advice on the best route combination from any origin to any destination in the city.

The choice of corridors had a strong influence on the degree of mobility benefits derived from the dedicated busways. In Lima and Cali, dedicated busways were appropriately placed in corridors with high public transport demand and congestion, where buses operating in mixed traffic experienced significant delays. In Montevideo, the dedicated corridors were considered lower-risk demonstration projects, so they were located in relatively uncongested avenues where negative construction impacts would be lower, but where they could potentially benefit low-income residents. However, key operational reforms were not implemented because of the weak institutional and technical capacity of the municipality and failure of negotiations with incumbent, consolidated, and well-organized bus companies. As a result, any benefit of the busway was seriously reduced. In future years, as the city grows, the segregated busway may provide an increased benefit in terms of reducing congestion delays, particularly if other supporting measures and design improvements are made to the system.

The projects had important explicit or implicit objectives of improving mobility for the poor, which in turn had potential to foster economic development. However, although several of the corridors and/or feeders were placed in or near low-income or poor neighborhoods, little or no diagnoses of mobility needs of the poor were conducted to inform the projects' design. In Cali and Lima, low-income and poor people who live near the BRT routes still use the traditional bus system more than they do the BRT system, suggesting that while the BRT systems served some of their mobility needs, the traditional systems, which have different fares and service characteristics, are still meeting a greater portion of these needs. In Lima, the most often-cited barrier to using the BRT system or its feeders was a lack of service to their destinations, indicating a need for deeper analysis of mobility patterns in order to achieve pro-poor objectives. In Cali, a growing share of the poor are using the BRT system; however, poor service quality in comparison to the traditional bus service was the top stated reason for not using the system among non-BRT users from lower socio-economic strata who live near the service, indicating room for improvement of system characteristics with respect to pro-poor objectives. The evaluation also identified gaps in coverage of the BRT system feeders, particularly where buses cannot reach into steep hilly areas.

In addition, the widespread policy in LAC countries that BRT systems are financially self-sustaining, combined with a flat fare structure, implies that, at least for shorter trips, the fares may be less affordable than traditional buses with distance-based tariffs (Lima). However, for longer trips with multiple transfers, the integrated flat tariff (providing free or reduced priced transfers) increases affordability. The evaluation found that in Cali the BRT was in fact slightly more affordable than the traditional sector, while in Lima the monetary cost per trip in the traditional bus sector was lower. Subsidies provided through vouchers to the poor are more efficient than those targeted at fares generally; however, lower fares may serve also to promote usage by all user groups and encourage more environmentally sustainable mode choices among non-captive public transit users. Another argument for subsidizing BRT systems is their public benefits in reduced pollution and congestion and the need to counter-balance implicit subsidies toward non-sustainable forms of passenger transport such as private automobiles.

Weakness in the design and implementation of complementary measures to support the infrastructure investments–such as public-private partnership (PPP) contracts pedestrian planning, and bus scrapping programs –presented risks that were realized to varying extents in each of the cases and that hampered the achievement of expected project benefits. These project components could have benefited from increased Bank involvement and support during design, implementation and operational phases. Although some land developments around the corridors were realized, none of the projects included transit-oriented development (TOD) strategies in their design. While these components could increase project complexity and require increased inter-institutional coordination, they could not only support increased ridership over time, but also potentially enhance revenue through innovative financing schemes such as land value capture.

The implementation of the urban transport projects required coordination and buy-in among numerous institutions and stakeholders, and were influenced by a myriad of factors including the project design, and institutional, policy, and political-economy contexts. In two of the projects, cost overruns and delays compromised important components, such as institutional strengthening and services to retrain displaced bus drivers for new occupations and place them in jobs. On the other hand, delays sometimes presented opportunities for improvements in project design, such as the use of natural gas buses in Lima. Cost overruns were also related to requests by municipalities for additional infrastructure that enhanced the projects - an underground station that enabled a thriving mall development in Lima and increased public spaces in Cali being two examples. In all three cities, difficulties in reforming the existing bus sector resulted in incomplete implementation of some project components, compromising project results.

Achievement of environmental objectives was hindered by slow implementation of programs to scrap polluting buses, incomplete reforms of the bus sector, lower-than-expected ridership, and increasing private vehicle ownership. Lima's fuels and vehicle choices benefited from a Bank-supported technical cooperation, enabling substantial corridor-level emissions reductions. However, numerous old polluting buses remain in operation in the initial years of the program. In Cali, while the large scale of the project implied the greatest emissions benefits, the resurgence of informal buses could threaten to dampen these emissions benefits. Finally, in Montevideo, failed dialogue with bus companies thwarted the planned bus fleet modernization, and poor intersection engineering has resulted in reduced operational efficiency and little to no reduction in emissions.

Finally, the systems in Cali and Lima are facing financial sustainability issues, as are many other BRT systems across the LAC region. The increasing demands placed on such systems in terms of scale and quality, and the significant public benefits such systems can bring when well designed, implemented and maintained, calls for a reexamination of assumptions of cost recovery and consideration of operational subsidies.

OVE makes several suggestions for future Bank-supported urban transport projects centered on BRT systems.

1. **The Bank should support municipalities in choosing appropriate corridors for BRT systems.**

   - Corridors with low demand and congestion stand to benefit little from an exclusive dedicated busway, particularly absent the implementation of other necessary reforms in support of the system such as government supported land use policies that would shape land use around corridors to increase demand (such as in the case of Curitiba). BRT corridors should be selected based upon three basic criteria: (i) high public transit demand, (ii) ability to connect major activity centers to support the demand, and (iii) existing or predicted near-term levels of congestion that create significant bus service delays. The Bank should continue its efforts through TCs or other mechanisms to support the development of urban transport plans, ideally in coordination with land use planning, to inform corridor choices.

   - When considering pilot BRT systems on relatively minor corridors (in terms of demand and levels of congestion), the risk of negative impacts during construction should be carefully weighed against the likelihood that other institutional reforms that are necessary for bus system improvements will be implemented. Corridors lacking congestion should be avoided altogether and may be better candidates for other bus system improvement measures (e.g. improving stop spacing, bus arrival information systems, providing signal priority at intersections, among others). This requires generating buy-in on the part of key stakeholders, especially the bus consortia, through early and ongoing dialogue.

2. **The Bank should offer increased support and technical assistance during loan preparation and implementation for the necessary complementary reforms (e.g. route-restructuring, station designs, fleet modernization, inter-modal integration, institutional frameworks, PPP arrangements among others) and engage in dialogue to foster sustained and strong political buy-in of key stakeholders early on.**

   - During project preparation, design and implementation, the Bank should take steps to improve the likelihood that local governments will implement important supporting measures based upon sound technical analyses and best practice guidelines, providing incentives and possibly conditions on loan disbursements for critical components. Although difficult to legally enforce, conditions can serve as points of discussion during supervision missions. Agreement can be fostered through dialogue with the client that engenders mutual understanding of the importance of such measures for project success. In addition, the Bank should promote a dialogue among key stakeholders- such as the executing agencies and incumbent bus operators- to help garner consensus on needed sector reforms.

- PPP models have been widely utilized in LAC, with varying success in terms of bus service quality and financial sustainability, calling for a re-examination of the PPP model and possibly increased government participation. Where a PPP model is utilized, project teams should provide technical assistance that includes analyses of the risk of demand shortfalls and mitigation measures and the inclusion of well aligned incentives between governing entities and private bus operators to provide ongoing high-quality bus service, possibly in collaboration with the Bank's private sector arms. PPP contracts should be flexible enough to allow necessary adjustments to changing conditions that might affect service after operations begin.
- The Bank should provide increased assistance for cost-effectiveness and alternatives analyses of fuels and bus technologies (as in Lima). This support should give careful consideration to the design of compensation schemes and economic incentives for fleet renewal (to facilitate vehicle scrapping and to spur bus companies to invest in low-emissions vehicles).
- The design (size, layout, and access and egress points) and placement of stations should be adequate to handle peak passenger flows; provide a comfortable, weather-protected environment for passengers; allow level boarding; and enable efficient bus flows. This requires adequate demand forecasts at the station level and well-designed pedestrian planning to support a rational distribution of the passengers among and within stations. Stations should also provide adequate, clear, and accessible user information on bus routes and arrival times that is legible to all user groups. Stations and the system as a whole should be designed to integrate well with other environmentally sustainable modes and existing public transit systems. Implementing off-board fare payment systems with sufficient, well-placed kiosks for recharging cards is important to reducing delays associated with passengers boarding, station congestion, fare revenue loss, and passenger delays due to long lines to charge fare cards.
- Projects should include robust institutional and technical capacity-building components that are protected from potential infrastructure cost over-runs and that increase executing agencies' ability to effectively oversee, manage, and update route planning over time in response to changing demand patterns. In addition, clients may benefit from more technical advice in the initial BRT operational phase with issues such as scheduling, bus operations, and over-crowding.

3. **Given the two-way interaction between transport supply and land development, urban planning should be carried out in an integrated manner and involve inter-institutional coordination between both transportation and planning agencies.** To this end, the Bank should support ridership and access to stations by environmentally sustainable modes, and work to integrate BRT systems with land use planning, such as through transit-oriented development (TOD), especially in medium-sized and growing cities. This could be fostered through increased collaboration between the urban development and transport divisions of the bank, technical assistance and grants for transit-oriented land use planning

around corridors (including zoning and design of incentives to increase density and mixed uses), and a long-term programmatic approach in cities.

4. **Urban transport projects should incorporate components for well-designed pedestrian and bikeway facilities connecting to BRT and mass transit systems**. Systems should be integrated with surrounding public transit modes (e.g. restructured route systems) as well as non-motorized modes. Pedestrian facilities should be planned to enable safe and comfortable access to and around stations for all user groups, including the disabled, elderly, and children. In particular, studies of high-demand areas for pedestrian crossings should be conducted to avoid unintended barrier effects created by the busway. Bikeway facilities that are part of an inter-connected network are more likely to be utilized than those that are fragmented.

5. **The inclusion of objectives and specific components to improve access and mobility for the poor in the Bank's urban transportation programs is essential to the Bank's mission of economic development and poverty reduction.** To this end, the Bank should deepen its diagnosis of mobility needs of low-income populations to inform project design, including analyses of issues around access, spatial mismatches between skill-appropriate jobs and housing, travel patterns, and affordability. This is relevant both from a safeguards point of view –projects that seek to radically reform the informal bus sector should be careful to avoid unintended negative impacts on mobility for the poor– and for projects with explicit objectives of improving transit for the poor. To improve mitigation measures for displaced bus drivers, the Bank should enhance social safeguards components and protect their funding from potential infrastructure cost overruns.

6. **The Bank should support LAC governments in considering whether to subsidize BRT system operational costs and the use of innovative financing mechanisms to ensure long-run financial sustainability and affordability.**
    - Such subsidies can be efficient and welfare-enhancing when designed to provide incentives for high-quality service (i.e., targeted subsidies conditioned on service quality measures). To improve affordability for the poor, targeted vouchers may be more effective, however, lower fares may serve also to promote usage by all user groups and encourage more environmentally sustainable mode choices among non-captive public transit users.
    - Land value capture mechanisms, while requiring inter-institutional coordination, could be a significant source of revenue under specific conditions –e.g. land value increases resulting from transit investments and well-designed tax and levy instruments -and has the potential to significantly improve the long-term financial sustainability of urban transportation projects**.** Payroll taxes earmarked for transit (as used in France), are another public transit finance mechanism that could be considered.

7. **As complements to BRT systems, future urban transport projects, should seek to integrate other innovative public transit reforms that incorporate**

incumbent private bus operators (e.g., *colectivos*, mini-vans, paratransit). Such operators have traditionally filled the gaps in centrally planned public transport systems, and/or in a context of deregulation, offering flexible and demand-responsive services, but often with several negative side effects such as pollution, high accident rates, or gaps in coverage. Appropriate strategies could include regulatory reforms to mitigate these negative effects (e.g., emissions control standards, safety and vehicle standards) while harnessing and improving the mobility benefits. Traditional *colectivos* that operate informally and according to demand (formally known as paratransit) can fill an important role in cities' peripheral areas, serving as both feeders to BRT systems along high-demand corridors and complementary services in lower-demand corridors; they should be integrated in such reforms rather than treated solely as threats to viability. The use of modern ITS technology (e.g. GPS, Internet, and mobile phones) makes possible innovative business and regulatory models in which oversupply and aggressive driving behaviors could be monitored and controlled. This might be implemented in collaboration with the Bank's private sector windows.

I. CONTEXT AND MOTIVATION

1.1 **An efficient and well-functioning urban transportation system is critical to cities' economic vitality, development, and overall competiveness.** It provides residents with mobility and access to jobs and services and, by lowering transport costs, increases the productivity of firms. Moreover, by affecting transport costs, the quality of transport infrastructure and services has a high degree of influence on the location decisions of residents and firms, and thus on urban spatial patterns and development. Urban transport systems also have social implications: more efficient and inclusive systems can provide the poor with more affordable mobility and access, potentially reducing poverty and inequality.

1.2 **The Latin America and Caribbean (LAC) region has experienced growing urbanization and motorization during recent decades, generating large mobility challenges and negative externalities such as high rates of congestion, pollution, and traffic accidents.** Urbanization rates in LAC countries have risen from just 50% in 1970 to 80% in 2013 (United Nations, 2011). In addition, rising incomes have contributed to a surge in vehicle ownership rates in the past two decades, with the average per capita auto ownership rate for 10 LAC countries grew from 0.09 in 1990 to 0.20 by 2008. Growth in motorcycle ownership has surpassed that of autos in many cities, where motorcycles make up 10-49% of the vehicle fleet. Overall motorization rates are expected to more than double by the year 2030 (relative to 2002). Public transit accounts for a significant share of passenger travel in LAC cities–approximately 43% of trips (CAF-OMU, 2007). However, as a result of widespread privatization and deregulation in the 1980s and '90s, in many countries the sector is characterized by an over-supply of numerous small private operators that operate informally in aging and highly polluting vehicles and compete fiercely for passengers (also known the "penny war"), contributing to unsafe conditions and compounding levels of congestion and pollution in urban areas (WHO, 2004).

1.3 **Road safety is a pressing problem in LAC countries.** Approximately 142,000 people die annually in LAC of injuries incurred in road traffic accidents, and 5 million people are injured, with the highest prevalence in countries of low and medium economic development.[1] About half of the victims are among the poorer and most vulnerable road users: pedestrians, cyclists, users of motorized two-wheelers, and occupants of buses and minibuses.

1.4 **Urban transport is also the largest source of air and noise pollution in LAC cities.** Air pollution levels in many cities exceed WHO guidelines for major pollutants.[2] In 2007 the estimated costs of ground-transport-related local air pollution in 15 major metropolitan areas in LAC ranged from US$32 million

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1 The LAC Region reported an average rate of 17.5 fatalities per 100,000 inhabitants, compared to 9.1 deaths per 100,000 inhabitants for the United States and Canada (World Health Organization, 2009).

2 Sources: UN-Habitat, 2012; Major local pollutants include NO_2, SO_2, $PM_{2.5}$, PM_{10}, and O_3.

(Montevideo) to US$1,201 million (Mexico City).[3] Although CO_2 emissions from LAC urban transport are small relative to those of OECD countries in per capita terms, the share of energy-related CO_2 emissions in urban areas from the transport sector in LAC is 38%[4] (29% of the total from transport in LAC).[5] Given current trends, by 2050 the Region's emissions from transport are likely to increase by 80% (IEA, 2009).

