



Global  
Green Growth  
Institute

# Comparative Analysis of Bus Public Transport Concession Models

Full Report









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# 01 Introduction

The Global Green Growth Institute (GGGI) has been supporting the Megalopolis Environmental Commission of the Central Region of Mexico (CAME) to establish strategies for climate change and develop green growth initiatives. The CAME is a multi-jurisdiction commission created in 2013 to address environmental issues in the following states: Hidalgo, Morelos, Puebla, Tlaxcala, State of Mexico and the Mexico City (formerly known as Federal District). These six states make up the Megalopolis of Central Mexico -including its nearly 190 municipalities<sup>1</sup>-, with an estimated population of 30 million people and concentrating a third of Mexico's GDP, resource use and waste output.

As part of the joint work between the two institutions, GGGI Mexico has launched a project with CAME's Executive Committee for the Renovation and Transformation of Public Transport. The project aims to provide the Megalopolis states with guidelines and best practices to change the prevailing owner-operator transport model. The need for change is based on the multiple flaws of the current model, where there is no government control over revenue, operators engage in "on-street competition" in order to maximize passenger boarding and increase profit; there are no requirements for fleet renewal and no clear incentives to promote service quality and safety.

The project includes: a) several analyses of alternative concession models for bus operation; b) the definition of an economic model to financially test and plan transport systems and their modifications, and c) the evaluation of externalities. In addition, tasks will be carried out to engage potential financial sources in order to evaluate and design financial instruments to access funds. The final objective of the project is to structure a framework that can lead to an organized and regulated public transport.

In order to address a part of the Renovation and Transformation of Public Transport project, GGGI contracted GSD+ to develop a comparative analysis of public transport concession models. The main objective of this work is to propose alternative concession models to local authorities that could help them attain their mobility and environmental goals, considering the circumstances of each state and ministry. This report is divided in three sections:

A comparative study of public bus concession models in five different cities that include a critical appraisal of their effects on operations, considering their characteristics and context.

An examination of the evolution of concession models in cities that have gone through transformations and the lessons learned from their implementation.

A conceptual outline of a concession model and implementation plan for a city of the Megalopolis to help them attain their mobility and environmental goals, considering local circumstances.

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<sup>1</sup> 173 municipalities in the States and 16 boroughs in Mexico City.

The first section presents five case studies of cities that have implemented public transport reforms, where an organized and integrated bus system is in operation. The five cities were selected because of their success in the implementation of reforms and lessons learned from the concession contracts in place. The population of the metropolitan area was also part of the criteria to choose and categorize the cities, since different public transport models could be used depending on the city size and the complexity of the transport system. The goal is for the case studies to provide valuable insight to authorities in the Megalopolis.

The five cities considered in this report are classified in the following three categories:

Large cities with population above 5 million include London (United Kingdom), Bogota (Colombia) and Mexico City (Mexico).

Medium cities with a population between 1 million and 5 million, include Stockholm (Sweden).

Small cities with a population below 1 million include Uberlandia (Brazil).

Each case study follows a basic structure and includes an explanation of the most important features of the concession model and the context of the city's public transport. The following sections are included for each city:

A brief description of the city, the public transport system, and the bus service operation.

The institutional organization of the public transport, which defines the stakeholders and their main roles and responsibilities.

A synthesis of the regulatory framework is presented to identify strategies and policies set in each city.

The relevant clauses of the concession contract are presented in order to understand features such as the type of contract, contract duration, quality of service indicators, incentives schemes, parties' specific roles and responsibilities and the allocation of risks for the stakeholders.

The overall revenues and costs of the system are outlined, in order to assess the revenue and subsidies that have been required to meet the city's objective in public transport use and quality of service standards.

The key results of the concession models are summarized to support the arguments of positive contract features or the areas where there's still room for improvement.

A conclusion is drafted for each case to summarize the main findings and closing arguments.

A benchmark matrix is included to perform a comparative analysis of the public transport characteristics, the contracts' core clauses, and the roles and responsibilities of the authorities and operators.

The second section presents the case studies of two cities that have transformed their public transport systems from an owner-operator model to an organized and integrated bus system. Pasto (Colombia) and León (Mexico) were selected for this study, due to their success in the implementing

the public transport reform. The case studies present the main challenges faced by the authority, the main concerns of bus operators over the new operational model, and how the Municipality handled bus operators' resistance to change. For each case study the following areas are developed:

A description of bus and BRT services, before and after the organized bus system was implemented.

