The São Mateus-Jabaquara Trolleybusway Concession in Brazil

By Jorge Rebelo and Pedro Machado[1]

Exclusive or segregated bus lanes or busways are lanes primarily for bus operation, which are physically separated from other traffic by medians and barriers with grade separation or priority at intersections. In general, they are the most cost-effective means of transport with a demand of up to 20,000 passengers per peak hour per direction. Traditionally, busways have been built by the State/Municipality and most often operated by private operators under a short-term operations contract. In this note we describe a concession of an existing busway, in which the State's objective was to grant a concession for operation of the busway for a 20 year term. In addition, the concession would include, as an obligation of the concessionaire, the replacement of the diesel bus operation with electric traction (trolleybuses). Although this was not a "greenfield concession", it is, to our knowledge, the only example of a "busway" concession undertaken so far in the world. This note describes the rationale behind the concession, the highlights of the concession process and the results to date.

The São Paulo Metropolitan Region (SPMR), with 8000 sq. km, has 16.8 million inhabitants spread irregularly over 39 individual municipalities which are dominated by the São Paulo Municipality (SPM) with 8.5 million inhabitants. The SPMR generates roughly 20% of GNP and is considered the most important economic region of the country. Each day, 30.9 million person trips take place in the SPMR of which 10.6 million are walking trips. Fifty percent of the motorized trips are by private automobile (10.2m) while the remaining are 38% by bus (mostly private operators), 8% by metro and 4% by train. Of the 10.1 million trips by public modes, about one third use more than one vehicle, requiring some sort of modal transfer: 78% of all metro trips, 61% of all train trips and 16% of all bus trips require one or more transfers to be completed. This level of urban transport activity, dominated by the road-based motorized modes has significant impacts on the SPMR's environment. Despite an existing 250 km rail network, the lack of integration between the metro and the suburban trains discourages more rail trips, in favor of buses and the automobile, creating heavy congestion during peak hours which significantly increases home-to-work trip time.

With approximately 16,000 buses in the SPMR (of which 12,000 are in the SPM), competition for urban road space between buses and road traffic is a daily struggle in São Paulo. While public buses are theoretically given preference through measures such as

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parking restraints along bus routes, the reality is that traffic policies which enhance bus flows are rare. As a result, buses are subject to the general traffic conditions that prevail throughout the arterial network in the area, which keep them from providing fast and reliable transport services. One key traffic control feature that significantly interferes with bus operations is the current traffic signal timing logic, which favors the flow of automobiles. Another interference to bus operations is the excessive time at stops, caused by the ticket collection system and poor accessibility for bus passengers which creates longer boarding and alighting times. The result of these interferences is an average bus speed of around 13 km per hour, headways which vary greatly, and poor service reliability.

Reserved and Exclusive Bus Lanes

São Paulo has adopted certain practices aimed specifically at improving bus operations. To this date, reserved or exclusive bus lanes[2] have been incorporated in about 100 km of arterial streets. These bus lanes are roughly divided between right-side lanes (52 km) and central lanes (46 km). In most cases, bus lanes are separated from general traffic lanes by rubber stud dividers. These types of bus lanes can be rapidly implemented at low cost and are easy to reverse if problems arise. They are, therefore, quite attractive to traffic authorities. However they also pose several problems, such as conflicts with turning vehicles and freight loading/unloading operations. Furthermore, in the absence of constant enforcement, regular traffic will tend to invade the reserved lanes and mix with bus flows. They therefore require constant supervision and enforcement. That problem does not exist with segregated bus lanes, because they are protected from other traffic by some type of barrier.

In 1983, the State determined that the São Paulo Metro Company (Metrô) would be responsible for planning and implementing a set of exclusive intermunicipal trolleybus corridors, which would be integrated with the São Paulo municipal bus lines and the State-owned rail-based network. As part of this mandate, the Metrô had the task of implementing the first priority connection between ***São Mateus and Jabaquara***, creating an interconnection ring along the perimeter between São Paulo (São Mateus, in the east) Santo André, São Bernardo do Campo, Diadema and São Paulo (Jabaquara in the south). The implementation of infrastructure works, acquisition and installation of equipment, as well as the development of the Operational and Integration Projects, took place from 1984 to 1987, at which time the responsibility of all State "intermunicipal" bus service operations were delegated to the Metropolitan Urban Transport Company (Empresa Municipal de Transportes Urbanos - EMTU), also under the State.