1.5 **Disparities in the distribution of the costs and benefits of transportation systems contribute to and reinforce LAC's already high inequality.** Low-income populations often bear the highest transportation-related burdens, including higher exposure to pollution and risk of traffic accidents. Lack of access to affordable and efficient transport generates social exclusion, impeding access to employment opportunities, services, and markets. Poor people often live on the periphery of cities and must travel long distances to reach jobs and services in the center; thus they tend to have the longest travel times and incur more transfers.[6] While they incur long travel times to the central business districts (CBD) many take trips to more dispersed locations outside of the CBD. Moreover, women tend to make more off-peak trips, travel to disperse locations, not necessarily located in the central business district, and trip chain more often; thus they rely on informal, demand responsive, and door-to-door services (GTZ, 2007).

1.6 **A range of strategies can be used to solve urban transportation problems.** For example, investments in new transport infrastructure can be accompanied by demand-side management measures to increase the efficiency of the use of existing road space, increase access to and efficiency of transport by coordinating land use and transportation services, and reduce emissions and transport-related accidents by improving vehicle technology and shifting travel to collective modes. Given the negative externalities associated with increasing motorization, several LAC cities have begun to re-regulate the sector and to prioritize investments in public transit infrastructure over traditional approaches of widening and expanding roads and highways. Best practice calls for an integrated multimodal transportation and land use planning approach that prioritizes investments in physical infrastructure and system design through a comprehensive long-range vision based on stakeholder input and sound technical, policy, and financial analysis (Also see Annex).

A. Bus rapid transit systems

1.7 **Due to their significantly lower costs when compared with rail-based public transit systems, several LAC cities have turned to bus-based rapid transit systems (BRT).** BRT systems have been especially attractive to cash-constrained developing countries on the premise that their operational costs can be sustained

3 Average annual costs for the cities –Ciudad de México, São Paulo, Buenos Aires, Lima, Río de Janeiro, Bogotá, Guadalajara, Caracas, Porto Alegre, Belo Horizonte, Curitiba, San José, Santiago, León, and Montevideo– were US$304 million (CAF, 2009).

4 Significantly higher than the worldwide average share from all transport of 25% (IEA, 2009).

5 Vergara et al., 2013.

6 In Bogota, for example. In addition, in some cities poor people walk an average of 5 km per day (Ardila-Gomez, 2012).

through fare revenues. Designed to emulate several features of rail-based systems, BRT systems tend to have significantly lower capital and operating costs and much shorter start-up times on average vis-à-vis rail based systems**.**[7] The first BRT system began in Curitiba in the late 1970s, when municipal budget constraints halted plans for a light rail system. The success of Curitiba's system gave rise to the development of BRT systems across LAC: more than 45 cities have invested in such systems, and many more are planned for the near future (Rodriquez and Tovar, 2013) in 11 LAC countries.[8] While in some countries (e.g., Brazil) BRT systems date back to the 1970s, most of the projects were developed in the 2000s (e.g., Bogotá's *Transmilenio*; see Box 1.1).

1.8 **If well designed, BRT systems can achieve significantly higher average speeds and capacities than conventional bus systems.** Average speeds of BRT systems in LAC cities range from 18 to 28 km/hour (compared with 7-14 km/hour for a conventional bus). Bogotá's *Transmilenio* system was the first to reach operational productivity levels[9] equivalent to a metro.[10]

1.9 **BRT systems also have been found to reduce emissions of local and global pollutants as well as traffic accidents.[11]** Bogotá's *Sistema Integrado de Transporte Público* reduced emissions of particulate matter ($PM_{2.5}$) by approximately 74% per passenger trip and of CO_2 by 20%. A study on Mexico City's first BRT line found a reduction in CO_2 emissions of 10% in the corridor, due to modal shifts from private cars to the BRT, improvements in bus emissions and energy standards, and the general increased energy efficiency of travel in the corridor (Schipper et al., 2009). BRT systems can improve traffic safety through associated improvements in street geometry and design (e.g., inclusion of medians that serve as points of pedestrian refuge and reductions in left-hand turns), driver training and monitoring (through control centers and GPS), and improvements to

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7 Capital costs range from US$2.4-3.5 million/km for the BRT systems developed in Curitiba, Mexico City, or Guayaquil (minor physical improvements) to US$3.8-12.5 million/km for those in Bogotá or Pereira (for instance, because of the reconstruction of corridor roadways) (Carrigan, et al, 2013).

8 Argentina, Brazil, Chile, Colombia, Ecuador, Guatemala, Mexico, Panama, Peru, Uruguay, and Venezuela, according to the Global BRT Database http://www.brtdata.org/.

9 Operational productivity is defined as the number of passengers carried per lane per direction per hour on the system.

10 Bogota's *Transmilenio* carries 40,000 passengers per direction per hour (equal to the operational carrying capacity of a metro) at a commercial speed of 28 km/h (Hildago and Carrigan, 2010).

11 Key elements that reduce emissions include: (i) increasing energy efficiency through improved vehicle flows through the provision of priority infrastructure and traffic signal design, (ii) reducing and/or replacing the large number of minibuses and small buses with fewer large buses in cases of over-supply of such vehicles, (iii) optimization of routes to reduce bus kilometers per passenger trip, (iv) inducing modal shifts away from private motorized modes to public transit, and (v) improving transit vehicle technology and fuels.

the organization and flow of traffic (Duduta, et al, 2012), reducing fatality rates on average by 52%.[12]

1.10 **BRT systems can have some unintended negative side effects in the absence of adequate integrated planning measures.** For example**,** poor traffic planning and lack of adequate design for pedestrians or intersections can exacerbate traffic congestion and crashes or shift them to nearby streets or particular intersections and can create barrier effects. Since poorer people often live on the peripheries of urban areas, the benefits of BRT systems for the lowest-income groups may be lower than expected if well designed feeders and complementary bus systems are not included. Moreover, in the absence of fare integration (enabling free transfers), fares on BRT systems may be unaffordable.[13] In some cases, route restructuring, while improving bus operation efficiency, can result in increased transfers, which tend to be unpopular with transit users.

1.11 **With the growing popularity of BRT systems, a wide variety of models have been implemented, with varying success in terms of objectives achieved and with significant debate about what constitutes best practices.** In 2010 the American Public Transportation Program published design guidelines on Bus Rapid Transit.[14] The recently created international standard for BRT systems (Institute for Transportation and Development Policy, 2013 and 2014) defines the basic elements a bus-based system must have to be considered a BRT.[15] The standard is based on a set of design and operational elements that have been found in practice to improve operational speeds and service quality. These elements minimize conflicts with mixed traffic, delays at intersections, and boarding and alighting times of passengers, and facilitate access for disabled passengers and passengers with strollers or shopping carts. According to the standard, five basic elements are required for a system to qualify as a BRT system: (i) center busway alignment, (ii) dedicated right of way, (iii) intersection treatments, (iv) off-board fare collection, and (v) level platform boarding.[16] It also provides guidelines for several key system dimensions: corridor choice, intersection treatments, service planning, and station and infrastructure.

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12 The construction of dedicated BRT lanes and of sound infrastructure (secured pedestrian crossings, guardrails, intersections, station access, and platform boarding), and the consolidation and formalization of numerous bus operators engaging in aggressive driving behaviors are key design features to improve safety (Duduta et al, 2012).

13 A study of Bogota's *Transmilenio*, for example, found that while all income groups benefited from decreased travel times on the system, in some cases the transit fares and the distances between low-income neighborhoods and employment centers presented barriers to access for the lowest-income groups (Bocarejo and Oviedo, 2012).

14 http://www.apta.com/resources/standards/Documents/APTA-BTS-BRT-RP-003-10.pdf

15 https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/about-the-brt-standard/

16 Aligning busways in road medians is considered the most effective way to reduce traffic conflicts and improve operating speed. In addition, for reasons of both safety and operational efficiency, intersections should be designed to give priority to buses and minimize conflicts with turning traffic. Finally, level boarding and off-board payment systems delays due to passenger alighting and boarding time.

1.12 **Some contexts may limit the extent to which all recommended BRT elements can be implemented and may also affect the degree of relevance of particular design features (i.e. passing lanes at stations may not be warranted at bus volumes less than 20-30 per hour).** In such cases, it is important to identify the key operational features needed to attain travel time improvements to justify investment costs given the particular features of a corridor.[17] As BRT systems are relatively new transit technology (compared to metros[18] for example), the international standard for BRT systems is likely to continue evolving as more systems are studied and best practices in certain contexts are better understood.[19]

1.13 **The introduction of BRT systems is often coupled with measures to improve the efficiency of the wider public transportation system network.** Common measures involve replacing a variety of transportation services by a single operation agency under a public-private partnership (PPP) arrangement, renovating aging public transport vehicle fleets, setting common standards for drivers and vehicle maintenance, establishing an integrated fare system, and improving feeder bus systems. Although business models can vary by region, a common BRT business model used in LAC cities includes three components managed by one public agency: (i) the infrastructure, (ii) the bus operations, and (iii) the fare collection. Under this model, all three components are purchased through competitive bidding; the first is fully paid for by the government, but the last two entail service provision agreements in which some risks are shared with the private sector, and they are paid in part, or in full, from the revenues generated by the project (ITDP, 2007). In this model, the role of the public sector is to ensure that service responds to local objectives and that the private sector has the incentives to improve cost-efficiency and provide high-quality service. Alternative models include those in which the public sector has an increased role or in which services are completely publicly owned and operated.[20] A range of system approaches have been implemented in LAC, from single isolated corridors, to planned incremental reform of the entire system in stages, to large scale reorganization of entire systems at once (Santiago, Chile).

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17 The basic BRT criteria provides guidance on this, however, there are some particular cases, such as the bus system corridor on Avenida de 9 de Julio in Buenos Aires, an innovative set of BRT system elements was employed with positive outcomes.

18 BRTs came on the scene about 40 years ago. In comparison, the first metro was implemented in London around 147 years ago, in 1863 (Day and Reed, 2010).

19 The basic BRT criteria provides guidance on this, however, there are some particular cases, such as the bus system corridor on Avenida 9 de Julio in Buenos Aires, an innovative set of BRT system elements was employed with positive outcomes.

20 In fact, Gomez-Ibanez and Meyer (1993) have observed a cycle of privatization and regulation of bus service within countries. In the entrepreneurial stage, services are provided entirely by the private sector. Overtime as firms consolidate, governments move to regulate fares and grant franchises along routes. With pressure to keep fares low, in the case of rising incomes and increased auto ownership, the profitability of firms decline and firms begin to operate on deteriorating capital and begin cutting back services. The government moves in to subsidize service and take over failing companies; however subsidies often are followed by increased costs, through higher public wages and unionization. Declines in productivity, and subsequently ridership, in turn, lead to calls for re-privatization.

1.14 **BRT systems have encountered several glitches during implementation (Hildago, et al, 2007).** A lack of government funding has hindered the prioritization of planning and feasibility studies. In addition, several systems have suffered from design issues related to rushed implementation, many of which were then solved in the first months of operation. In many cases, the systems implementation have encountered infrastructure and fare collection system delays, contractual problems, a lack or delay in driver training and user education on the new system, and protests by displaced transport operators (e.g. Quito, Bogota, Santiago). During operations, while users have enjoyed reduced travel times, a common issue has been overcrowding in peak hours, pavement maintenance (due to poor materials or construction), and quick deterioration of barriers for bus.

Box 1.1. BRT systems in Curitiba and Bogotá

The city of Curitiba, Brazil, was the first to develop a BRT system (1977). Based on Curitiba's model, in the year 2000, the city of Bogota, built its BRT system, incorporating technological innovations that led to it achieving the highest capacities and speeds of any BRT system globally. In 1972, on the basis of the city's 1996 Master Plan, Curitiba built exclusive bus lanes and encouraged population densification through the use of coordinated mixed land use and high-density development along major transport corridors. The city built the first BRT system 1977; it consisted of 2 express lines and 8 trunk lines, and transported 54,000 passengers a day (CAF, 2011). It gradually expanded to 9 express lines, 33 trunk lines, and 34 integration terminals that together provide about 45% of the total trips in the city–the highest share in Latin America (Santos, 2011). The system later incorporated fare integration up to 30 km from the city, adopted bi-articulated buses with a capacity of 270 passengers (1992), and introduced a smart card system (2002). Today the system is organized around five main structural axes that are 81 km long; it provides service for about 510,000 passengers a day, and in some corridors the system reaches the capacity of 16,000 passengers an hour (Suzuki, Cervero, and Iuchi, 2013), a level comparable to rail-based systems.

The Bank supported the Transport System of Curitiba with loans in 1995 and 2004. In 1995 (Loan BR0209, US$120 million) the IDB supported the extension of the bus networks to improve service and to decrease congestion, including alleviating overcrowding on buses in the busiest corridor of the city, speeding up the boarding and off-loading of passengers, shortening travel times, paving and street lightning along bus routes, and the construction of sidewalks and bicycle paths. In 2004 the Bank supported the creation of the Linha Verde (Loan BR-0375, US$80 million), a new BRT corridor that transformed an old interstate highway that had divided the city into two parts. The new corridor also included 3 transfer terminals and 12 intermediate stations and measures to optimize the traffic signal system and road safety improvement. Although some of the components were modified in response to currency devaluation, the program successfully led to an increase in the number of BRT users, a 94% decrease in the number of accidents around the BRT corridors, and a 26% reduction in travel times; however, it failed to decrease travel times in stations and to increase the number of bus routes by 13% (PCR).

Drawing on and improving upon Curitiba's model, in 2000 the city of Bogotá built its ambitious BRT system, *Transmilenio*. *Transmilenio* spans the most important public transport axes of the city (Suzuki, Cervero, and Iuchi, 2013). The system is 112 km long, and includes feeder buses in the urban periphery and extensive bike and pedestrian paths. Related policy measures limit the use of cars and restrict car parking (EMBARQ, 2013). The system carries about 2.2 million passengers per day–the highest level achieved so far for BRT systems, with more than 45,000 passengers transported per hour per direction at peak load (in 2012)–and it has achieved important savings in travel time, operational cost, and emissions. It has been recognized as a gold standard BRT (Suzuki, Cervero, and Iuchi. 2013). However, the system has reached a saturation level: its services are not keeping up with demand, and the system is still not integrated with suburban buses. Service quality has declined, as has travel speed–down from 28 km/h in the main avenue to 23 km/h (2011) (Suzuki, Cervero, and Iuch,. 2013). The IDB is working with Bogotá (CO-T1146) to integrate the complementary and feeder buses into the BRT system.