The institutional organization of public transport, which defines the stakeholders and their main roles and responsibilities.

The institutional structure before and after the organized bus system was implemented.

A description of the main regulatory changes introduced to facilitate public transport reforms.

Steps taken to organize public transport. This includes a summary of the authority's goals, traditional bus operators' concern and steps taken to achieve the objectives set by the Municipality.

A comparison of the route concession models before and after the organized system implementation.

A comparison of risk allocation before and after the organized system implementation.

The third section includes a toolkit for cities facing a public transport transformation. The section first describes the needs of the main stakeholders involved in a transit system (users, operators and authorities). It then discusses the different aspects that need to be assessed when designing concession models for a Integrated Transport System (ITS), such as the allocation of the service contracts, contract duration, operator's remuneration scheme, quality clauses, among others. This section is based on global experiences within the context of the stakeholders' needs described in section 5. Contracting processes are explained by describing how each one works, their advantages and disadvantages, what the cases are, and where they apply. In addition, the alternatives of compensation, applicable quality clauses, incentives and penalties, technological and technical requirements, and stakeholders' risks will be analyzed in order to outline the allocation operation model.

The final section presents a brief description of implementation plans that a city should take when migrating from the current system to an integrated transport system type model.

## 02 Case Studies

### A. London

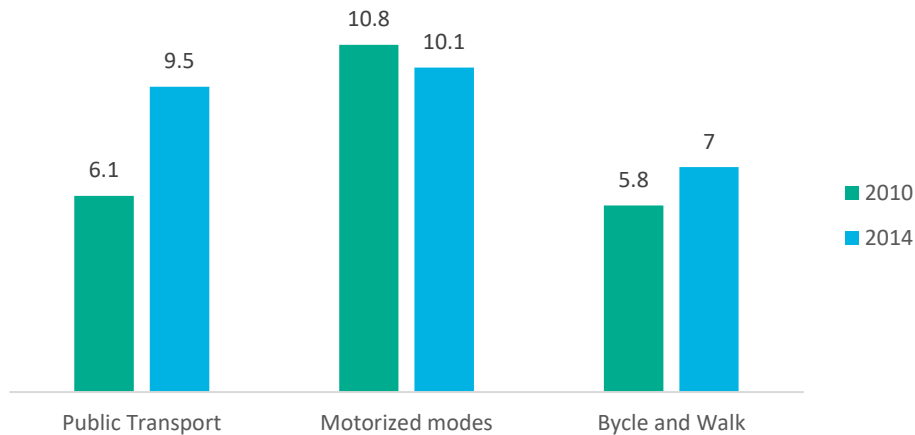
London has been successful in promoting public transportation. Since 2000, bus and rail system demand has increased by nearly 70% while trips by car and motorcycle have decreased by 6%. Some of the key factors for this success include a clear transport strategy provided by the Greater London Council, the creation of Transport for London (TfL) as the authority responsible for transport in the urban area and an operating model focused on quality of service and the promotion of safe, integrated, efficient and economic transport facilities.

In the case of bus operation, there has been improvement under quality incentive contracts and a structured tendering program based on a multi-criteria evaluation that promotes fair competition and helps to determine the capability of the bus service operators. In addition, there is the strong TfL technical team with an extensive monitoring system to assess operators' performance. The following sections provide an overview of London's bus system and the main characteristics of bus operation contracts.

#### A.1. Public Transport Overview

London is both the capital and the main city of England and is one of the largest cities in Europe. The Greater London area, or simply London, is a region with 33 districts, which includes 32 boroughs and the City of London. The population estimated in 2014 was 8.5 million, while population density stood at 5,432 people/km<sup>2</sup> [1, 2].

Daily trips in London averaged 26.6 million in 2014, of which 9.5 million were in public transport, 10.1 million in private motorized modes, and nearly 7 million were on bicycles or on foot. The authorities have been successful in implementing incentives to increase the ridership on public transport. As a result, public transport trips increased by 3.4 million, while motorized trips were down by 0.7 million between 2000 and 2014.