[2] ***Reserved bus lanes*** are traffic lanes which are reserved for bus operations. These lanes are identified as such but are not physically separated from other lanes by medians or barriers. ***Exclusive or segregated bus lanes*** or busways are lanes physically separated from other traffic by medians and barriers with grade separation or priority at intersections.

Project Rationale

The main objective of the São Mateus-Jabaquara corridor was to satisfy an important lack of public transport supply in the southeastern region of the SPMR, due to very high passenger demand between two important regional nodes, which until now were only served by conventional bus services. The program also attempted to reconcile the needs of the municipalities involved by providing a structural transport connection which took into account land use and physical ,operational, and tariff integration.

The project had two basic goals:

- to provide an intermediate capacity public transport service with a design concept and changes in the road infrastructure to ensure its priority over other road traffic. The traffic segregation of the trolleybuses from the rest of the general traffic allowed for greater commercial speed and facilitated the control and reliability of supply.
- to become a factor in inducing a process to reorganize and discipline conventional bus service in its area of influence.

This corridor project was originally intended to satisfy a daily demand of 250,000 passengers, with operation totally based on electric traction (trolleybuses). However, due to higher than planned for need of public investment and for a cost-effectiveness comparison of trolleybuses versus diesel buses, the original project was only partially implemented. As a result, until 1995, of the 188 vehicle fleet in the São Mateus-Jabaquara corridor only 46 were trolleybuses and the rest were diesel single or articulated buses. The operation and maintenance of this corridor was done through operations contracts with private sector companies, while the EMTU was responsible for management and supervision of services.

The determinant factors in the decision to concession out the trolleybus corridor to the private sector were:

- to reduce the involvement of the State in public transport operations.

- to reduce (by 30%) State costs in the management of operation services which, until 1995, were outsourced to private operators. The State would continue with the responsibility of regulating and monitoring services.

- after approximately 10 years without being able to complete the corridor as planned, due to lack of state budgetary resources, the concession would allow the completion of fleet electrification which had been postponed for more than 10 years.
- to allow a longer term concession making the trolleybus a viable option. Since the Brazilian legislation (Law 8666/93) only allows operations management contracts for periods not exceeding 6 years, EMTU was forced to call for new public bids every 6 years to maintain the operation. If this six-

year concession period for management contracts was maintained, the electrification of the fleet would be financially unattractive.

EMTU decided that a concession rather than an operations contract for services would allow longer terms and therefore, a depreciation compatible with the useful life of an electric traction system. The comparative advantage of diesel buses over trolleybuses would then be minimized. In this specific project, the main difference consists of the investment and operating costs of a diesel bus and a trolleybus, since the other investments on infrastructure, such as the segregated right-of-way and partial electrification, had already been done by the State. Among the advantages and reasons which led EMTU to opt for total electrification of the fleet and return to its original concept for the São Mateus-Jabaquara corridor were:

- the emission of pollutants is zero and the noise caused is much less than the normal noise on urban roads, allowing more comfort to the users and less degradation in the areas surrounding the corridor. In fact, the famous 9th of July busway corridor with diesel buses, carrying record volumes of 18,000 passenger per hour per direction (pphd) is, in retrospect, a failure from the environmental standpoint, since it transformed what was once a beautiful avenue into an area where only auto mechanic shops and depots are located.

- the operating conditions in segregated rights-of-way is favorable to trolleybuses because they allow controlled acceleration and deceleration with maximum speeds which can be limited to 60km/hour, thereby improving safety conditions.

Once the advantages of a trolleybus operation were identified , both for the users as well as for the population who lives close to the busway, EMTU undertook a financial simulation to determine the cost increment to be incurred by the concessionaire by replacing diesel buses with trolleybuses, all other assumptions held constant. The evaluation pointed out that the incremental financial costs to be supported by the concessionaire with the electrification of the corridor would be equal to 2.5-2.8% of the fare revenues. The comparison of the situation with project (trolleybus fleet) vs. without project (diesel bus fleet plus existing EMTU ‘s trolleybus fleet), using operational life spans for the diesel buses and trolleybuses of respectively 10 and 20 years, yields an internal rate of return of 14% for the situation with project excluding environmental benefits.