1.15 **BRT projects thus require high levels of local technical capacity and strong coordination within and between local governments.** Institutional weaknesses inhibit the achievement and sustainability of project results in even the best-designed systems (Mitric et al., 2009; IEG, 2013). Three organizational shortcomings are often cited as affecting BRT performance: (i) loose coordination (organizational, inter-municipal) between key actors; (ii) weak governance arrangements regarding the BRT oversight agency; and (iii) deficiencies in the operational arrangements between public and private sector actors.[21]

1.16 **Finally, transit-oriented development (TOD), in which high-density mixed land use is developed around transit stations and corridors, has been shown to be important to supporting ridership on BRT systems and can also be a tool to foster economic development** (Rodriguez and Tovar, 2013). In Curitiba, for example, land use plans are strategically designed to bring a mix of retail, residential, and office development, and densities are graduated outward along the transit corridor (that is, higher densities are located near the corridor). The goal of this strategy is to generate more demand for transit trips and to balance travel demand spatially and temporally along the corridor to prevent transit vehicle bunching and increase cost-efficiency.[22] A BRT system should also fit within a city or metropolitan area's wider transportation and land use plan that includes a multi-modal approach, that integrates the system with major land uses, and other transport infrastructure, such as bikeway and pedestrian facilities and other public transit modes lanes (Also see Annex for an expanded literature review on urban transport, BRT models, and implementation experience).

B. IDB support for urban transport projects with BRT systems

1.17 **The IDB's support for urban transport projects has grown significantly in recent years, and nearly half of that support has gone toward BRT systems.** Average annual urban transport loan approvals grew from 16.5% (US$56.5 million) of total transport approvals in 2000-2004, to 33.2% (US$653.3 million) in 2009-2013 (see Annex). Between 2000 and 2014, IDB approved 35 loan operations for mass transit projects, of which 17 (49%) were for building or supporting BRT systems.[23] IDB has supported BRT projects in 12 different cities,[24] investing about US$1 billion in BRTs.[25] Most of these BRT projects have

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21 Including flaws in contract design for PPPs, tensions between rising operating costs and the politically sensitive fee-setting process, or weaknesses in oversight capacity by the BRT public agency.

22 The Arlington Corridor in Virginia is another example of this type of TOD strategy, Suzuki, et al, 2013.

23 The IDB also finances important improvements to urban infrastructure, including local roads and pedestrian facilities within loans for neighborhood upgrading and broader urban development projects.

24 IDB has approved BRT loan operations in small cities (Blumenau, São Bernardo do Campo, and Cascavel in Brazil), intermediate cities (Cali, Fortaleza, and Curitiba); medium-sized capital cities (San Salvador, Tegucigalpa, Montevideo, Brasilia, and Asunción); and one city of almost 10 million inhabitants (Lima).

25 This amount excludes loan operations that were cancelled or were not implemented after being approved, and it reflects only the amount invested in BRT-related components.

sought to (i) improve mobility and overall transport system efficiency, (ii) reduce pollution (both local and CO_2), and (iii) reduce the numbers of accidents. Some have also had the objectives of improving access to transport for the poor and supporting overall urban development.[26]

1.18 **IDB's support for BRT systems and for urban transport generally, is likely to become increasingly important in the coming decade.** The GCI-9 identifies increasing investments in sustainable transport alternatives in urban areas as a specific area for development within the Infrastructure for Competiveness and Social Welfare priority, one of five sector priorities for investments aimed at reducing poverty and inequality and promoting sustainable development in LAC and sets a lending target of 25% of the approvals to address Climate Change mitigation and adaptation. It also calls for IDB projects to promote social inclusion and reduce inequality. In addition, in the Rio+20 meetings, eight major multilateral development banks–including the IDB–committed to investing a total of US$175 billion over the next decade toward environmentally and socially sustainable transportation; the IDB portion of this commitment totals US$17.5 billion over the 10-year period.

II. EVALUATION OBJECTIVES AND METHODOLOGY

2.1 **This evaluation aims to identify lessons learned from Bank-supported integrated mass transit projects involving BRTs to inform future Bank operations**. The evaluation uses a mix of quantitative and qualitative methods to identify key factors that have affected the successes, challenges, and barriers to effective implementation of Bank-supported integrated urban transport systems, and to assess the extent to which the projects were able to achieve their key objectives of improving mobility and access for the general population and for low-income populations, and reducing local and global pollution and traffic accidents. The evaluation assesses the cases against the OECD-DAC criteria of *relevance*, *efficiency*, *effectiveness*, and *sustainability*. Box 2.1 presents the key evaluation questions.

2.2 **The team selected three BRT-related projects supported by the Bank.** The cases were selected according to four criteria: (i) projects that included a BRT system investment as one component; (ii) loan projects for urban transport infrastructure that were 75% or more disbursed; (iii) the BRT system is in service; and (iv) the projects were approved within the past 10 years. Of the four projects that met these criteria, three were selected for case study: Urban Transport in Lima (PE-0187), Cali Integrated Transit System (CO-L1001), and Montevideo

26 Many Bank-financed urban public transit systems have been complemented with a range of measures to support the transit system's ridership and efficiency and the achievement of environmental and social goals –for example, infrastructure for bicyclists and pedestrians and major reorganization of the private bus sector. In some cases financing is also provided for scrapping of old polluting buses, fare policy restructuring, institutional strengthening, and land use planning.

Urban Transportation Program (UR-L1025).[27] For each case, OVE interviewed IDB staff both at headquarters and in the country offices, as well as a range of stakeholders: local and national authorities involved in planning, managing, and operating the urban transport systems; academics; the private sector; bus companies; and citizen groups. The team also conducted extensive document review and examined data on the systems' operational and design characteristics – operating speeds, demand, bus productivity, ridership, vehicle emissions rates, modal shift estimates, and socioeconomic data on users– as well as reports from user surveys. Additionally, the team estimated emissions impacts compared with the business-as-usual scenario and, in Cali and Lima, surveyed low-income and poor populations living in the area of influence of the system to ascertain the degree to which they benefited from the projects.

[27] Urban Transportation Curitiba II (BR-0375**)** was excluded from the study because it was an addition to an already well-established system that was developed outside of Bank financing and has been well studied.

Box 2.1. Evaluation questions

Relevance and design	**a.** ***Relevance of project objectives.*** Were the projects at loan approval well designed with respect to their objectives and the cities' transport needs?
	b. ***Relevance of project design.*** Were the design and scope of planned components relevant to the city's transport issues? When improving mobility and access for the poor was an objective, was there an adequate diagnosis of the mobility needs of the poor (including coverage, affordability, and spatial and temporal travel patterns), and did the project design respond to that diagnosis? How well was land use planning integrated into the system as part of the design to support the projects' objectives such as improved mobility and access?
Implementation and efficiency	**a**. ***How efficiently was the system implemented***, in terms of both monetary cost and time? What were the main causes of any delays?
	b. ***What opportunities and challenges arose in implementation,*** and how did they affect the project outcomes?
Effectiveness and results	**a.** ***Delivered BRT system***. How does the BRT system design (as implemented in the field) compare to what was planned and how well does the design of the system support project objectives?
	i. ***System infrastructure.*** How effective are the BRT system infrastructure (stations, segregated right of way, intersection treatments, etc.) and operational characteristics (bus service, routes, payment systems, buses, etc.) with respect to international BRT standards[a] and to the projects' *targets and objectives*?
	ii. ***System performance***. How well is the BRT system performing with respect to daily ridership and system productivity vis-a-vis expectations?
	b. ***Mobility***. To what extent have projects increased mobility through decreased access, wait, and travel times in the corridor and area of influence of the corridor?
	c. ***Poverty***. How well does the BRT system (including its feeders) cover poor areas in the city? To what extent do low-income groups use the BRT compared to other mass transit modes? Is the system affordable to the poor?
	d. ***Emissions.*** To what extent did the project reduce emissions from the public transport system within the project's area of influence? Were improvements made through fleet renewal and adoption of lower-emissions buses? Were there modal shifts from private automobiles or more polluting modes of public transit to the BRT system and its feeders (both non-motorized and public transit modes)?
	e. ***Citizen satisfaction***. How is the system rated in public opinion surveys? What are user perceptions?

Note: To the extent possible, the team also examined the political, economic, and public policy factors that influenced the design, construction, implementation, and outcomes of the projects.

[a] As one of *many* criteria, the team examined how the systems were rated on the ITDP BRT Standards and scorecard. The ITDP scorecard rates projects on various infrastructure and service quality dimensions that have been found in practice to contribute to the achievement of mobility and system performance objectives, with a total possible score of 100 points. The achievement of the project's objectives was also evaluated with design of systems at implementation one of several contributing factors that led to outcomes.

III. CASE STUDIES

3.1 **At project inception, all three cities were experiencing rapid urbanization, urban sprawl, and growing private vehicle ownership rates that brought high levels of congestion, pollution, and traffic accidents.** Lima and Cali had low levels of overall mobility, severe traffic congestion, an oversupply of transit vehicles, high levels of air pollution, and significant informality in the public transport sector. Montevideo had a more developed and formalized and cooperatively owned public transport sector run by five bus companies, and comparatively much lower levels of air pollution and congestion. Nevertheless, there, too, increasing car ownership and urban sprawl had been undermining the effectiveness and sustainability of the city's transport system in the city and contributing to increasing emissions from transport as well as a rising number of traffic accidents.[28] Table 3.1 provides an overview of the three projects, along with Table 1 and Table 3 in Annex present a contextual comparison among the three cities.

Table 3.1. Overview of three IDB-supported BRT projects

	Lima	Cali	Montevideo
Project Details	PE-L0187	CO-L1001	UR-L1025
Project name	*Lima Urban Transport Program*	*Cali: Integrated Mass Transit System*	*Montevideo Urban Transportation Program*
Approval year (completion)	2003 (2010)	2005 (2014)	2008 (2013)
Main Objectives	-Improve mobility, public transport, and urban environment - Mobility for the poor - Reduce accidents & emissions	- Improve mobility, public transport, and urban environment -Mobility for the poor - Reduce accidents & emissions	-Improve mobility -Increase public transit efficiency - Reduce accidents & emissions
Number of trunk lines	1 (28km)	3 (49km)	2 (17.9km)
Expected demand (pass./day)	600,000	850,000	260,000
Planned IDB contribution	US$45 million	US$200 million	US$80 million
Total planned cost	US$124 million	US$300 million	US$100 million

3.2 **The three projects shared similar objectives, but there were striking differences in their design and scope.** The projects pursued the common objective of improving mobility through improvements to public transport corridors and systems –in Lima and Cali, particularly the mobility of the poor[29]– while also improving the safety and environmental sustainability of the transport system by implementing a BRT system and accompanying components.

- Lima created a north-south single-corridor BRT, aiming to cover 5% of demand, improving feeder roads, and creating cycle lanes and pedestrian infrastructure, improving public spaces (plazas), formalizing the informal transport sector (by scrapping old vehicles and hiring drivers into the new system), and using low-emissions buses.
- Cali took a more comprehensive approach, aiming to cover 98% of demand, creating three BRT trunk lines; investing in feeder bus routes, secondary roads, and cycle/pedestrian parallel infrastructure; and integrating informal drivers into the system and renewing the fleet, improving public spaces (such as plazas).
- Montevideo financed plans for what was intended to be two BRT corridors (with dedicated bus lanes in high-demand segments), terminal stations, feeder lanes, and

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28 See http://www.iadb.org/document.cfm?id=37808600. Also, please see the Case Study Annexes of this report for more details on initial conditions and for a description of the three projects.

29 In Montevideo, this was an expected co-benefit of the project, although not an explicit objective.

traffic lights as a pilot project for the rest of the city; it focused more on improving the overall efficiency of public transport services, which had not been updated to meet changing demands.

3.3 In all three cases, the infrastructure for the BRT systems was financed by a mix of local budget allocations, transfers from upper levels of government, and external financing (domestic or multilateral lending), including from the IDB, while both the bus operation and fare collection services were to be provided by private companies under a PPP business structure.

A. Lima

3.4 **With about 9 million inhabitants, Lima represents one-third of the population of Peru and is the center of the country's political and economic life.** In 1991, after struggling for years with an undersupply of public transport vehicles, the government liberalized the system by eliminating fare regulations and barriers to entry. This change allowed any person or company to provide public transport service, and it created an oversupply of aging minibuses. In 2003 the public transport fleet[30] had an average age of 16 years, contamination by fine particulate matter was twice the levels considered safe by WHO,[31] and there were 44,604 traffic accidents[32] (of which 779 were fatal) and an average of two deaths per day; 78% of traffic fatalities were pedestrians (WHO, 2009).[33] Traffic congestion affected everyone, but particularly the poor workers living in the outskirts of the city, whose average trip lasted 90 to 180 minutes. Poverty rates in Lima were 44.8% in 2004. Lima presents marked center-periphery divides that relate to socioeconomic conditions of the population. While more central districts are located closer to the center of the city, less wealthy groups are located at the peripheries, except from the coast. In a concentrated city that was and is largely dependent on traditional public transport to reach the center from the peripheries like Lima, this presented considerable barriers for access and inclusion.

3.5 **In 2003 IDB approved the Metropolitan Lima Urban Transportation Program (PTUL, PE-0187) as part of the financing package required to build and operate the first stage of Lima's public transport system, COSAC 1.** The total public investment was originally estimated at US$134.4 million, of which US$90 million was jointly financed by loans of the IDB and the World Bank (US$45 million each), and the rest by the MML. For both banks, these were the first loans to a subnational government in Peru: the borrower was the MML with a sovereign guarantee from the central government (IDB 2003a). Unlike most other public transport projects, this effort didn't have the financial or technical support of the national government.

3.6 **The general objective of the loan was "to improve mobility conditions for the population of Metropolitan Lima, particularly among lower-income groups" through the implementation of "an efficient, reliable, environmentally sound and safe rapid transit system."** The total public investment was originally estimated at US$134.4 million,

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30 Of the public transport fleet, 90% was low-capacity vehicles (minibuses and pick-ups), and 10% was buses.

31 For particulates with a diameter of 2.5 micrometers or less, the World Health Organization suggests a level of 25 parts per million, while in Lima it is around 50 parts per million.

32 Source: http://ditoe.minedu.gob.pe/Materiales%20DITOE/B14.pdf

33 http://www.camara-alemana.org.pe/downloads/120328_2-ViasalFuturo_FundacionTransitemos.pdf

of which US$90 million was jointly financed by two loans from IDB and the World Bank (US$45 million each), and the rest by the Metropolitan Municipality of Lima. In support of the loan, the IDB approved several grant operations that financed pre-investment studies, studies on intelligent transport technology, and studies to analyze the viability of clean fuels.[34] *El Metropolitano* BRT consists of 28.6 km of segregated busway, with 35 stations, two terminals, and a central transfer station. The service was initially envisioned as four separate lines of business, each given out in concession through competitive bidding: (i) operation and maintenance of 300 articulated buses and 300 feeder buses, (ii) the control center, (iii) compressed natural gas (CNG) service stations, and (iv) a fare collection system. The loan also included components aimed at institution building, improving the urban environment (e.g. paving of parallel streets, restoration of sidewalks, landscaping, improvements to public plazas, air quality monitors, among others).

3.7 **The project connects Lima's north and south cones to major destinations and reduces travel times significantly.** The system includes all the features of a full BRT, with high-capacity articulated buses running on CNG. The project was particularly vulnerable to local political cycles; a new mayor delayed the construction for several years while the city attempted to complete a metro line. *El Metropolitano* was opened partially to the public in May 2010 with an incomplete set of articulated and feeder buses, and the city still needed to address the removal of competing service along the corridor. The initial results were not promising, as ridership reached only 220,000 passengers per day, about a third of the projected demand. Since then the city has improved the service by offering a better fare structure that encourages the use of the feeders, and by progressively adjusting the routes offered.