**FIGURE 1. EVOLUTION OF TRANSPORT MODES IN LONDON**  
SOURCE: TRANSPORT FOR LONDON [3]

London has one of the most highly developed and strong public transport systems in the world. The systems in operation include London buses, the London underground rail network, Docklands light railway, London Trams and London trains. Other smaller public systems include public bicycles, river bus services and cable cars. Nine and a half million trips take place daily on the rail, underground, bus and tram systems.

The bus and tram systems cover 4.1 million of the city's daily trips. The bus system has become especially important and its operational expansion has been the authority's focus due to restrictions on capacity increase of the underground [3]. The following is a breakdown by public transport system in 2014.

**TABLE 1. DAILY TRIPS IN LONDON ON THE MOST IMPORTANT PUBLIC TRANSPORT SYSTEMS (2014)**

Transport Systems	Average daily trips (millions)	% of total
<b>Public transport systems</b>	<b>9.5</b>	<b>100</b>
Rail	2.8	29
Underground/Light Rail	2.6	27
Bus/Tram	4.1	43

SOURCE: TRANSPORT FOR LONDON [3]

Certain route services operate between 5 am and 12 am and others from 12:00 am to 4:00 am. There are over 19,000 stops and 675 routes operated by approximately 9,000 vehicles [4]. London buses are cashless. The Capital's entire bus fleet is low-floor and wheelchair accessible, except for a small

number of vintage Routemasters operating on two heritage routes in central London. There are 21 bus companies (7 groups and 2 independent) [5].

There is an integrated fare collection system operating on all transport modes and all fleets use contactless Oyster cards. The system has been a success in revenue management and has eliminated the loopholes in revenue that occurred when fares were paid in cash on buses.

## **A.2. History of Bus Services and Organization**

London has had a long history of actions aimed at organizing public transport, under which several institutional and strategic changes have been made. The following is a review of main events during its recent history:

Due to the prevalent disorganization of transit systems, it was necessary for the Central Government to create, for the first time, a single authority responsible for public transport in London. The London Passenger Transport Board (LPTB) was established in 1933 and took control of the bus operations inside London, as well as management of the underground, railways and trams. With the existence of the LPTB it was possible to effectively plan and coordinate London's public transport development. At the time, bus services covered not only Greater London but also many neighboring counties.

Between 1933 and 1984, LPTB went through several changes in its scope of work, organizational structure and name; this included its nationalization in 1948.

In 1970, London Transport (LT) came under control of the Greater London Council (GLC). The area for which LT was legally responsible was reduced to 610 square miles.

Under the London Regional Transport Act of 1984, London Transport was again placed under Central Government control, which was prior to the complete abolition of the GLC. The Act also stipulated that, when appropriate, competitive tendering should be considered. This was introduced to ensure that LT operated economically and to reduce public assistance funding. The Act also required the creation of an LT subsidiary company to manage bus services.

London Buses Limited (LBL) was created in 1985. Route planning and fare structures remained the responsibility of LT. By that time, the Tendered Bus Division had been created in order to start the competitive tendering process. London Buses Limited was required to compete against privately owned operators on bus routes operated on behalf of LT. Its operation was established under a Gross Cost Contract. Routes were awarded to the operators who could run the best service at the most cost effective price. Approximately 40% of the initial contracts were assigned to private companies rather than to LBL [6].

As a step towards the privatization of London Buses Limited, the Government created 13 locally based subsidiary companies. By 1994, all the subsidiaries had been sold to the private sector and London Buses Limited privatization was completed.

Bus services outside London were deregulated in 1986. Licensed operators could decide to run a route without any authorization and regardless of the existence of other operators on the same route. This was intended to permit extended deregulation of the eleven London bus services when they became less dependent on Government assistance.

In 2000, the new Greater London Authority and Transport for London (TfL) were created. TfL has so far been the institution responsible for transport in the Greater London Area [7].

### A.3. Institutional Organization

London's institutional organization has a clear definition of roles and responsibilities among the different regulatory bodies governing the management and monitoring of transport systems. Institutions have the strength and technical staff to carry out their tasks. One of the key features of their organizational structure is to have Transport for London as a single institution responsible for the implementation of the transit strategy and management in the Greater London area.