Scope of the concession of trolleybus services to the private sector:

Objective of the Concession;

- operation and maintenance of the metropolitan corridor (São Mateus-Jabaquara) including total fleet electrification within five years;

- maintenance of the road exclusive right-of-way and the aerial network;

- implementation of electrification and operation of the trolleybus system in a 14 km link between the Diadema (center) municipality and São Paulo, Brookline, on the banks of the Pinheiros River, near a future train station.

- acquisition from EMTU-SP, at market prices, defined in the bidding documents, as the trolleybus fleet in operation (46 vehicles); auxiliary vehicles, depots, tools and equipment.

Table 1: Physical Characteristics of the trolleybusway

Length	Terminals	Stops	Electrification
33 km *Of which :* 30 km in exclusive segregated busway and 3 km in shared way	9 (nove) *Of which :* (6 with physical integration and 4 with physical and tariff integration)	55 each way *Or:* 111 both ways	22.5 km already electrified and 10.5 km with electrification to be executed

Table 2: Ridership Data in 1995

Total passengers (monthly average for 1995, in millions)	Nº of trips taken	Level of Service	Maximum Headway (minutes)	Fleet	One way Tariff
Paying 4.5 Integrated 1.5 Others 0.4 **Total 6.4**	92,525	Peak hour = 5,4 Passengers/m² off peak = 3,5 Passengers/m²	20	46 Trolleybus 120 diesel buses 23 articulated diesel buses	R$1,00 (US$1=R$1.06)

Concession Characteristics

Concession Term:: 20 years. This would allow ample time for amortization of the trolleybuses and new investment.

Ownership: a) infrastructure, including administrative installations, parking and vehicle maintenance areas, exclusive right-of-way integration terminals, bus stops and systems and equipment which already exist continue as state property; **b)** the trolleybuses totally depreciated during the concession will be transferred to the government. The trolleybuses which are not fully depreciated by the end of the concession could be acquired by the state for their residual value.

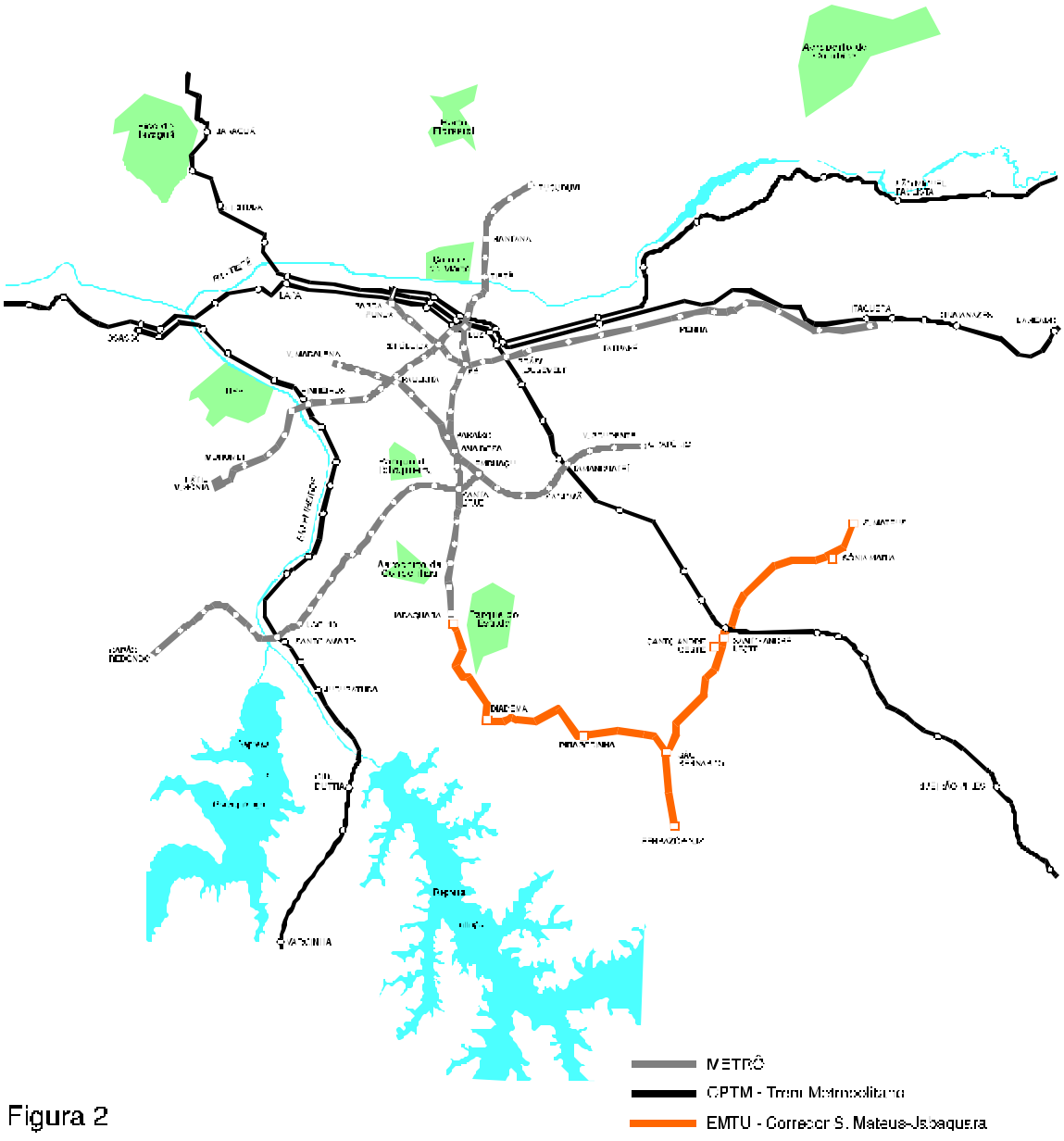
METRÔ
CPTM - Trens Metropolitanos
EMTU - Corredor S. Mateus-Jabaquara