3.8 **The system has come a long way, gradually reaching its projected demand and living up to its promise of transforming public transportation in Lima and saving passengers considerable travel time.** However, the city has been slow in implementing complementary measures like improving station access and building a proposed 11 km extension to the north, integrating it with other public transit modes, or removing conventional bus services from the BRT corridor. Fare revenue has so far been insufficient to cover operating expenses, and operators are still receiving payment below the price they bid per programmed bus kilometer. Finally, changes in political priorities put the sustainability of the BRT system at risk: the national Government has been developing plans for a multibillion dollar metro system, while the city has been unable to finance the proposed extension of the BRT, or to reorganize the rest of the traditional bus service (see Lima Case Study Annex).

[34] IDB approved several grant operations to support preparation of the loan. In 2002, it approved a US$490,000 grant (TC-0107023) to develop some of the pre-investment studies required for preparing the Lima project, including preliminary designs and environmental studies for the selected corridor (IDB 2002). In 2003 a grant (TC-0110056-PE) of US$450,000 was approved to design and prepare bidding documents for Intelligent Transportation System technology, including the fare collection, bus operation control, and traffic signal control systems (IDB 2003c). Finally, a 2003 grant (TC-0108041) of US$150,000 financed consulting services to analyze the viability of clean fuel technologies for the system (IDB 2003b).

B. Cali

3.9 **Cali is the third-largest city, and one of the most densely populated cities, in Colombia.** At the beginning of this century, the city's transport system was highly chaotic and fragmented, partly informal, inefficient, and polluting. An unregulated and growing oversupply of public transport and lack of structured routes or bus stops had led to severe competition for passengers, creating high levels of congestion, overlapping routes, and low public transit productivity. Nearly 40% of the buses were more than 20 years old, and the fleet had poor or no emissions control technologies (Moller, 2006). During rush hour, the average bus speed was 8-12 km/h and, on average, it took 90 minutes to cover routes that were about 40 km long. Air quality in Cali was also poor, largely because of the numbers of aging transit vehicles and the congested driving conditions.[35]

3.10 **The levels of poverty and inequality in Cali were very high at project inception.** In 2005, a third of the population lived under the poverty line.[36] According to the national socioeconomic stratification, about 52% of the population belonged to the poorest strata 1 and 2, and only about 1% belong to stratum 6 (high income).[37] Low-income and poor populations tend to be concentrated in the western hills and, especially, the eastern areas of the city. In contrast, the middle-class (in the city center) and the richest populations (in the south) reside along a north-south axis around which the city's infrastructure developed (Poverty Analysis Annex and Cali Case Study Annex).

3.11 **In 2002, the Government developed a National Program for Urban Transport to develop integrated public transport systems in several Colombian cities, seeking financial support from the multilateral development banks.** On the model of Bogotá's *Transmilenio*, it decided to implement BRT-oriented integrated mass transit systems in the country's seven largest cities: Barranquilla, Bucaramanga, Cartagena, Pereira, Santiago de Cali, Medellin, and Soacha.[38] The city of Cali had initially envisioned a light rail system supported by several buses operating on trunk lines and feeder routes. However, feasibility and alternatives analyses determined that a BRT system was the more cost-effective and affordable option for the city (DNP, CONPES 3166, 2002).

3.12 **The city took an ambitious approach, attempting to reform the entire public transport system rather than piloting a few corridors.** The project sought to improve the transportation alternatives for Cali, especially for low-income populations, by modernizing and integrating the bus transportation system to connect the low- and middle-income areas with the areas where job-generating activities and social services are concentrated. The modernization of the transportation system included measures to improve service quality; reduce travel time, accidents, and air pollution; and increase service frequency and reliability. The system included the secondary roads and

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35 For the trunk lines, in 2005 the measured total suspended particles averaged 108 $\mu g/m^3$, sulfur oxide 6.8 $\mu g/m^3$, and carbon monoxide 4 ppm.

36 Taimur, et al., 2012.

37 *Censo General 2005*, DANE. The strata and corresponding socioeconomic status are defined by the national Statistics Office of Colombia as follows: 1 = Low-Low; 2 = Under; 3 = Medium-Low; 4 = Middle; 5 = Medium-High; 6 = High.

38 The Colombian Government assigned the project in the largest city to the IDB, and the projects in the other six mid-sized cities to the World Bank.

complementary corridors, and the project involved the construction of five trunk lines and their related infrastructure (stations, terminals, and line terminals), the construction of patios for bus operators, and the extension of the upgraded bus fleet. The project took four years longer than expected because of unforeseen technical issues with utility lines, resettlement of affected populations, limited local technical capacity to assess design proposals, and strengthening of the Colombian peso relative to the US dollar during construction. Today there are still segments of unfinished infrastructure –terminals, several bus yards, and portions of one key trunk line.

3.13 **Project results offer a mixed picture: the implemented BRT has saved in-vehicle travel time in the main corridors and emissions, but there are significant issues with operational performance, user satisfaction, and financial sustainability.** The delivered BRT system met many of the international BRT standards: center-aligned rights of way running along protected segregated corridors, off-board payment systems, level platform boarding, multiple routes, passing lanes at most stations, and accessibility for disabled populations. It also included many significant upgrades to public spaces, as well as pedestrian and bicycle infrastructure. Ridership has been gradually growing as the system has expanded but is still significantly below levels need to cover operating costs (DNP, 2011; SDG, 2013). The system has substantially reduced local and global emissions from public transit and saved travelers significant in-vehicle travel time; however, users have complained about increased wait times and overcrowding on buses, as the private companies' financial struggles and unfinished infrastructure have led them to withhold buses from the system,. Operating tariffs are currently not sufficient to cover debt and operational (plus depreciation) costs, and financial issues are threatening to put the companies out of business (Cali Case Study).

C. Montevideo

3.14 **Montevideo is both the capital of Uruguay and one of the country's 19 administrative regions.** In 2004, the city contained 41% (1.32 million) of the national population.[39] The operation of public transportation is formalized and highly concentrated, with five cooperatively owned bus companies providing service for about one million people per day (2007). In the five companies the majority of the shareholders is also workers, such as bus drivers or fare collectors, and own a share of the vehicles. The transportation system lacked dedicated infrastructure to prioritize public transport over other modes, and public transit service had not adapted to demand: oversupply in some areas was matched by lack of frequency, infrastructure, and bus routes in others. As a consequence, the system's overall productivity and efficiency were low. These factors, coupled with growth in motorization and an aging bus fleet, led to significant growth in congestion in some areas,[40] affecting both mobility and air quality. Although Montevideo had comparatively good ambient air quality, the public transit system was inefficient and outdated, with high levels of tailpipe emissions from bus vehicles, posing significant public health risks through high exposure to pollution at the street level and in enclosed

39 Density in the city (2,500 hab/km^2) is higher than the average of the large LAC cities (1,747 hab/km^2) (CAF, 2007) and strongly contrasts with the rest of the country (19 hab/km^2).

40 Buses were running at 16 km/h (6-8 km/h in the center of the city) on average (TC document).

spaces where emissions infiltrate.[41] In addition, in spite of growing demand for bicycle facilities, the city possessed only 9.5 km of priority infrastructure for pedestrians and bicycles (CAF, 2007) –a fact that also affected road safety (TC document).

3.15 **In 2005, Montevideo initiated a two-phase Mobility Plan, proposing the creation of a Metropolitan Transportation System organized around exclusive segregated public transport corridors**. The system encompasses passenger transport, freight and logistics, and measures to ensure priority to public and non-motorized transportation. The IDB supported the first phase of the plan (2008-2010), for the construction of two trunk lines and their related infrastructure through the Montevideo Urban Transport Program (Loan UR-L1025), approved in 2008.[42] The objective of the Bank's program was to improve mobility and the efficiency of the urban transportation system –to provide *"an accessible, safe, efficient and sustainable transportation system"* (IDB 2008) by upgrading mass transit infrastructure and restructuring and streamlining services. The Bank's program[43] was intended to finance infrastructure for exclusive and preferential bus lanes, terminal stations, feeder lanes, and traffic-light systems.

3.16 **The implementation of the project has been complex: various political and technical factors led to design issues and construction delays.** As a result, the current system design does not meet the basic definition of a BRT, the peak hour passenger volume has declined slightly compared to before the project, the bus speeds in the corridor remain similar to before the project, and travel times have increased for some passengers. The pilot project on Avenida Garzon began with low potential for mobility benefits associated with an exclusive busway relative to most BRTs due to a lack of congestion in the corridor; and because various stakeholders lacked the willingness, and the executing agency lacked the technical capacity, to implement the complete set of necessary and sufficient reforms around the infrastructure investment, the pilot project was not a successful demonstration. As a result, there was strong political backlash against the project, and in June 2014 the government rejected the Bank-supported Phase 2 of the project, which was to be a BRT located in the denser areas of the city with more potential mobility benefits (see Montevideo Case Study).

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41 For example, bus stop enclosures, buildings near streets, private vehicles in mixed traffic with buses, etc.

42 A technical cooperation –*Apoyo a la Preparacion del Programa de Transporte Urbano de Montevideo* (UR-T1015, US$720,000– supported the preparation of the Montevideo Urban Transport Program.

43 It was planned for four years, until the end of 2012, and works in Corridors Agraciada-Garzon and Flores and in Terminal Colon were to be done by mid-2010. In counterpart, the Municipality was to develop demand and transit management measures, adapt the bicycle network, and overhaul the road network.

IV. COMPARATIVE CASE ANALYSIS

A. Relevance

1. Relevance of project objectives

4.1 **The objectives of the urban transport projects –to increase mobility, particularly for the poor, and reduce accidents and emissions, through improvements to the public transit systems– were, overall, highly relevant to the cities' urban transport issues.** The introduction of the BRT systems and accompanying reforms had the potential to cost-effectively improve public transit efficiency, mobility, air quality, and traffic safety within the BRT system's area of influence for all three cities. The *planned* reorganization of routes would have substantially improved mobility and reduced the population's exposure to pollutant emissions. The projects' intentions to improve mass transit with systems that reached into low-income areas had significant relevance with respect to improving mobility for the poor. Furthermore, to the extent that the poor realized travel time savings from using the system, the projects also had the potential to indirectly reduce poverty by increasing their access to markets, services, and jobs.[44]

2. Relevance of project design

4.2 **The overall design of the urban transport programs had significant potential to address each of the cities' mobility, environmental, and traffic safety challenges in the projects' area of influence.** The projects not only financed BRT corridors but attempted to address several other problems associated with public transit in the cities –inefficient bus routes and outdated, polluting, and dangerous bus vehicles– along with improving the road infrastructure of both the main BRT corridor and feeder routes. Moreover, BRT as a mass transit technology was a cost-effective option, costing a fraction of that of rail-based systems; this meant that the cities could afford to invest in substantially larger systems or obtain substantially broader urban transport improvements for the amount invested (Table 5 in Annex).

4.3 **The ambitious scale of Cali's program implied significantly greater potential to address the city's transport issues, compared to the more incremental approaches in Lima and Montevideo.** Cali's system proposed to transform the entire public transport system, reaching 98% of the city. Lima's was planned as the first part of a future network of five BRT corridors, with this first segment serving roughly 5-6% of the city's public transit demand. Montevideo's corridors (also planned as part of a future network of BRT corridors) were estimated to carry approximately 17% of the public transit demand in the city. While Cali's "big-bang" approach offered the potential for larger-scale benefits, it also carried higher risks in terms of added complexity and potential scale of unintended adverse impacts if problems arose during execution and operation.

4.4 **In each case, corridor selection was a critical determinant of the degree of travel-time savings and mobility benefits that could be realized.** In Lima and Cali, the BRT

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44 Poverty rates were 44% in Lima (in 2005), 33% in Cali (in 2005), and 22% in Montevideo (in 2009).

system corridors connected important activity centers of the cities, serving high levels of public transit demand but also suffering from significant traffic congestion that impeded public transit service efficiency. In Montevideo, the project was developed in two corridors with relatively lower demand and congestion; conceived as a lower-risk demonstration project that also could improve transport for lower-income residents, it stopped well short of the downtown central business district. While improving public transport for the poor who greatly depend upon such systems is an important objective, a better design might have been to implement trunk lines (with exclusive corridors) in more congested areas, while improving feeders and bus lines in poor neighborhoods to connect them to the BRT and/or other relevant origin-destination (OD) pairs.

4.5 **The projects included key components to reduce transport-related air pollution such as improved bus operations, vehicle scrapping programs, and the use of low-emissions buses operating on cleaner fuels.[45]** Many of the measures to improve bus system operations would also improve overall energy efficiency per passenger trip and would therefore reduce emissions –for example, restructuring overlapping and redundant routes and creating segregated corridors in which buses could operate more efficiently, at greater speeds and with less acceleration and deceleration. While modal shifts from cars to public transit would add to emissions benefits, the lion's share of such savings would be expected from the public transit system efficiency improvements. Moreover, if the quality of service and mobility benefits of such systems could be achieved, emissions would be saved (relative to the business as usual scenario) by stemming the trend of increasing modal shifts towards private motorized transport, by both retaining *existing* and attracting *new* public transit users. In this sense, the objectives of improving mobility for the poor and environmental objectives were well aligned given that a high share of public transit users are from lower income populations and that to the extent that transit improvements slowed or prevented first time vehicle purchases, it would represent a large long-run emissions benefits relative to the business as usual scenario.

4.6 **The IDB supported fuels and vehicles alternatives analysis; however, the designs of vehicle scrapping programs, as well as the choices of vehicles and fuels, were shaped mostly by the local policy environments and political economy.** In Montevideo the IDB funded a study on vehicle and fuels alternatives, but the analysis lacked information on cost-effectiveness, and there were no economic incentives for the bus companies to adopt new technologies. Moreover, a bus scrapping and fleet renewal program was not included in the project. Therefore, the only fleet renovation process occurring in the corridor[46] responds to a recent local regulation requiring new buses to meet Euro III emissions standards, leading to a slow renewal process. While plans to restructure routes would have improved energy efficiency, the omission of any fleet renewal program considerably reduced the project's potential to address environmental concerns.[47] The

45 In the case of Montevideo, the IDB loan did not specifically mention fleet renovation but rather "fleet management."

46 The renovation process is slow –around 10% annually, according to the city's environmental agency.

47 Moreover, the minimum emissions standards dictated by the recent law were constrained by the low-quality diesel fuel produced by outdated fuel refineries that were only slated to be revamped after the law was passed. As a result, although the law is an improvement, vehicles are required only to meet relatively low emissions standards (Euro III), rather than the more stringent ones that would be available with higher-quality fuels, (Euro IV and Euro V).

projects in Lima and Cali included components to reduce the oversupply of old polluting buses, introduce lower-emissions buses, and implement bus scrapping programs; however, the financial incentives in the scrapping program designs were not strong enough, particularly in Lima, to fulfill scrapping goals. In addition, in Lima, no system for scrapping was yet in place at program inception.[48] However, the Bank funded an instrumental study that analyzed cost-effective options for clean fuels and led to the adoption of low-emissions CNG buses. In addition, a Peruvian Government mandate to promote the use of natural gas, following its investment in the pipeline to connect Lima and Callao to the Camisea Gas Project, helped support the choice of CNG and led to significant emissions benefits for the BRT project.[49] In Cali, the bus fleets were planned to be renewed according to national laws, and Euro III emissions standards were required at the time of project design.