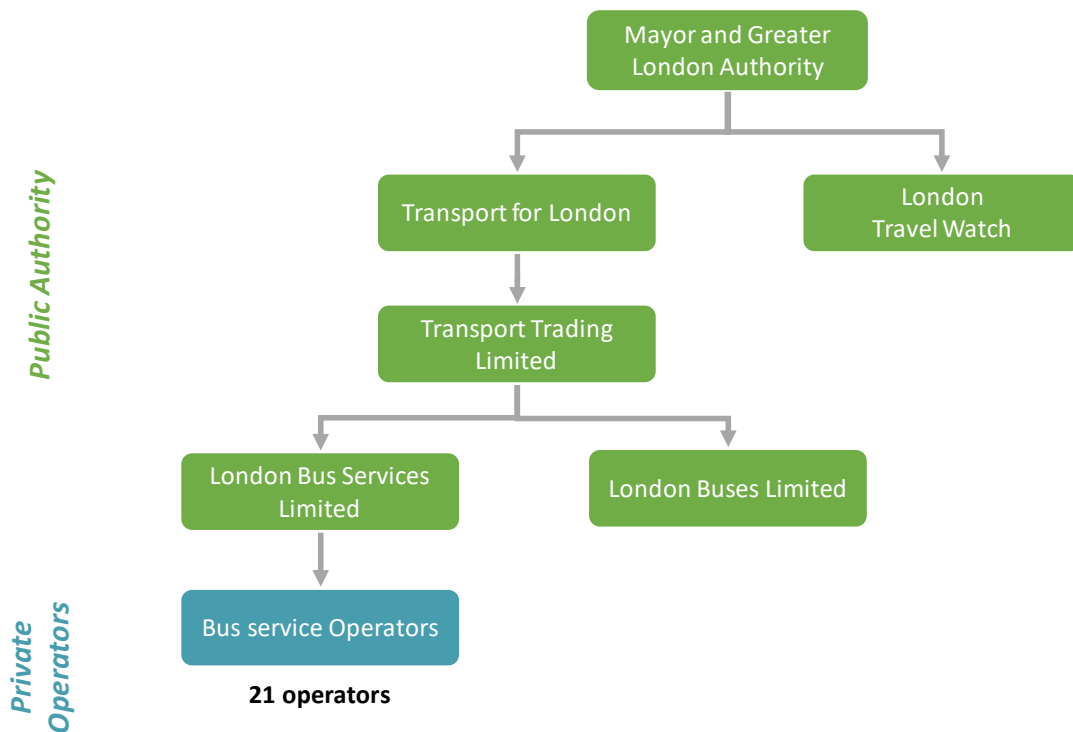


FIGURE 2. LONDON'S INSTITUTIONAL ORGANIZATION

The role of each of the transport institutions and companies is described below.

#### Mayor and Greater London Authority

Develops and implements policies for the promotion and encouragement of safe, integrated, efficient and economic transport facilities within Greater London. It defines the overall London transport strategy, sets fare levels, approves TfL budget and arranges its financing [8].

#### Transport for London (TfL)

TfL is responsible for the implementation of the Mayor of London's transport strategies. TfL plans, procures and manages a network of services in a consistent and coordinated manner. It is committed to promoting fair and sustained competition in the provision of bus services. Furthermore, it is committed to the integration of public transport services, to provide unified services, such as

ticketing, and managing subsidiary companies such as LBL [6]. TfL has three subsidiaries: London Transport Insurance (Guernsey) Limited, TfL Trustee Company Limited and Transport Trading Limited.

#### **Transport Trading Limited**

Transport Trading Limited is the holding company for all operators in the different transport modes within the Greater London area. The subsidiary companies of Transport Trading Limited are responsible for rail, tram, underground and bus services. In addition, one of the subsidiaries carries out trading and financial transactions on behalf of the other members of the holding company. Among Transport Trading Limited subsidiaries are London Bus Services Limited and London Buses Limited.

#### **London Bus Services Limited (LBSL)**

This entity is in charge of planning routes, specifying service levels and ensuring service quality. It is also responsible for bus infrastructure maintenance. LBSL also manages Croydon Tramlink, which is a light rail serving several areas in South London [8].

#### **London Buses Limited (LBL)**

Responsible for Dial-a-Ride, which provides door-to-door transport for the disabled [8].