Figura 2

The São Mateus-Jabaquara has an extension of 33km of which 30 km are totally segregated busway

Aerial View of the São Mateus-Jabaquara corridor

Service Specification: a) the State defines the norms and guidelines for the services to be operated and these must be clearly specified in the bidding documents. Emphasis is put on the maximum interval between departures and the number of passengers/square meter at peaks. The concessionaire prepares the Operating Plan and submits it for the approval of the EMTU-SP, which will also be responsible for its enforcement. It requires that present schedules be maintained for 90 days after contract signing. This would avoid problems in the first days related to the approval of the fleet in case the whole fleet required from the concessionaire would not be immediately approved. Cleaning and maintenance of the busway infrastructure is also a responsibility of the concessionaire.

Tariff Authority: the State is responsible for setting the tariff and for reviewing it in such a way as to ensure the economic and financial equilibrium of the trolleybus system taking into account its integration with other modes in the SPMR. Tariffs will always be set by the State.

At the time of the bid, the tariff was flat and equal to R$1.00 (US$ 0.94). A clause for annual adjustment of the tariff was included using a locally accepted price adjustment index. It was made clear that price adjustments were essentially to compensate for loss of buying power of the currency. There were no demand guarantees. A clause on how to readjust tariffs in the 30 days after readjustment is authorized was introduced to protect against anticipated acquisition of tickets and monthly passes.

A clause to ensure that there would always be an economic-financial equilibrium of the concession according to Brazilian Concession law. This is a controversial concept. It means:

-The State must compensate the concessionaire for any unilateral decision to modify any clauses that may add to the costs of the concessionaire.
-The State and/or Concessionaire must compensate for any new legislation enacted after the contract is signed (e.g. new federal/state/municipal) which has an impact on revenues or costs either way.

Service Remuneration: will be a revenue for the concessionaire, the revenues derived from the fares paid by the user, the revenues resulting from legally accessible advertisement in the vehicles and other revenues previously approved by the State.

Incentives for fleet electrification

- Heavy fines and loss of performance guarantees if electrification schedule is not complied with.
- A premium of 0.0169% of revenues for each diesel bus replaced and 0.0307% for each articulated bus replaced. These values were obtained by estimating the operating costs of a trolleybus and of a diesel bus over 20 years with amortization of one trolleybus and two diesel buses and return on investment of 14%/year for investor.