4.7 **In all three cities, the BRT corridor alignments passed through or reached into low-income or poor neighborhoods, and in two, the design included feeders that reached into poor areas to provide connections to the main BRT trunk lines.** However, beyond placing the projects in or near low-income and poor neighborhoods, they did not include in-depth diagnoses of mobility needs, spatial and temporal traffic patterns, and affordability needs of the poor to inform the projects' design. Furthermore, of the two projects with explicit poverty objectives, only Lima's had specific indicators in the results matrix to measure to what extent the poor would benefit from the program; and these indicators were limited to measuring the share of users coming from less advantaged socioeconomic groups. Moreover, two of the projects' planned elimination of the traditional bus services, often operating informally, that reached far into poor neighborhoods, presented a risk of unintended reductions in poor people's access to public transit. In contrast, the BRT projects were designed to reconfigure these traditional services from long-established routes to a trunk-and-feeder configuration; to what extent such a configuration serves the mobility needs of the poorest income strata is unknown.

4.8 **The urban transport projects were expected to have road safety benefits within the projects' area of influence.** The planned formalization of the public transit sector in Lima and Cali would be expected to improve safety by reducing both the aggressive driving patterns associated with competition for riders, and the mechanical failures and the less safe vehicle designs of the older, poorly maintained, transit vehicles. In addition, BRT systems entail geometric changes to streets that if well designed, can improve road safety.[50] Modernized and regularly maintained bus fleets would reduce the crash risks associated with vehicle design[51] and mechanical failures (e.g. failing brakes). The potential safety benefits

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48 Source: Interviews, Ministry of Housing (Lima, Peru).

49 Increasing the demand for natural gas would prove beneficial for COFIDE as they had to fulfill their commitments with the private investors, and *El Metropolitano* was a particularly convenient project to support. With a supply of 10 million cubic meters of gas per day and very little demand, COFIDE had the responsibility of promoting projects that encouraged natural gas consumption or risk paying the investors the revenue guarantees agreed in the contract.

50 For example, prohibiting left-hand turns reduces severe crashes by an average of 22%, and the including medians that are accessible to pedestrians can reduce serious and fatal collisions by 35% (Duduta et al, 2012) and personal communication from Claudia Adriazola, Traffic Safety expert EMBARQ, WRI, February 25, 2015).

51 For example, larger buses with better safety designs could reduce the risk of serious injuries in the event of a crash.

are enhanced by the fact that traffic accidents tend to concentrate along busy arterials in cities where bus systems tend to also operate (Duduta et al, 2012). While Lima's project was the only one to hire a traffic safety expert to guide the design, the expert's advice was provided after the construction began and was limited to *within* the direct BRT right of way (inside stations and inside the busway), stopping short of the area of influence of the BRT, such as pedestrian access to stations and traffic affected by street geometry and engineering changes.[52] The project included financing for five pedestrian overpasses; however such bridges have been shown to do little to improve safety since pedestrians find them inconvenient and prefer to jaywalk rather than use them (Duduta et al, 2012).[53] In Montevideo the municipality incorporated wide sidewalks and upgraded pedestrian crossings. In Cali, the IDB played a stronger role, financing a comprehensive set of well-designed infrastructure to facilitate pedestrian access in and around the stations and corridors.

4.9 **The projects included important measures for upgrades to the urban environment and public spaces, such as pedestrian plazas, improved sidewalks, street lighting and landscaping.** The design could have been improved with increased focus on land use planning for TOD around stations, which could have helped to support ridership on the systems by clustering a mix of land uses near transit stops and promoting densification to reduce trip distances between origins and destinations.

4.10 **The IDB took a relatively more active role in the feasibility studies, initial design of the infrastructure, and corridor choice, but left to the local governments the development of several of the supporting measures that had critical bearing on development outcomes.** The IDB provided technical assistance during the transport planning and diagnosis phase –preliminary designs and feasibility studies, environmental studies, and other technical studies to develop bus operation control systems, traffic signal control systems, fare collection systems, and infrastructure design. In addition, the IDB played an important role in guiding and supervising the construction of infrastructure and the development of monitoring and evaluation systems. However, guidance from the Bank was less prominent for other key supporting measures –the design of scrapping programs; coordination of pedestrian, bicycle, and land use planning around station areas of influence; and PPP concessions contracts– and in issues that arose later in operations.

4.11 **PPP contractual arrangements became critical determinants for the success of the system, affecting factors such as frequency of service, fare levels, and the degree of participation of existing bus owners.** IDB loans and technical cooperations (TCs) financed studies regarding the bus and fare collection technologies and the IT infrastructure, but given the political nature of deciding fare levels and the complex negotiations with existing bus owners and drivers, the fare structure became a mostly local arrangement. Although a World Bank study informed the PPP design in Lima, the design of PPP contracts was left mostly to the local governments. Furthermore, although the loan proposals mention the potential risks associated with negotiating with incumbent bus operators, determining fare policy, and dealing with social issues, they do not address the risks of a PPP business model and possible mitigation measures.

[52] Interviews with transport planners involved in the project, March 2014.

[53] Moreover, such bridges are not accessible to persons with disabilities.

4.12 **As a result, even where the national Government had a highly supportive regulatory role and extensive experience with BRT systems (Cali), unforeseen issues, weak local technical capacity, and fragmented local institutional structures resulted in design and implementation issues that adversely affected the project's results.** In Montevideo, for example, the political-economy, regulatory, and institutional context, and the government's inexperience with BRT systems, led to several issues that significantly compromised the project's design. The Bank provided technical assistance in the design and early implementation phases; however, in light of high staff turnover, a weak institutional structure, shortage of technical staff specialized in urban transport, and gaps in Bank supervision, the government autonomously changed the original project designs[54], resulting in negative impacts on the project outcomes. The government subsequently rejected the Bank-approved second BRT project in an area of the city that would have been better suited to a BRT line.

4.13 **The IDB included in the projects comprehensive monitoring and evaluation systems to facilitate project supervision and the measurement of project impacts, though baselines and indicators for some objectives were ill-defined or inconsistent and in one case the monitoring mechanism was insufficient to track project impacts.** The BRT systems were built with information technology that would enable live monitoring and adjustment of the operations and performance evaluation; they also included automated fare collection, GPS on all buses, and a centralized control center. Most projects planned to measure vehicle travel-time savings, but only one (Cali) included the important goal of reducing wait time for buses as an indicator. Cali's project stood out in that it included as part of the contractual design a planned comprehensive ex-post evaluation, which included the collection of several baseline indicators for the planned assessment of socio-economic, mobility and environmental impacts. While all of the projects had laudable plans for air quality monitors along the corridors, Lima's indicator lacked clear definition,[55] and in Montevideo the single air quality station was too far from the corridor to give a meaningful indication of changes in air quality that were attributable to the BRT.

4.14 **Project indicators for improving mobility for the poor were centered on the percentage of users of the new system, without reference to affordability, the share of public transit users generally that are poor or travel time changes for the poor.** In Cali an indicator in the Bank's loan proposal results matrix focused on Afro-descendent users, not mentioning low-income or poor users explicitly.[56] In Lima, the number of users is also an indicator of project impact. The expected percentage of low-income users (strata C, D, and E) of the BRT was 60%, or 240,000 per day, without reference to the share of total public transit users who are poor or to the proportion from strata D and E, the poorest. The project included a component to develop baseline indicators and monitoring systems that were not fully implemented during project execution.

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54 In interviews, the mission team also heard that the government was not receptive to the consultant's initial design of the BRT.

55 It wasn't clear from the results matrix if the target was for emissions rates from vehicles (i.e., tons per year of pollutants from vehicles) or ambient concentrations of pollutants (i.e., ug/m^3 SO_x).

56 However, the socioeconomic appraisal developed recently takes into account the users from strata 1, 2, and 3.

4.15 **Since the agencies that would participate in the urban transport programs suffered from weak technical and institutional capacity, the IDB appropriately incorporated institutional strengthening components in each of the cities.** In Lima and Cali, the institutional components entailed strengthening staff in the agencies or units that had been created to operate the BRT. These components generally included training of urban transport staff, development of public transport regulatory frameworks, inter-institutional coordination mechanisms, and, in Lima, guidance on the design of concessions to operate the buses and fare collection system. In Montevideo, the unit developed to manage the BRT was created within the city's transport department by staff transfers, rather than new hires; according to interviewees, this measure weakened complementary departments – such as the traffic engineering and planning departments– that had functions supporting the executing unit.[57] In both Cali and Montevideo, these supporting departments were not included in the institutional strengthening component.

B. Implementation

4.16 **As complex endeavors, the urban transport projects were affected by a myriad of factors that arose during implementation, including construction challenges and cost over-runs, design issues in PPP contracts, weak technical and institutional capacity, delays in infrastructure that compromised service quality and efficiency, political cycles, and political economy issues.** Policy reforms that had been planned to support the infrastructure investments were undermined by the weak institutional and technical capacity of the local governments, political cycles, and strong resistance to reforms by incumbent stakeholders, and inadequate public consultation processes. For example, in Lima, while the IDB and World Bank supported technical studies for solid transport engineering and infrastructure designs, the projects suffered from implementation issues surrounding supporting measures such as PPP designs, pedestrian planning, and flaws in station design. In Montevideo, high levels of risk aversion resulted in poor corridor choice in a relatively uncongested and low demand corridor, reducing the potential benefits of a dedicated busway. Under such circumstances, most of the mobility outcomes (due to enhanced bus speeds) were dependent on such complementary measures as bus restructuring, fleet modernization, off-board electronic payment systems, level boarding, and traffic light reconfigurations; however, these were reforms that never fully materialized. Low technical capacity, the lack of strong institutional reforms, and the political power of bus companies impeded effective implementation of these critical measures, negatively affecting project outcomes.

1. Challenges during construction

4.17 **As in many large infrastructure projects in urban areas, each of the projects encountered obstacles in the construction phase that led to cost overruns and delays (Table 4 in Annex).** In Lima, rising construction costs, exchange rate fluctuations, and the addition of the underground Central Station more than doubled costs, from the initial budget of US$125 million to around US$350 million. Cali's project cost nearly four times as much (US$1,481 million versus US$395 million) and took three years longer than expected (8.3 versus 5.2 years), while Lima's took twice as long (7 years versus

[57] Interviews with Montevideo urban planning department staff.

3.6). Although Montevideo's first project finished two years later than planned (6 versus 4), one of the two planned corridors is still under construction, with additional funds from the government.

Table 4.1. Comparative project costs and time: Planned vs. actual

	Cali		Lima		Montevideo	
	Planned	**Actual**	**Planned**	**Actual**	**Planned**	**Actual**
Time	274 weeks (5.2 years)	432 weeks (8.3 years)	168 weeks (3.5 years)	336 weeks (7 years)	192 weeks (4 years)	288 weeks (6 years*)
Total cost (US$ million)	395	1,481.7	134.4	300	100	109
IDB (US$ million)	200	200	45	45	80	80
Local (US$ million**)**	100	911.7	44.4	125.4	20	28
Other (US$ million)	Private sector 95	Private sector 370	World Bank 45	World Bank 45		

Note: Information about the cost for Cali's project comes from national official sources (Contraloria, 2013). Local contribution is as of April 2014; see http://www.juntamvd.gub.uy/es/archivos/actas/1061-1673e-acta-final-20082013.pdf and http://www.juntamvd.gub.uy/es/archivos/actas/1132-1706e-acta-final-30042014.pdf.
*6 years for first corridor (Av. Garzon).

4.18 **Weak technical and institutional capacity at the local level and political cycles contributed to the cost overruns and delays.** In Cali, high turnover among Metrocali's management and staff created low institutional capacity to assess the quality of engineering designs that had been outsourced to external consulting firms.[58] The unexpected discovery of unmapped underground utility services in Lima and particularly in Cali required the redesign of trunk lines and stations and led to construction delays. This, in turn led to problems such as prolonged congestion in construction zones and adverse impacts on affected businesses. Preexisting capacity weaknesses in the city's planning department (outside the project) and a weak linkage between the project and overall city planning contributed to these issues. In Lima, the low wages established by government policy meant that executing agency staff had limited technical capacity and experience with BRT projects (World Bank Implementation Completion Report). This, in combination with high staff turnover and declining support for the project associated with political cycles, caused several disruptions and delays in the project's start-up. In Montevideo, although the BRT construction was well under way according to plans, in 2011, the municipality decided to revise previous technical studies on route rationalization, unnecessarily delaying construction.

4.19 **Delays sometimes presented opportunities for improvements in project design, such as the use of natural gas buses in Lima.** Cost over-runs also sometimes resulted from requests by municipalities for additional infrastructure that enhanced the projects, such as an underground station that enabled a thriving mall development in Lima and increased public spaces in Cali. The projects' preliminary designs at loan approval allowed the flexibility to adapt to unforeseen construction issues and to respond to changing government priorities, while at the same time added uncertainty regarding final infrastructure costs. Despite over-runs, the systems were still a significantly more cost-effective means of providing rapid mass transit compared to rail based technology.

58 Source: IDB's Project Completion Report (PCR, 2013) and Case Study Annex.

4.20 **However, in Cali and Lima cost overruns resulted in reallocations of IDB funding across planned components, so that local governments needed to either find alternative sources of funding or reduce the scope of the components.** As a result, system efficiency and service levels were adversely affected by unbuilt portions of infrastructure in Lima and particularly in Cali, which still has several terminals and infrastructure unfinished and required additional government funding to cover cost overruns.

4.21 **While each of the cities included a public consultation phase, the consultations appeared to be more informative than participatory, with limited bottom-up feedback in the project design phase.** As a result, citizen complaints about the unintended adverse impacts of the BRT systems arose. For example, in the historic neighborhood of Barranco, Lima, overly narrow environmental studies failed to identify barrier effects to properties and adverse impacts from displacing traffic congestion into neighboring streets, leading to a formal complaint through the World Bank's Inspection Panel mechanism.[59] In addition, inadequate assessment of and planning for pedestrian traffic across the planned busway led to significant barrier effects at numerous locations along the BRT corridor and unsafe pedestrian crossings into the BRT lanes, which also gave rise to citizen complaints[60] (World Bank PCR). Finally, a program to mitigate job losses related to downsizing the bus sector through retraining, microcredit, and compensation programs was not implemented because of cost overruns and political issues, compromising environmental and social objectives.[61] In Cali, as a result of construction cost increases, funding for measures anticipated by the Bank's social safeguards policy were delayed or reduced in scope, leading to negative economic and social impacts. For example, the program to retrain bus drivers in new occupations was incompletely implemented, spurring large protests by traditional bus operators. In Montevideo, both civil society and the bus companies reported in interviews that they felt there was a lack of consultation by the municipality during the construction phase. As a result, there were several protests in the area of the BRT construction even before the opening of the corridor.[62]

2. BRT systems infrastructure and traffic engineering

4.22 **While BRT stations were generally well designed, including key features that allowed off-board payment and level boarding, there were some issues in station design and planning in all three cities.** Lima's and Cali's stations included several important features including signage, off-board payment and enabling level boarding, accessibility for disabled passengers). However, in Lima, some stations had insufficient

59 Given that the scale of the bidirectional busway was large in comparison with that of the historic and narrow streets, the busway design was insensitive to existing urban form in this section of the city. The system has also generated additional traffic congestion in neighboring streets, which is adversely affecting the neighborhood, although the share of traffic attributable to the BRT rather than other factors is difficult to assess.