#### **London Travel Watch (LTW)**

It is the official watchdog organization. It represents the interests of transport users in and around the capital. Besides that, LTW assists with complaints about transport in London when the service provider has not satisfactorily resolved them. LTW deals with services operated or licensed by Transport for London. Consequently, LTW works for the promotion of higher standards of quality, performance and accessibility [9].

#### **Private Bus Companies**

Private bus companies are responsible for providing bus services, maintaining assets (including buses and garages) and operating under a contract to London Bus Services Limited [8].

### **A.4. Regulatory Framework**

The legal and regulatory environment in the United Kingdom allows full contractual enforceability. The regulatory framework is subject to the following legislation:

The Greater London Authority (GLA) Act 1999 defines the powers and functions of the Mayor and general assembly. The Act includes Greater London Authority's duties with regard to transportation. The definitions of powers and functions for TfL and LBL are also defined under this Act (as described in the Institutional Organization section). The GLA Act establishes that it will be the duty of the Mayor to produce an integrated transport strategy for London.

Under GLA Act, TfL is directly accountable to the Mayor and is responsible for implementing his/her transport strategy. In addition, TfL is responsible for road maintenance and traffic management on GLA roads. The Act also establishes that the Mayor has extensive powers covering the direction of all TfL activities [10].

With regard to bus service regulation, the GLA Act stipulates that it is the responsibility of TfL to determine which bus services are required to make up the London bus network and to ensure that it is provided. This Act also introduces local London service agreements between TfL and another entities for the provision of services within the London bus network [10].

The London Regional Transport Act 1984 created the statutory company named London Regional Transport and defined its powers and obligations. It also established requirements for the provision of transport services.

European Directive 017/2004 that coordinates the procurement processes of entities operating in the water, energy, transport and postal services sectors.

## **A.5. Bus Operation Contracts**

### **A.5.1 Type of Contract**

The quality incentive contracts were introduced in London in 2000 and since then have been widely used. These are based gross cost contracts but also contain incentives in the form of performance payment bonuses and deductions. The contracts are set for an initial period of five years and a possible two-year contract extension. Contracts define a Minimum Performance Standard which will be fixed for the life of the contract and which reflects the particular characteristics of the route [6]. This standard will be the reference point to compare operator performance.

### **A.5.2 Route Allocation**

The contracts in the Greater Area of London are allocated per route and a tendering process is implemented for each of the 675 routes in the Greater London Area. Each year, 15% to 20% of the routes are tendered. Prior to bidding, London Buses Service Limited thoroughly reviews each route, taking into account LTW considerations. In accordance with this review, the following aspects are defined or modified: i) specific bus routing; ii) timetable and service frequency; iii) type and capacity of buses, and iv) a series of Minimum Performance Standards (MPS) [8].

### **A.5.3 Technological and Fleet Requirements**

The London fleet must comply with a series of requirements and specifications. Regarding features of the buses, LBL has defined the following requirements [11]:

Vehicle technical specifications, such as the chassis and body type, the need for upper deck air cooling system, minimum and maximum standing and seating capacity, maximum length and width, number of doors and engine type in accordance with specific Euro rating, among others. All of these features are specified in the contract between the bus service provider and LBSL. The operator may choose the vehicle manufacturer provided the vehicles meet all of the criteria in the vehicle specification [6].

The entire London bus fleet is equipped with cameras to monitor any incident and identify offenses that take place during service hours. This equipment is provided by LBSL.

Each bus is equipped with a two-way radio system to report disruptions in operation and emergency calls. A central communication system is provided and operated by LBSL.

The bus service operator must meet the requirements to ensure energy supply for all on-board equipment. This includes fare collection, fleet management and user information equipment. The buses must have cabling and an energy platform for this purpose. The bus service provider must guarantee fleet availability for the installation and maintenance of on-board equipment.

Requirements for the safety of the public in general, advertising positioning and painting specifications are included.

In addition, prior to starting operation of a new vehicle, it must have an approved risk assessment, which guarantees that any risks involved in the operation of that type of vehicles have been adequately mitigated [12].

#### A.5.4 Bus Operation Remuneration

The amount payable to the operator for the provision of the bus service is based on an agreed yearly contract price, minus deductions for kilometers not operated for reasons under the bus operator's control. In addition, the incentive scheme includes payments and deductions. Under London remuneration scheme, TfL retains the fare revenue and the operator pays the full operating costs [5].