Compulsory payments to the State

- 10% of non-operating revenues such as advertising in the vehicles and in the right-of-way. All advertising projects to be approved by EMTU prior to launch
- 15% of operating revenue over the term of the concession
- 1.55% of the operating revenue for amortization of the 46 trolleybuses
- concession fee to be proposed by the concessionaire in its bid. The highest net present value of this payment would define the winner. This fee could never be lower than the incentives allowed by the State for replacement of the fleet

***Important aspects of the bidding process*:**

- All companies Brazilian or foreign could participate either as firms or joint ventures
- After concession award the firm or joint venture had to create a Special Purpose Company

Obligations of the Concessionaire

- provide the State all the documentation and information required for monitoring and auditing purposes
- maintain up-to-date inventory of assets related to the concession
- inform the State of any special occurrences which may have an impact on operations and service
- not to introduce diesel vehicles for the first time which are more than 10 years old
- not have trolleybuses in operation that are more than 30 years old
- not replace vehicles in operation with other vehicles that are older
- be responsible for any expenses due to alterations in the road infrastructure or in terminals
- maintain satisfaction ratings at least at the level of the latest ANTP-GALLUP polls
- install more automated ticketing equipment for Edmonson type cards or later on, smart cards

Obligations of the State

- Monitor, on a permanent basis, the level-of-service provided by the concessionaire
- modify unilaterally, the regulations if need be in the interest of the public, with adequate compensation to the concessionaire
- stimulate the creation of user associations
- intervene in the operation if need be, retake it from the concessionaire if justified by the contract and or legislation
- undertake periodic audits to verify the condition of the road infrastructure and the technical resources used
- undertake public opinion surveys
- ensure that the eventual increments of traffic in the shared right-of-way are not causing negative impacts on operations and their costs
- hire independent safety audit companies to review, evaluate and propose rules and procedures which safeguard users and pedestrians

Bidding Process

- The Bidding process had 4 stages:
  - Pre-Qualification
  - Technical Evaluation
  - Cost Proposal
  - Fleet Inspection

The Pre-qualification called for Legal, Technical, Financial and Fiscal requirements, a Bid bond of R$1 million and a Minimum capital requirement of R$10 million and other financial ratios.

The Technical Proposal asked for: a) Experience in operation of public transport; b) experience in operation of public transport in trunk corridors with feeder lines; c) experience in operation of public transport with trolleybuses or other electrical traction vehicles ; d) factor referent to age of fleet which would be deployed from the start; e) factor referent to the acceleration of the schedule for replacement of diesel buses by trolleybuses.

- Each criteria received a maximum number of points. A maximum of 1000 points would be achieved for a rating of 100% in all criteria
- Any firm which would have 500 points or more would be qualified to move to the next stage, i.e., the cost proposal.
- All firms qualified would be treated equally in the next stage
- The criteria for assigning the points were very objective
- There were no requirements for a minimum point average for each of the qualifying criteria
- one could have 0 points in one criteria but if the total number of points was 500 or more the firm would be qualified for the cost proposal
- Cost Proposal
  - The additional percentage of the gross operating revenue over and above the 16.5% which was compulsory
- Fleet Inspection Stage
  - Within 90 days of signing the winner would have to submit his vehicle fleet for inspection and approval

Results

- There were 3 bidders
  - The winner was the Consórcio Metropolitano de Transportes which offered 0.45% of the gross operating revenues over and above the required 16.5%. Gross revenue is expected to be US$7.5 million/year
  - The process started in May 1996 and ended with an award in March 1997. The operation started in May 1997

The State of São Paulo learned from the Municipality experience (see WPS 1859) and was more cautious in the design of this concession. The concession was for the full operation for 20 years but, insofar as investment is concerned, only part of the equipment had to be acquired, because part of it was already in place. This allowed the winning consortium to generate revenues using the existing system and helped reduce the amount that must be borrowed to complete the fleet electrification. The concession was less risky for the concessionaire, and the government was achieving its objectives of completing an environmentally friendly project with the help of the private sector. With this concession, the State was able to overcome a chronic lack of budgetary resources needed to transform the diesel into an electric traction operation. Given the length of the period of the concession, a clearly established tariff review policy and the ownership of traffic revenues, the concessionaire had fewer problems in obtaining the financing required to complete the fleet electrification. This concession has so far been a success and an example to be followed. The traffic results so far are given in Table 3.