60 The busway impeded pedestrian crossings along major activity centers in up to 8 locations along the corridor (pedestrian crossings were incorporated in response) and also impeded homeowners' access to their garages. Personal communication with Oswaldo Patino, consultant, February, 2015.

61 The mayor implemented a "Zero Impact Policy" and called for bus operators to be relocated to other parts of the city to avoid rather than mitigate adverse impacts. The mayor was planning to run for president, and this solution posed fewer political risks compared to disbanding operators and placing them in new businesses.

62 Source: Interviews with local stakeholders and http://www.montevideo.com.uy/auc.aspx?193216,1,1149.

egress and access capacity to handle passenger loads in peak hours; inaccurate station-level demand forecasts and poor pedestrian planning led to bottlenecks at entrances and severe station crowding. As a result, long lines spill out into sidewalks not designed to safely hold large crowds.[63] In Montevideo, stations were placed too close to the intersections, causing uneven bus distribution (or bunching).[64] Station geometry also resulted in unsafe passenger movements into the street,[65] prevented level passenger boarding and alighting, and provided minimal weather protection. While all the systems display information on bus routes and schedules at stations, Cali's and Montevideo's systems lack real-time information on bus frequencies, creating uncertainty for users about bus routes and arrival times. In Lima, such real-time information is not clear at all stations. Maps of bus lines and routes are reportedly confusing to passengers in both Lima and Cali.

4.23 **Land constraints in Montevideo and Lima have resulted in inefficient placement of bus terminals, undermining system performance and reducing efficiency.** In Montevideo, placing the bus terminal about 600 m from the trunk line added 6-7 minutes to travel time compared to aligning it along Avenida Garzon, and the transfers to the feeder buses added approximately 3 minutes to each passenger trip.[66] In Lima, placing one of the bus yards 7 km north of the terminal has created inefficiencies, wasted fuel, and lost revenue opportunities.

Well utilized bike parking at Lima's Matellini Terminal station increases access by an environmentally sustainable mode

Photo: Oscar Quintanilla

4.24 **Prohibiting left-hand turns and giving buses signal priority at intersections improves operational speed and reduces potential vehicle-bus conflicts.** These measures were implemented in Lima and Cali, but in Montevideo, as a result of strong opposition from drivers inconvenienced by such restrictions, the municipality reversed them. Since the street had only two lanes approaching the intersection, this resulted in an increased number of signal phases, longer delays for buses, and increased hazards of vehicle conflicts and

63 Several such stations have been or are being redesigned.

64 Field observation. They should be located at least 40 m from intersections to avoid delays with passengers taking a long time to board/alight (IDTP, 2013).

65 Passengers first have to disembark from vehicles into the street and then on the bus station at some stops.

66 After some weeks of experimentation, most services were restored to their original configuration, but the routing is still, inconveniently, via the Terminal.

accidents.[67] Additionally, intersection vehicle detectors are not in operation, causing unnecessary stops and slowing bus speeds, as buses receive little green-light time.

4.25 **Bike lanes and pedestrian infrastructure were shaped mainly by local demand, funding availability,[68] and policies, resulting in varying design qualities.** In Lima, a positive feature of the project was the inclusion of bicycle parking at bus terminals, and several bike lanes were built with funding through a Global Environment Facility grant. However, although the project had set a target of doubling bike trips, bike paths are reportedly not yet widely used.[69] In addition, as a result of poor pedestrian planning and infrastructure, passengers needing to access stations are often forced to walk along overly narrow sidewalks and brave busy unprotected intersections, generating significant safety hazards. In Montevideo, although bicycle lanes, bike parking, and bike share systems were originally part of the city's transport plan, none were installed near the corridor despite wide sidewalks and level terrain. Moreover, the corridor previously had a wide, grassy median that served as a point of refuge for pedestrians crossing the wide, busy, high-speed avenue; eliminating or narrowing this median between intersections to make way for the bus lanes had caused a perception of decreased pedestrian safety.[70] However, pedestrians have benefited from the wide sidewalks and increased signalization of previously unprotected intersections in a corridor that was characterized by high levels of pedestrian-vehicle collisions. Cali's pedestrian and bikeway components were of particularly high quality because of a supportive regulatory environment and high local demand for such infrastructure improvements. The project included 24 km of bikeways (half of which have been built to date), generally well-designed pedestrian infrastructure around stations, pedestrian overpasses, and well-utilized public spaces. Pedestrian and bicycle design associated with the project benefited from national standards regarding pedestrian access around public transit infrastructure, although an ex-post evaluation found some discontinuities in pedestrian infrastructure at specific locations (SDG, 2013).

Unprotected crossings to access Lima's BRT stations increases access time and decreases safety

Photo: Lynn Scholl

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[67] Prohibiting left-hand turns reduces severe crashes by 22%. Signals have been incorporated at intersections to enable safe left-hand turns across the busway for mixed traffic. Several intersections have long cycles, with up to five phases lasting from 80-120 seconds (field visits). Efficient BRT operations would minimize the number of traffic-signal phases (IDTP, 2013).

[68] National governments did not have a policy of funding bicycle infrastructure in any of the cases.

[69] The World Bank's Project Completion Report states that bike surveys revealed a lack of familiarity with the bike paths; the paths were also under-promoted because of their late implementation and lack of advanced planning. Increasing integration of the bike network, improving safety, and extension into higher-demand areas are some measures that might improve usage.

[70] Interviews with an NGO and bus operators in Montevideo.

3. PPP design and BRT system operations

4.26 **Flaws in PPP designs and risk allocation structures have undermined planned bus reforms and project outcomes, particularly project sustainability.** In both Cali and Lima, the financial risk of unmet system demand forecasts was placed mostly on the private operators, while the cities lacked strong incentives to take politically sensitive or financially costly measures that could increase such demand, such as restructuring the competing bus services, scrapping the old buses, and finishing key infrastructure segments that had been delayed by cost overruns.[71] To compensate for the unmet demand (and on the grounds that several aspects of the infrastructure and other factors that affect demand have not been implemented), cities are not enforcing several of the contract clauses designed to improve service quality, such as fines, liquidated damages, and tow truck availability.[72]

4.27 **Long and rigid concession contract terms and political economy issues have negatively affected fare collection systems and system sustainability**. In Cali, 20- to 25-year concession contracts for the bus and fare collection operations proved to be too rigid to account for all the changes that could happen in such a long period of time. In both Lima and Cali, a shortage of fare-charging machines, attributable to binding contractual provisions with fare collection companies, has led to long lines at stations to charge cards, a black market for trips, and a loss of revenue for bus operators, in the case of Cali. In Montevideo, the off-board fare collection system, important to facilitate fast passenger flows, was omitted because of opposition from bus companies concerned about possible job losses of onboard fare collectors and fare revenue losses.[73]

4.28 **The choice of bus technology was important to emissions, operational performance, and service quality objectives.** In Montevideo, where the bus companies were well established and consolidated (into five companies), and no competitive tendering process took place, the city did not require the companies to purchase modern buses. The companies fiercely opposed reforms such as the introduction of new buses to their fleet[74] or change the fare collection model, for which they had little economic incentives, particularly given the low perceived return on such investments in a low density and demand corridor. In contrast, in Cali and Lima the bus companies were required through concessions contracts to purchase new low-emissions vehicles. The systems incorporated a range of bus sizes and types tailored to service levels; doors on both sides of the buses gave them the flexibility to operate on both the trunk and feeder routes. However, until

71 Placing the demand risk solely on the operators affects the quality of service since the operators had no way to increase their revenues except by reducing operating costs and not paying their debt obligations. The city should have a bigger share of this risk since it is responsible for reorganizing the competition, building the infrastructure, programming, and promoting the service.

72 In addition, in Lima, the fact that the board of the executing agency is disproportionately represented by bus companies (4 of 5 members) has, according to the municipality, given the companies too much negotiating power related to fare increases (interviews with Protransporte staff).

73 Off-board payment systems would entail a separate company to collect and redistribute fare revenue based upon bus kilometers traveled, resulting in possible revenue losses for the operators with the highest passenger load factors per bus kilometer.

74 New buses were opposed by bus companies under the pretext that they needed to run on the busway and in mixed-lane traffic in other sections and that the size of the investment required on their part may not be justified by the scale of the project relative to the city (interviews with bus companies).

recently Cali's buses lacked onboard call buttons to indicate when a passenger needs to disembark, making the system initially less efficient by causing buses to stop unnecessarily.

C. Effectiveness and outcomes with respect to project objectives

4.29 **The success of Lima's *El Metropolitano* BRT system in terms of mobility benefits in the trunk corridor stands out, as it saved passengers significant travel time and received a gold standard award from the ITDP**.[75] Besides incorporating the basic BRT features, it includes an integrated feeder and trunk system, passing lanes, high-capacity articulated buses[76] with wide doors and universal access, and a programming and control center. It serves one of the highest-demand corridors and provides service late at night and on weekends. The system's passing lanes allowed the addition of highly popular express and super express services[77] between high-demand stations. Nevertheless, the system faced several challenges in the first years of operation that led to lower than expected net emissions benefits, demand and service levels, and financial sustainability concerns. In Cali, the engineering and operational design of the BRT corridors also included several of the best practice engineering features of a BRT system mentioned above (earning it the silver award from the ITDP), with well-designed stations, multiple integrated routes, feeders and complementary buses. It also included several positive and important improvements to public spaces and extensive pedestrian and bikeway infrastructure. However, the system's operational and implementation issues have led to low public approval ratings in recent years, lower-than-expected mobility benefits, and significant social upheaval surrounding reforms to the traditional bus sector.[78] Montevideo's project design was diluted to such an extent from the original plans that, aside from the establishment of a 6.3 km dedicated busway, new bus stops, a bus terminal, and electronic payment cards, the system incorporated no other design features associated with a BRT and is not improving mobility or reducing emissions in the corridor.[79] (See Table I.1 for a summary of project results for all three case studies).

1. Mobility and system performance

4.30 **Demand for the systems was initially much lower than projected in all cases; however, with improvements to services and completion of key infrastructure, demand has been growing rapidly over time in Lima and to some extent in Cali (See Figure 3 in Annex).** In Cali, while the actual demand has grown, to 550,000 passengers per day (as of 2013), it is still only 54% of that projected and well below the point at which tariffs will cover operating and maintenance costs (700,000 passengers/day). In Lima, initial demand was also well below the expected level (220,000 per day versus 600,000 predicted). Ongoing adjustments

75 The system received 87 of a possible100 points on the international ITDP BRT scorecard.

76 Articulated buses are buses with two rigid sections and a pivot joint for maneuverability, allowing longer overall length (about 25 meters) and higher passenger capacity (around 200 passengers).

77 In express services, buses skip several stops to enable faster transport between high-demand origins and destinations.

78 The system received 85 out of a possible total of 100 points on the ITDP international BRT scorecard.

79 Montevideo's system received 42/100 points on the BRT scorecard as scored by Gerhard Menckhoff during the team's mission.

and improvements to the system–such as the addition of express and super express services, an integrated tariff, and on-going route restructuring–have bolstered demand to near the target values (approximately 590,000 on a typical weekday). Ridership on Montevideo's system is around 95,000 per day. The expected demand was not included in the loan proposal; however, the project's alternatives analysis estimated potential demand on *both* corridors, assuming route restructuring, to be 257,000 to 260,000 passengers per day.

4.31 **Lower-than-forecasted demand is attributable to unfinished infrastructure, continued competition from traditional and informal buses, and the incomplete set of buses in operation, resulting in lower service quality**. Financially struggling bus companies have kept the number of buses in the systems lower than needed, leading to longer intervals between buses, and thus longer wait times, crowding on buses in peak hours, and lower demand for the system. In Cali, while 852 buses were planned to meet service level needs, only 76% (644 buses) are in operation. In Lima, the system opened with only 22% of the envisioned buses, 64% were in operation by 2011, and now nearly a full set of buses is in operation (280 of the 300 planned). However, crowding on buses is an issue in peak hours due to too few buses in service. Demand for Montevideo's system has been growing over time; however, between the opening of the system (December 2012) and August 2014, the number of passengers transported per day on the busway has remained stable (about 95,200/day). This trend is not surprising, since the second corridor is still under construction and the first corridor has failed to improve operational efficiency and travel times.

4.32 **Lima's BRT has achieved relatively high levels of transit capacity and bus speeds and Cali's a moderate level, while Montevideo's capacity fell slightly (Figure 4 in Annex).**[80] Lima's BRT carries an impressive volume of 32,000 passengers per direction per hour (pphd) in the most heavily traveled sections, with estimated average commercial speeds of 20 km/h, with higher speeds for express services (24-27 km/h).[81] Cali has moderate peak-hour passenger volumes (21,100 pphd) on the trunk line (DNP, 2011), with a system-wide passenger load of 13,000 pphd and average bus speeds of 17.7 km/h (Data provided by Metrocali, 2014). In Montevideo, peak-hour volume on Avenida Garzon probably declined compared to before the project to about 2,200 passengers in each direction, a relatively low level for a BRT busway.[82] Lima's high performance is related to all-around strong BRT system design, choice of a high demand corridor, and frequent buses. However, its performance, like Cali's, could be higher, with more buses in operation, shorter bus headways, and measures to reduce bus bunching. Montevideo's system could benefit from improved intersection treatments to enable faster bus speeds and from increasing the use of electronic fare cards (to enable faster boarding), perhaps through pricing incentives (such as lower fares for those who use the electronic smartcards rather than cash).[83] System productivity, measured as passengers per kilometer, increased in two of the cases, with

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80 System capacity is measured as passengers transported per hour per direction. Transit system capacity is a function of several factors: bus speeds, ridership, number of buses in service, size of buses, number of bus lanes, and bus service frequency.

81 In comparison, Bogota's *Transmilenio* system, which has the highest peak hour passenger throughput of any system, exceeding those of many metro systems, is roughly 37,700 (in 2013). Source: http://www.chinabrt.org/en/cities/bogota.aspx

82 According to the executing agency.

83 Given the political resistance from bus companies to off-board fare payment, this might be a more feasible option.

Lima's having the highest, followed by Cali. In Montevideo, basic system characteristics indicate that IPK could not have improved (see Montevideo Case Study).

4.33 **Weak technical capacity, coupled with political economy issues around incumbent bus operators, has also resulted in incomplete bus system restructuring and lower-than-expected system performance, particularly in Montevideo.** In Lima and Cali, bus routes that were part of the BRT system were restructured to fully utilize the segregated corridor and include express and local services; however, both systems have suffered to some extent from competition from traditional bus operators. In Montevideo, bus lines were not significantly restructured, resulting in suboptimal utilization of the corridor and minimal to no mobility and emissions benefits.[84] As mentioned previously, although the bus companies acknowledged the importance of restructuring bus routes to better serve passenger demand and to improve operating efficiency, they generally opposed reforms that in their view posed threats to jobs, control over fare collection and distribution, and service provision.[85]

4.34 **Lima's and Cali's BRT systems saved passengers significant amounts of in-vehicle travel time along the trunk line routes; however, in Montevideo, passengers complained of increases in travel times of 6 to 10 minutes.** Lima's passengers have saved the most in-vehicle travel time–on average 34% (from 53 minutes before to 35 minutes after the project). The addition of express and super express services has likely bolstered time savings considerably. In Cali, travel-time savings are on average 29% (65 minutes to 46 minutes on the north-south trunk-line). However, system-wide in-vehicle travel-time savings were more modest (5-6 minutes on average) because not all bus lines operate in dedicated lanes. In addition, wait times for buses and crowding have been increasing given the under-supply of buses to the system. In Montevideo, the project led to an increase rather than decrease in travel times for passengers and considerable public backlash against the project (7 minutes on average were added to routes that now had to stop in the new terminal, which was 500 m from the trunk line). None of the projects measured access times to stations, while Cali's did measure wait times.