#### A.5.5 Quality of Service Indicators

Performance quality is measured taking into consideration the mileage operated, the regularity and punctuality of services, driver and vehicle quality, mechanical fleet condition, customer satisfaction, contract compliance audits, passengers and staff safety, among others. All of the performance measures have a direct impact on bonuses or penalties for operators, except for safety. The following are the most relevant quality incentive clauses, with a brief description of how each indicator is measured and/or monitored.

##### **Reliability performance**

The reliability indicators measure the operator's ability to schedule, control and adjust services. Indicators are calculated with information from the operator's fleet real time tracking system (iBus) that provides real time fleet position. The reliability measurements vary for high and low frequency routes. In addition, figures are calculated separately for routes operating between 5:00 am and 12:00 am and those between 12:00 am and 4:00 am.

High frequency routes run with five or more buses per hour. Reliability for these routes is measured on the basis of regularity. The aim is to ensure that buses are evenly spaced and to guarantee that passenger waiting time does not exceed half of the advertised frequency. The following are the indicators defined for high frequency bus services.

**TABLE 2. LONDON RELIABILITY PERFORMANCE INDICATORS FOR HIGH FREQUENCY ROUTES**

Bus Frequency	Indicator Name	Description	Target value
High	Excess Wait Time (EWT)	Average time passengers had to wait above the average scheduled wait time (SWT).	0
High	EWT/SWT	Average excess wait divided by scheduled wait, which determines how many more passengers are waiting as multiples of scheduled time.	0
High	Long gaps by range	Percentage chance of waiting less than 10 minutes, 10-20 minutes, 20-30 minutes and more than 30 minutes.  Long gaps between bus arrivals at stops to identify problems with operation such as cancelled services or bunching.	0

Low frequency routes run with four buses per hour or less. These routes are controlled by a timetable so that two performance indicators are calculated based on compliance with scheduled services.

**TABLE 3. LONDON RELIABILITY PERFORMANCE INDICATORS FOR LOW FREQUENCY ROUTES**

Bus Frequency	Indicator Name	Description	Target value
Low	On time departures	Percentage of departures that leave on time, which means that departures are within a window of 2½ minutes earlier to five minutes later than expected.	100%
Low	Bus not running	Percentage probability that a bus is not running.	0%
Low	Early departures	Percentage of departures that start 2.5 minutes ahead of schedule.	0%
Low	Late departures	Percentage of departures that start between 5 and 15 minutes after scheduled.	0%

## **Quality monitoring of Driver and Vehicle**

The driver and vehicle quality monitoring program is contracted by an independent research agency and consists of:

- Static audit of buses in service assessed at bus stands. Aspects evaluated include bus conditions, visibility of variable message signs, cleanliness, timetable or frequency information display at bus stops and lighting, among others.
- Mystery shopping surveys [2] to assess both the bus route service and the driver's performance. Bus service questions refer to crowding, reliability and overall performance of equipment on board, including smart card validation, doors and route information displays. In addition, the driver is evaluated on aspects such as his/her availability to answer questions, driving skills (e.g. smoothness of braking and acceleration) and his/her appearance.
- Statistics of recent years are not published on a webpage, but submitted upon request to TfL. Survey results are used for a joint review of operators and to identify their areas of weakness [13].

## **Driver Quality Assessment**

LBSL hires a specialist to perform periodical assessments of driver's technical ability with regards to the vehicle. The assessment differs from the driver and vehicle quality monitoring referred to above in that it focuses as much on the technical ability –use of mirrors, lane discipline, braking - of the driver as it does on passenger consideration [13]. A record is kept with the scores for each driver.

## **Engineering Quality Monitoring**

LBSL hires an independent contractor to perform a review of the mechanical condition and maintenance procedures of the fleet in operation. Each year approximately 25% of each operator's fleet is evaluated.

## **Customer Satisfaction**

Bus Customer satisfaction is performed through 13,000 face-to-face surveys to users and is carried out yearly at a pre-defined set of bus stops. The surveys aim to assess 11 specific aspects: personal safety & security; crowding; reliability; information; state of repair of bus; cleanliness; bus stations; bus stops & shelters; smoothness of ride; staff behavior and value for money [14].

LBSL hires an independent contractor to perform the customer satisfaction survey. The data gathered is used to monitor user satisfaction and to identify areas for improvement.