Table 3- Traffic evolution – 1995-1999 (passengers)

	1995	**1996**	**1997**	**1998**	**1999**
JAN	5,532,437	5,746,435	5,401,643	5,363,898	4,741,431
FEB	5,214,813	5,623,097	5,192,229	5,048,727	4,578,841
MAR	6,475,907	6,112,755	5,890,611	6,165,732	5,596,083
APR	5,714,651	6,235,643	5,925,337	5,727,744	5,004,747
MAY	6,221,245	6,102,514	5,763,412	6,155,375	5,229,245
JUN	6,126,756	5,771,683	6,029,135	5,834,559	4,928,762
JUL	5,929,020	6,066,797	6,294,858	5,846,822	4,873,525
AUG	6,432,294	6,474,253	5,878,890	5,991,709	5,028,237
SEP	5,086,417	5,909,164	6,098,434	5,808,699	4,914,123
OCT	6,007,340	6,111,077	6,240,909	5,654,271	4,908,075
NOV	5,903,340	5,919,973	5,818,919	5,474,578	4,899,083
DEC	6,090,546	5,000,027	5,795,304	5,415,191	5,026,544
Total	***70,734,766***	***71,073,418***	***70,329,681***	***68,487,305***	***59,730,695***
Ave./month	5894564	5922785	5860807	5707275	4977558
Source: EMTU : Concessionaire took over on May 24, 1997					

Lessons learned two years after the concession

As indicated in Table 3, after an initial increase, traffic demand in the busway started to fall in 1998 and 1999. However, this had nothing to do with the concession itself but rather with the overall fall in demand in the SPMR. This fall in demand in the SPMR is linked to a number of factors which also affected other brazilian metropolitan regions. Amongst those factors are: a) Reduction in the number of jobs due to an economic slowdown; b) strong proliferation of informal transport (vans) which are more flexible and sometimes more comfortable because they offer door-to-door service; and c) a growth in the motorization rate with a migration of public transport users to automobiles. Comparing the first 8 months of 1999 with the same period in 1996, the São Mateus

Jabaquara busway shows a reduction of 17% in total passengers compared to a total of more than 30% for other public transport modes

The Concessionaire and its Obligations

In general, the concessionaire has complied with its obligations although the schedule for replacement of diesel buses by trolleybuses is lagging , mainly because the improvements in the aerial network (which are the responsibility of the State) have not been undertaken. This might be one of the main aspects of the concession which displease the concessionaire, since when taking into account the overall concession term, the operating costs of the electric trolleybuses are lower than those of the diesel buses. The concessionaire had bought 32 new vehicles by the end of 1999: 22 single and 10 articulated trolleybuses . As established in the concession contract, the reduction in the demand is a commercial risk assumed by the concessionaire and does not justify an increase in tariff. To cut its costs the concessionaire can however adapt the supply to the demand by reducing the operating fleet and cutting a number of trips. Although the concessionaire did not do that immediately, he is now starting to do it.

The State and its Obligations

The formula used by the State in the concession contract appears to be working well to meet the objectives set for this project. However, the State has failed to: a) undertake the timely improvements and completion of the aerial network which caused the above mentioned delays in the replacement of diesel buses by trolleybuses; and b) complete the rehabilitation of sections of the roadway which were already in bad condition when the concession was signed and which the State had agreed to rehabilitate. As a lesson learned, the State representatives indicated that : a) maybe it will be better to exclude from future concessions any State obligation to undertake infrastructure works and find a mechanism to allow the concessionaire to do it; and b) turn over the administration of integration terminals to the concessionaire. State's obligations depend on State budgets which are fragmented and defined by the prevailing political priorities. The challenge will be to pass on these obligations to the concessionaire without undue burden and still allowing a reasonable return on investment.

Conclusions

So far, this is a very successful concession which has set the precedent for future busway concessions. State planners learned from the errors of previous failed attempts at the municipal level in the SPMR and crafted a model with which the private sector could live. Recent ridership surveys indicate a very high level of satisfaction of the users of the trolleybusway. The proliferation of illegal buses (vans) in São Paulo has affected all formal bus trips in the region, and may have a negative effect on the trolleybusway if the regulatory entity does not step in to stop illegal buses. Furthermore, delays on the part of the State to do its part, i.e., to complete the aerial network, might also have negative impacts on the concessionaire notwithstanding any compensation provided in lieu.