2. Mobility for the poor

4.35 **In Lima, numerous feeder buses reach into the poor neighborhoods, providing access to the BRT trunk terminals and destinations in between. However, feeder service to poor neighborhoods to the west could improve coverage, and in the north, 11 km of trunk-line service remain unfinished.[86]** In addition, in some cases, feeder routes did not reach far enough into neighborhoods, leading to long walk times to reach the feeder bus stops.[87]

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[84] Except for the creation of Line G, which operates along the entire corridor and carries only a fraction of the demand, the other routes remained unchanged, so that buses use only small portions of the 6 km busway.

[85] CUTCSA, especially, was skeptical about a project that would involve more equal participation and coordination among all operating bus companies (Departamento de Planificación Urbana).

[86] The new mayor's plans to complete the last 11 km of the system will enable the trunk line to reach even deeper into poor neighborhoods, north of the current terminal in Naranjal.

[87] Interviews with NGOs and citizen groups (Cali).

4.36 **In Cali, poor neighborhoods receive good coverage in the eastern portions of the city although several areas on the western side of the city do not receive adequate connections and service, especially in steep and hilly zones lacking sidewalks and stairs, where many MIO buses had difficulties with the terrain**. Hilly areas are now served by informal jeeps (SDG, 2013), which the transit agency is working to integrate into the BRT bus system. In addition, some low income users initially had trouble understanding the system and trusting some features (e.g., smart cards), reporting that the maps and instructions were overly complex and difficult to understand. Notably, 10% of OVE's survey respondents among non-BRT users (but regular public transit users) living near the feeder routes cited long walks to bus stops as a barrier. Increasing integration with other public transit modes, and reducing access time, both in terms of distances to bus stops and wait times for buses, are two measures that could increase ridership and utility of the BRT systems for the poor (see Poverty Analysis Annex).

4.37 **While the poor in Lima and Cali benefit from the BRT systems, poor[88] public transit users living in the area of the BRT system use the system less than alternative public transit, indicating a need to better tailor services to meet their needs.** In Lima, the system has attained its goal of having 60% of its riders from socio-economic strata C, D, E (low-middle income, poor, and extreme poor, respectively). However, 43% are poor (D) and extreme poor (E), and the poor still use the traditional public transit system at higher rates (1 km from trunk and feeders). Roughly half (54%) of strata C, D, E, use the BRT system at least once a week. Rates of usage are much lower among the extreme poor, with 57% of the extreme poor not having used the BRT in the previous week (see Poverty Analysis Annex).[89] Much higher shares – 95% of the poor and 97% of the extreme poor – had used other public transit modes at least once a week. The results indicate that while the BRT system serves the poor, other public transit systems in their neighborhood continue to serve a larger share of their mobility needs. Similarly, an

The "last mile" problem in Cali. Jeeps that serve poor residents in the steep hillsides of Cali serve a unique mobility niche that MIO has not yet been able to fill, pointing out a need for more innovative and flexible solutions to solve the "last mile" problem in outlying areas.

Photo: Lynn Scholl

88 Strata, D, and E.

89 We define middle income as stratum C, poor as stratum D, and extreme poor as stratum E. For example, 33% of poor and 37% of the extreme poor used other public transit five days a week, while daily use of the BRT among the poor was 15% and among extreme poor was 8%. In 2013, BRT trips comprised approximately 2.2% of all trips taken by middle-income groups, 0.6% of those taken by the poor, and 0.2% of trips by the extreme poor (OVE analysis of JICA Origin Destination survey, 2013).

ex post evaluation commissioned by Metro Cali in 2013 found that the MIO is the main mode of public transport among public transit users; however, the system is used more by the middle class (stratum 3) than the poor and extreme poor (strata 1 and 2). For the extreme poor (stratum 1), modes such as informal *camperos* are important (close to 10%).[90]

4.38 **A survey conducted by OVE of poor (strata 1-2) public transport users confirmed this trend, finding that 26% of *all* the trips taken by low-income users involve the BRT**. When excluding walking trips, the BRT is serving a greater portion of trips, with 42% of their trips are by the BRT and 58% by other non-BRT public transit. Therefore, the BRT systems are providing benefits to the poor who utilize it, though the higher rates of usage of other public transit modes among those who live in walking distance of the systems indicates that the BRT service characteristics could be improved to better meet pro-poor objectives. This is particularly relevant in the case of Cali, where the system was intended to serve nearly all the city's public transport demand, as compared to Lima, which only serves a single corridor and operates alongside other services.

4.39 **Route-destination mismatch, or system coverage, service quality, and long lines at stations were among the top reasons poor people cited for not using the BRT system.**[91] In Lima, non-BRT public transit users stated that they did not use the *Metropolitano* because (i) the routes did not serve their destinations (67%), (ii) lines at stations to charge cards and enter buses were too long (21%), and (iii) the buses were often delayed (13%). In Cali, non-BRT users in strata 1 and 2 stated they did not use the MIO because (i) other modes of public transit were faster for their destinations (32%), (ii) the MIO buses were often delayed (18%), and (iii) lines at stations were too long (18%). In addition, in interviews with a local NGO in Lima, the prohibition of large packages and bags on BRT buses was cited as a barrier for some poor micro-entrepreneurs who need to transport their products on public transit services.

4.40 **Flat public transit fares that allow free transfers may increase affordability for longer trips involving transfers.** In Lima, before the BRT was in operation, someone living in the poorest areas who wanted to reach the center of the city would have to pay a mototaxi to reach a micro stop, then pay a micro to get to a *colectivo* or bus stop, and finally get the *colectivo* or bus to complete the journey; the cost of the trip could add up, and the trip could take two to three hours. Lima's survey from 2004 shows that more than 50% of the population in the far north (where the poor are concentrated) paid more than US$1 per trip for public transit. Therefore, the new BRT system and feeders may be more affordable for poor people who need to travel downtown; and the flat fare represents a cross-subsidization, since the poor tend to live in the periphery. However, for shorter trips the BRT may be more expensive: the traditional system charges by distance beginning at 0.50 soles, whereas until very recently the *Metropolitano* cost 1 sol for the feeder.[92]

90 The ex post evaluation shows that the number of users from the poor areas is close to 260,000 for Stratum 1 and 211,000 for stratum 2.

91 Survey respondents to this question were poor regular public transit users living in the area of influence of the BRT system that did not use the BRT at least once a week.

92 In early 2015, after OVE's survey, Protransporte lowered feeder fares from 1 sole to 50 centavos.

4.41 **OVE's survey analysis found that travel expenditures among low income and poor Metropolitano users were on average twice that than that of those of regular users of other public transit modes, and travel times were 50% longer.** These findings may imply a higher willingness to pay for faster service and usage for trips that are longer given the integrated fare and travel time savings in the trunkline. In Cali, in 2010, in comparison with users of collective transport, travel times for BRT users are 4 minutes *longer* (7% difference) on average while travel costs of on average 130 COP (11%) *lower*. Integrated fares and introduction of feeder routes that replace the need for two or more transfers in traditional transport at full fare cost is likely a factor explaining the lower costs for MIO users (analysis of 2010 OD survey). Similarly, given the trunk-feeder configuration and reduced stop spacing within segregated corridors, the BRT would have a comparative advantage for longer trips as in Lima, a possible explanation for the longer average travel times on the BRT (see Poverty Analysis Annex).

4.42 **In Montevideo, although the project was expected to benefit low-income passengers,[93] the lack of bus system improvements implies little mobility benefit for low-income residents in the project's area of influence.** However, the development of an integrated fare system combined with the introduction of smart cards (2010) that developed in parallel to the Bank's project as a result of a Bank TC could have improved affordability for the poor. In 2010 an electronic smart card was developed in the city; the first card is free and the second costs 50 pesos.

3. Emissions of local and global pollutants

4.43 **Emissions of pollutants decreased in Cali and showed no change or a possible increase in Montevideo, with Lima between these two (Figure 5, Annex I and Emissions Analyses Annexes).** In Montevideo, transit vehicles remained old and polluting, and changes to the operational characteristics of the corridors decreased the efficiency of bus service (more signals and stops and possibly slower average bus velocities). Consequently, emissions were not improved and may have actually worsened. OVE estimates range from an increase of 8% (140 ton/year) for CO_2 emissions and 12% for NO_x to a slight reduction of 40-80 tons per year (1.65-3.30%).[94] In Cali, the large-scale system was estimated to reduce CO_2 by 40-60% and $PM_{2.5}$ by 66%, implying significant public health benefits. Lima's BRT reduced emissions by 78,600 to 204,500 tons per year of CO_2 from 2012 to 2015, representing 3-8% of the total emissions from the city's entire public transport system.[95] The system's impact is considerable at the corridor level for $PM_{2.5}$, with estimated reductions of 17% in 2012 and 19% in 2013, close to the project's target of 20% (See Cali Emissions Analysis Annex and Lima Emissions Analysis Annex).

4.44 **In Cali and Lima, delays in vehicle scrapping kept emissions savings from reaching their full potential.** Vehicle scrapping programs have progressed slowly because of

93 The residents who use buses in this area were mainly low-income. Between 2007 and 2009, only about 7.73% of the poor households owned a car versus about 35% for the non-poor (IMM, 2009).

94 Given uncertainties surrounding the baseline, bus operating speeds (OVE received conflicting data from various sources, ranging from16 km/h to 23km/h as the baseline). Emissions estimates by OVE with consulting services of Juan Pablo Bocarejo, Universidad de los Andes.

95 This reflects that the corridor carries 500,000 daily trips (in 2013), representing less than 5% of the 11 million daily trips across the whole public transport network in Lima.

weaknesses in PPP contract design, poor enforcement, and incomplete or missing social programs for displaced bus operators. Nevertheless, although the process has been politically difficult, Cali has managed to scrap 73.5% of old vehicles (3,626 of the 4,685 targeted). In Lima, only 26% of old vehicles have been scrapped (as of May 2014). Bus companies contracted as part of the PPP for the BRT system could pay a fee in lieu of scrapping vehicles as part of their contracts; most bus drivers preferred this option because the fee was lower than the economic revenues from keeping the buses in service and also Lima had no established scrapping system. In subsequent years, the fund created from this fee has allowed the city to scrap buses by offering compensation to drivers outside of the concession who may have lower opportunity costs of removing vehicles from service. However, the funds have thus far been insufficient to reach scrapping goals. In Cali, public transit fares were earmarked into a special fund, and bus companies are contractually responsible for ensuring that vehicles are scrapped; however, due to unfinished infrastructure and financial sustainability issues, several bus operators are unwilling to scrap their buses. Finally, modal shifts (from private vehicles to public transit) were lower than expected (only 2% compared to the 4% shift from private vehicles to the MIO[96]).

4. Traffic safety

4.45 **Traffic safety is likely to have improved within the BRT systems, but an evaluation of this dimension was hindered by weaknesses in monitoring and evaluation of accidents around the corridors as well as data limitations.** For example, traffic accidents in Lima's BRT corridor declined by 65% (from 26 to 9 accidents per month[97]). However, only accidents occurring within the BRT system's right of way were recorded, and only in the first year of operations. Monitoring of accidents after this point has not occurred, while steadily growing demand and numbers of buses have increased exposure to traffic accident risk.[98] Moreover, analysis of accidents is limited to those occurring inside the busways and stations; it excludes accidents around the BRT and its stations, and in adjacent streets affected by traffic signal reconfigurations to accommodate the BRT.[99] Cali's ex-post evaluation system did not monitor traffic safety impacts directly; instead the evaluation applies estimates based on a study of Bogotá's system (SDG, Cost Benefit Analysis, 2013). The project's completion report states that accident reductions met the project's target (a 15% reduction). In Montevideo, while traffic accidents fell after the system opened (from 13 per month in 2012 to 10 per month in 2013), accidents had spiked during construction and had then fallen to an average that was close to the baseline years before construction (between 9 and 10 per month in 2006-2009).[100] Finally, driver training, which is important to preventing crashes associated with driver error in BRT systems, was implemented in Cali and Lima but not in Montevideo, where bus drivers reported in interviews having difficulties maneuvering buses in the first

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96 Clean Development Mechanism (CDM), 2012.

97 Lima's system recorded 26 serious or fatal accidents per month in the baseline; in the first year of operation (2010 to 2011), the figure fell to an average of 9 per month.

98 With growing demand and increased bus miles traveled, risk exposure rises, increasing the chances of accidents.

99 BRT systems, if not well designed, have been found to potentially increase accidents in adjacent streets and at intersections (Duduta et al, 2012).

100 Baseline data in the loan proposal differed from those provided by the city (13 versus 10 accidents per month, respectively), making the detection of traffic accidents before and after the project uncertain.

months of operations in the new busways. In all the cases, the evaluation of impacts on traffic safety was impeded by a lack of availability of detailed data and statistics controlling for exposure or population (i.e., accidents per vehicle kilometer or per unit population), as well as general controls for confounding factors over time that could simultaneously affect traffic safety and which are needed to make causal attributions to changes in accident rate trends.[101]

5. User satisfaction, land use impacts, and financial sustainability

4.46 **Maintaining high public approval ratings is important to garnering high ridership and, in turn, for system financial sustainability and serves as an indicator of system quality.** Lima's system has received relatively high public approval ratings, ranging from 60% to 82%, depending on the survey (Lima Case Study Annex). While Cali's approval ratings of 56% in 2009 were initially close the project's target of 60%, the latest public opinion surveys show that around 25% are satisfied and 30% think the system has improved mobility compared to the traditional system.[102] While most users in Cali appreciate the comfort of the stations and the impacts on air quality, limited bus frequency and overcrowding, have diminished the satisfaction and support for the system (Cali Case Study Annex). Montevideo's system was unpopular among public transit users, because of the implementation issues and lack of mobility benefits (Montevideo Case Study Annex) (See also Box 2, Annex I).

4.47 **While all three projects were expected to be financially self-sustaining, the fare revenues in Cali and Lima have been insufficient to fully cover operating expenses** (Figure 6, Annex I**).** In both cases, fare revenues are still below the price bid by the private operators, putting financial stress on the operators, the city, and related financing institutions. As demand remains below expectations in Cali and took several years to achieve in Lima, fare revenues have been insufficient to cover all the systems' operational expenses and the debt service for the buses. According to the bus operators in Lima, they were initially receiving only 56% of the price per kilometer they had bid, barely covering operation and administration expenses. However, with some improvements to the system and fare policy, demand has increased, bringing revenue rates up to 91% of costs per programmed kilometer (Lima Case Study Annex). In addition, bus operators have not begun paying back the loans they incurred to purchase buses; after 10 years, the initial payment period of the buses, the buses will have reached full depreciation, resulting in significant sustainability issues. Similarly, in Cali's MIO system bus operators with lower financial liquidity have gone bankrupt and were bailed out by other investors (Cali Case Study Annex). Financial struggles of the bus companies can result in a vicious downward cycle in which bus companies remove buses from operation to lower costs, leading, in turn, to lower demand and fare revenues, and larger cost-recovery shortfalls.