## **Contract compliance audits**

A team of LBSL visits operators regularly to assess compliance with contract specifications. The audits aim to evaluate the strength of the administration system to handle the business, compliance with drivers' labor regulations (e.g. working hours and contractual employment) and correct reporting of lost mileage.

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<sup>2</sup> Surveys performed by a person hired by a market research firm to visit the bus stand or the bus, posing as a casual shopper to collect information about the services, staff and other characteristics of the bus system.

## Safety

A key aspect is that safety is not defined as an indicator that will impact an operator's bonus or penalty. More precisely, the authority specifically states that safety of operation is in no way a negotiable trade-off against cost. Therefore, unsatisfactory compliance with safety clauses results in contract termination or restrictions on awarding the operator a new service contract.

Safety is assessed by London Bus Services Limited with data provided by operators of accidents or incidents while the bus is in operation. Additionally, operators' premises are visited to evaluate risk management plans, policies and personnel skills.

### A.5.6 Quality Incentives and Penalties

Quality is controlled through a set of bonuses and deductions determined by the operator's performance. Quality indicators are calculated on an annual basis by comparing the operator's annual reliability performance on each route against the contracted MPS. If the operator's performance is over the MPS, it can earn 15% of the contract in bonus payments. On the other hand, if the operator's performance is under the MPS, it can have up to 10% deducted from the contract price for poor performance. The iBUs (Automatic vehicle location) system has made it possible to calculate performance indices, which have facilitated the calculation of bonuses and penalties.

An example of the impact of the reliability indicator on remuneration is as follows. Reliability bonus and penalties are calculated for every 0.10-minute change in Excess Wait Time for High Frequency routes or for every 2.0% change in the On Time indicator for Low Frequency routes. Bonus payments are paid at the rate of 1.5% of the contract price for each point above the standard. Deductions are made at the rate of 1% of the contract price for each point below the standard [5].

In addition, two-year contract extensions are offered as an incentive mechanism. Extension to the initial five-year contract is assigned to the operator based on the reliability "Extension Threshold" criteria fixed in the tender documentation for that route. This reliability threshold is slightly higher but related to the reliability MPS. The operator may select acceptance of the extension. If the operator declines to accept the extension, the route is tendered in the usual manner. If the extension is accepted, the operator continues the current concession contract for two further years, at which point the route will be tendered again [6].

It is worth mentioning that an operators' profit above the base remuneration is low, because TfL has a robust cost model and defined a profit margin for contracts that leaves no room for operators to overcharge. Therefore, operators improve profit margins by maximizing incentives and minimizing penalties. On the other hand, it is notable that many operators companies have entered the London bus market, despite the low margins, as a way to access the United Kingdom public transport services market. Most of the current operators have dabbled in the train service market, a market that has higher profit margins.

## A.6. Roles and Responsibilities of the Authority and Operators

London's bus system operation maintains clear segregation of responsibilities between the contracting party and the bus service provider. The authority responsibility lies mainly in operational fleet enforcement, contractual management, and provision of on-board equipment, on-board equipment maintenance and the construction of infrastructure. In addition, the contracting party is responsible for revenue protection, which is carried out by on-bus inspectors. The service provider is

responsible for the provision and maintenance of vehicles, the daily management of routes, operational information supply and fare payment control.

The contracting party, LBSL, has the following responsibilities:

- Structures and runs the tendering program.
- Designs and monitors contracts.
- Defines technical requirements of vehicles (capacities and engine characteristics, among others).
- Supplies and maintains fare collection and manages the fleet's on board equipment (radios, vehicle tracking devices and emergency communication facility).
- Provides revenue protection (on-bus revenue protection inspectors).
- Provides and maintains bus network infrastructure (bus stops, stands and bus stations).
- Provides roadside staff to deal with diversions and major incidents 24 hours a day.
- Markets the bus services to the public.
- Is responsible for relationship management of local authorities and other stakeholders.
- Coordinates public customer service contacts – complaints, comments and compliments.
- Defines route design, schedule, frequency and other operational requirements of each route.