4.48 **Although the projects' design did not include extensive land use development around stations, several improvements to the urban environment -- such as public plazas, landscaping, and an underground mall -- were part of the projects' design and benefits.** In Lima, an underground station spurred a thriving shopping mall development. Montevideo's project attempted to create a shopping center at its terminal (Colon); however,

[101] A lack of controls for confounding factors that might affect traffic safety makes it difficult to attribute changes in accidents to the BRT system.

[102] Cali Como Vamos, 2013, and Steer-Davies Gleaves, 2013 (22% of system users, 14% of non-users in the area of influence of the system).

the location of the terminal in a low-density area with relatively low passenger demand seems to have limited the intended urban development impacts as shops remained empty at the time of the team's mission. Although TOD was not a part of Cali's original plan, a study of land use changes in Cali after the implementation of the project found increased densification around the trunk-line station stops (SDG, 2013). Over time in Montevideo, if appropriate improvements and adjustments are made to the system to enable faster service and attract more users, land use development could emerge. In all three cities, TOD could provide revenue opportunities to support the BRT operating costs through taxes on real estate value added to properties near stations where land value increases as a result of transit investments. This would require inter-institutional coordination, the capacity to track land value increases, and the application of well-designed tax and levy instruments (Smolka,2013)

4.49 **The institutional strengthening components helped raise the local capacity of the agencies charged with managing the BRT systems, but they would have benefitted from a broader scope and greater timeliness.** The three projects helped increase capacity in the BRT management agencies and were successful in orienting these agencies towards results. In all cases, the BRT agencies adopted detailed corporate results frameworks, carried out targeted trainings, and strengthened staffing in such areas as planning, infrastructure design, legal services, external communications, and customer services. The adoption of the semiautonomous agency model for implementing and operating the system created islands of excellence and technical expertise that, nevertheless, were not immune to political influences; nor are they yet well integrated with other key functions of the local government, such as planning, infrastructure, or traffic management. In Cali and Lima, the average tenure of the agency director was one year or less, reflecting the BRT agencies' lack of real managerial autonomy or stability. In the three cities, staff turnover rates were moderately high (up to 9% a year in Montevideo for 2014),[103] making it difficult to retain institutional capacity despite the projects' earlier investments in training. Finally, in both Lima and Cali, despite low local capacity at project inception, the implementation of the institutional component was delayed by cost overruns related to the infrastructure component. In contrast, In Montevideo, earlier support through a Japanese Trust Fund technical cooperation helped build capacities from project initiation.

103 Data retrieved from IMM (2015).

V. CONCLUSIONS AND SUGGESTIONS GOING FORWARD

A. Conclusions

5.1 **The urban transport projects were, overall, highly relevant to the cities' mobility problems and resulted in several important and positive outcomes, including increased mobility, reduced travel times, and lower emissions in two of the three cases.** Lima's system, garnered the highest travel-time savings of the three cases. Cali's system, receiving strong support from the national government, also provided substantial travel-time savings for trips along the trunk lines and had a much wider impact because of its ambitious scale. In addition, important improvements to public spaces were made in Cali and Lima. In Montevideo, while few if any mobility or environmental benefits were realized, the increased signalization of intersections may have increased the safety of pedestrian crossings in the high-velocity and multi-lane corridor. Passengers also benefited from improved sidewalks, a new electronic fare card system, integrated tariffs, and a system enabling information on the best route combination from any origin to any destination in the city. In future years, as the city grows, the segregated busway may provide an increased benefit in terms of reducing congestion delays, particularly if other supporting measures and design improvements are made to the system. Although the systems incurred cost over-runs, they still provided significantly more cost-effective mass transit improvements compared to rail-based alternatives.

5.2 **While the projects brought several positive results, several issues adversely affected their development outcomes that offer lessons for future projects.** The choice of corridors for a BRT system had a strong influence on mobility benefits. In Lima and Cali, dedicated busways were appropriately placed in high-demand corridors that experienced significant levels of congestion. In contrast, in Montevideo, the BRT pilot corridors were considered as demonstration projects and were placed in two relatively uncongested corridors with lower negative construction impacts but potential social benefits. However, the operational and institutional reforms that would have generated the most enhancements to bus performance, particularly given low levels of congestion, were not implemented due to weak institutional and technical capacity of the municipality, combined with failed negotiations with incumbent, consolidated, and well organized bus companies. Cali's system, given its scale, had wider benefits but also greater risk due to its comparative complexity and has suffered from service quality and implementation issues. Lima's corridor may have resulted in increased benefits due to a more focused incremental approach, though the system is still lacking integration with other public transit modes and suffers from unfinished infrastructure. Although all the projects included improving mobility for the poor as either explicit or implicit objectives, the Bank and local governments did not conduct sufficient diagnosis of mobility needs of the poor to inform project design. Moreover, the Bank's limited involvement in several key complementary measures to support the infrastructure investments–such as PPP contract design, pedestrian planning (in Lima), and scrapping programs–presented risks that were realized to varying extents in each of the cases, hindering expected project benefits.

5.3 **Several institutional and technical capacity weaknesses, political cycles, and political economy issues adversely affected the degree of support for the transport sector reforms in all of the projects at various stages, as well as the completion of BRT lines that had been planned for the future.** Regulatory capture presented barriers to policy reforms in two of the cases to varying extents, particularly when such reforms would entail significant losses to some stakeholders. Finally, the systems in Cali and Lima are facing financial sustainability issues, as are many other BRT systems across the LAC region. The increasing demands placed on such systems in terms scale and quality, and the significant public benefits they can bring, when well implemented and maintained, calls for the consideration of operational subsidies to improve long-term sustainability and results.

B. Suggestions for the future

5.4 **OVE makes several suggestions for future Bank supported urban transport projects involving BRT systems.**

1. **The Bank should support municipalities in choosing appropriate corridors for BRT systems.**
    - Corridors with low demand and congestion stand to benefit little from an exclusive dedicated busway, particularly absent the implementation of other necessary reforms in support of the system such as government supported land use policies that would shape land use around corridors to increase demand (such as in the case of Curitiba). BRT corridors should be selected based upon three basic criteria: (i) high public transit demand, (ii) ability to connect major activity centers to support the demand, and (iii) existing or predicted near-term levels of congestion that create significant bus service delays. The Bank should continue its efforts through TCs or other mechanisms to support the development of urban transport plans, ideally in coordination with land use planning, to inform corridor choices.
    - When considering pilot BRT systems on relatively minor corridors (in terms of demand and levels of congestion), the risk of negative impacts during construction should be carefully weighed against the likelihood that other institutional reforms that are necessary for bus system improvements will be implemented. Corridors lacking congestion should be avoided altogether and may be better candidates for other bus system improvement measures (e.g. improving stop spacing, bus arrival information systems, providing signal priority at intersections, among others). This requires generating buy-in on the part of key stakeholders, especially the bus consortia, through early and ongoing dialogue.
2. **The Bank should offer increased support and technical assistance during loan preparation and implementation for the necessary complementary reforms (e.g. route-restructuring, station designs, fleet modernization, inter-modal integration, institutional frameworks, PPP arrangements among others) and engage in dialogue to gain sustained and strong political buy-in of key stakeholders early on.**

- During project preparation, design and implementation, the Bank should take steps to improve the likelihood that local governments will implement important supporting measures based upon sound technical analyses and best practice guidelines, providing incentives and possibly conditions on loan disbursements for critical components. Although difficult to legally enforce, conditions can serve as points of discussion during supervision missions. Agreement can be fostered through dialogue with the client that engenders mutual understanding of the importance of such measures for project success. In addition, the Bank should promote a dialogue among key stakeholders- such as the executing agencies and incumbent bus operators- to help garner consensus on needed sector reforms.
- PPP models have been widely utilized in LAC, with varying success in terms of bus service quality and financial sustainability, calling for a re-examination of the PPP model and possibly increased government participation. Where a PPP model is utilized, project teams should provide technical assistance that includes analyses of the risk of demand shortfalls and mitigation measures and the inclusion of well aligned incentives between governing entities and private bus operators to provide ongoing high-quality bus service, possibly in collaboration with the Bank's private sector arms. PPP contracts should be flexible enough to allow necessary adjustments to changing conditions that might affect service after operations begin.
- The Bank should provide increased assistance for cost-effectiveness and alternatives analyses of fuels and bus technologies (as in Lima). This support should give careful consideration to the design of compensation schemes and economic incentives for fleet renewal (to facilitate vehicle scrapping and to spur bus companies to invest in low-emissions vehicles).
- The design (size, layout, and access and egress points) and placement of stations should be adequate to handle peak passenger flows; provide a comfortable, weather-protected environment for passengers; allow level boarding; and enable efficient bus flows. This requires adequate demand forecasts at the station level and well-designed pedestrian planning to support a rational distribution of the passengers among and within stations. Stations should also provide adequate, clear, and accessible user information on bus routes and arrival times that is legible to all user groups. Stations and the system as a whole should be designed to integrate well with other environmentally sustainable modes and existing public transit systems. Implementing off-board fare payment systems with sufficient, well-placed kiosks for recharging cards is important to reducing delays associated with passengers boarding, station congestion, fare revenue loss, and passenger delays due to long lines to charge fare cards.
- Projects should include robust institutional and technical capacity-building components that are protected from potential infrastructure cost over-runs and that increase executing agencies' ability to effectively oversee, manage, and update route planning over time in response to changing demand patterns. In addition, clients may benefit from more technical advice in the initial BRT

operational phase with issues such as scheduling, bus operations, and over-crowding.

3. **Given the two-way interaction between transport supply and land development, urban planning should be carried out in an integrated manner and involve inter-institutional coordination between both transportation and planning agencies.** To this end, the Bank should support ridership and access to stations by environmentally sustainable modes, and work to integrate BRT systems with land use planning, such as through transit-oriented development (TOD), especially in medium-sized and growing cities. This could be fostered through increased collaboration between the urban development and transport divisions of the bank, technical assistance and grants for transit-oriented land use planning around corridors (including zoning and design of incentives to increase density and mixed uses), and a long-term programmatic approach in cities.

4. **Urban transport projects should incorporate components for well-designed pedestrian and bikeway facilities connecting to BRT and mass transit systems**. Systems should be integrated with surrounding public transit modes (e.g. restructured route systems) as well as non-motorized modes. Pedestrian facilities should be planned to enable safe and comfortable access to and around stations for all user groups, including the disabled, elderly, and children. In particular, studies of high-demand areas for pedestrian crossings should be conducted to avoid unintended barrier effects created by the busway. Bikeway facilities that are part of an inter-connected network are more likely to be utilized than those that are fragmented.

5. **The inclusion of objectives and specific components to improve access and mobility for the poor in the Bank's urban transportation programs is essential to the Bank's mission of economic development and poverty reduction.** To this end, the Bank should deepen its diagnosis of mobility needs of low-income populations to inform project design, including analyses of issues around access, spatial mismatches between skill-appropriate jobs and housing, travel patterns, and affordability. This is relevant both from a safeguards point of view –projects that seek to radically reform the informal bus sector should be careful to avoid unintended negative impacts on mobility for the poor– and for projects with explicit objectives of improving transit for the poor. To improve mitigation measures for displaced bus drivers, the Bank should enhance social safeguards components and protect their funding from potential infrastructure cost overruns.

6. **The Bank should support LAC governments in considering whether to subsidize BRT system operational costs and the use of innovative financing mechanisms to ensure long-run financial sustainability and affordability.**

   - Such subsidies can be efficient and welfare-enhancing when designed to provide incentives for high-quality service (i.e., targeted subsidies conditioned on service quality measures). To improve affordability for the poor, targeted vouchers may be more effective, however, lower fares may serve also to promote usage by all user groups and encourage more environmentally sustainable mode choices among non-captive public transit users.

   - Land value capture mechanisms, while requiring inter-institutional coordination, could be a significant source of revenue under specific conditions –e.g. land value increases resulting from transit investments and well-designed tax and levy instruments -and has the potential to significantly improve the long-term financial sustainability of urban transportation projects**.** Payroll taxes earmarked for transit (as used in France), are another public transit finance mechanism that could be considered.

7. **As complements to BRT systems, future urban transport projects, should seek to integrate other innovative public transit reforms that incorporate incumbent private bus operators (e.g., *colectivos,* mini-vans, paratransit**). Such operators have traditionally filled the gaps in centrally planned public transport systems, and/or in a context of deregulation, offering flexible and demand-responsive services, but often with several negative side effects such as pollution, high accident rates, or gaps in coverage. Appropriate strategies could include regulatory reforms to mitigate these negative effects (e.g., emissions control standards, safety and vehicle standards) while harnessing and improving the mobility benefits. Traditional *colectivos* that operate informally and according to demand (formally known as paratransit) can fill an important role in cities' peripheral areas, serving as both feeders to BRT systems along high-demand corridors and complementary services in lower-demand corridors; they should be integrated in such reforms rather than treated solely as threats to viability. The use of modern ITS technology (e.g. GPS, Internet, and mobile phones) makes possible innovative business and regulatory models in which oversupply and aggressive driving behaviors could be monitored and controlled. This might be implemented in collaboration with the Bank's private sector windows.

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Table I.1. Effectiveness and Results: Summary

	Lima		Cali		Montevideo	
	Rating	Comments	Rating	Comments	Rating	Comments
1. BRT Design	Excellent ★★★★★	ITDP Gold Standard (87/100).	Excellent ★★★★★	ITDP Silver Standard (82/100).	Poor ★☆☆☆☆	Does not meet basic BRT definition (42/100).
3. Mobility	Excellent ★★★★★	34% travel time savings in trunk lines (vs 25% expected).	Fair ★★☆☆☆	28% travel time saving in trunk lines (vs. 29% expected). 5% overall. More segregated corridors and buses in operation could improve mobility.	Poor ★☆☆☆☆	Increased transfers, more signalized intersections, no bus priority, terminal off main corridor.
4. Environment	Fair ★★☆☆☆	Limited bus scrapping; good very-low-emission buses; high passenger/trip/corridor but low overall impact in city.	Good ★★★★☆	Later but significant progress in scrapping; relatively low-emission buses; high reductions due to scale of project.	Poor ★☆☆☆☆	No scrapping program; same polluting buses; no likely reductions in traffic and congestion.
5. Mobility for the poor	Fair ★★☆☆☆	Connecting north-south poorer areas, but comparatively lower usage by the poor.	Good ★★★★☆	Broad system coverage, including (with delays) most poor areas, except for hillside informal settlements. High use, moderate fare pricing.		
6. User satisfaction / public opinion	Good ★★★★☆	60-82% "Good/Very Good " in 2012 (vs. 64% metro, 12% combi or coaster).	Poor ★☆☆☆☆	Satisfaction rates have declined to 25% in late 2013 (target: 55%).	Fair to poor ★★☆☆☆	Public discontent with system was high according to press, but system adjustments have reduced complaints.
7. Sustainabi-lity	Fair ★★☆☆☆	91% recovery of operational costs.	Poor ★☆☆☆☆	Bus companies struggling financially.	Good ★★★★☆	Bus companies are financially solid.

Note: See Detailed Scorecard in Annex.