Bus operators are required to:

- Develop and submit bids.
- Assign staff and specific vehicles to each route, taking into account the operational requirements defined by London Bus Services Limited.
- Provide day-to-day operation and supervision of routes to maintain quality and deal with disruption.
- Provide and maintain premises and vehicles.
- Recruit, train and manage staff, fulfilling contractual requirements.
- Control and enforce on-bus fare payment.
- Comply with UK statutory and regulatory regimes, including Operating License.
- Provide data reasonably required by London Buses Services Limited [6].

## A.7. Risk Allocation

The London bus system's risk allocation considers the stakeholders' suitability. The following paragraphs describe the bus system risks allocation:

- **Demand risk:** LBSL maintains the system's demand risk. The operator periodically obtains the agreed contract sum, which is independent of the system's demand. As long as the operator complies with MPS, it will not be subjected to deductions. Therefore, the MPS do not include requirements relating to the demand of the system. Thus, excess demand constitutes additional income for LBSL, while deficits in demand result in lower income.
- **Fare evasion risk:** Fare evasion risk is underwritten by LBSL, which is in charge of on-bus fare evasion enforcement. The enforcement is executed through undercover operations across the entire transport network. Additionally, there are high penalties that discourage fare dodgers. On the other hand, since there are no MPS relating to system fare evasion, this risk is not allocated to operators, but to London Bus Limited Services.

- **Operational risk:** This risk is underwritten by bus operators since they are responsible for day to day fleet operation and maintenance. The way in which LBSL transfers the operational risk to operators is the remuneration model. The operators are subject to deductions for lost mileage under the operator control. Additionally, the operators lose quality incentive bonuses for failing to fulfill the MPS. On the other hand, one of the operators' mechanisms to mitigate operational risk is to carry out a periodic preventive maintenance of their fleet since it decreases the probability of fleet unavailability. It thus reduces the probability of deductions from remuneration.

The driver costs and availability risk is included as an ongoing operational challenge for bus operators because it is a heavily unionized market.

- **Implementation risk:** LBSL Services is responsible for implementation of the bus network infrastructure. Network infrastructure handled by LBSL includes bus stops, stands and stations. The operator's remuneration is not affected by non-availability of such infrastructure.
- **Market / Regulatory risk:** LBSL updates the operator's contract annually. The adjustments incorporate annual movements in labor rates, retail price index and retail price of fuel. The risk of changes in these indicators is underwritten by LBSL.

## A.8. Tendering Process

London's bus tendering program is a thorough process with several stages designed to assess operator adequacy. Operators must complete a pre-qualification assessment in order to be able to compete for LBSL tendering opportunities. The service providers are assessed based on a multi-criteria condition evaluation. The evaluation criteria are mainly aligned with customer satisfaction and quality of service. The London bus tendering program is subject to the European Union Procurement Directive 2004/17/EC of 31 March 2004. This regulation focuses mainly on directives for promoting fair competition among bidders. The following is a description of the main steps of the London tendering process:

### Pre-qualification

LBSL implements a pre-qualification system for every potential operator. Through a pre-qualification questionnaire, a preliminary assessment of a bidder's suitability is performed in terms of its financial strength and experience. Once pre-qualified, the operator may submit a dummy bid<sup>3</sup> that will be assessed by the authority in line with standard evaluation principles. The authority will provide feedback on the bid, in order to help the pre-qualified operator prepare for a real submission in the future.

A Bus Services Framework Agreement, which includes full details of the contract will be issued to the approved operator, as well as a Master Invitation to Tender, which includes a guide to the respective submissions. The awarding of any contract is conditional upon the signing of Framework Agreement [6]. A pre-qualified operator is included in TfL's list of approved operators, which will be notified of new tendering opportunities.

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<sup>3</sup> A dummy bid is a "fake" proposal submitted by the pre-qualified bus operator to the respective authority in order to practice how to present a bid and receive feedback from the authority on their performance.

The Operator's performance in previous or current contracts is taken into consideration in the pre-qualification process, such that operators that do not meet quality standards may be disqualified at the front end in new tendering processes.

### **Requirements and specifications**

Prior to all new tendering processes, LBSL reviews the route and takes into account its course, service frequency, passenger demand to determine the type and capacity of vehicles and the route MPS. This review takes statutory consultants into account, including London TravelWatch.

### **Invitation to tender**

After the review, a complete invitation to tender, that clearly defines the route requirements and specifications, is opened. Approved operators may submit their proposals and propose alternatives to improve passenger benefits.

### **Evaluation**

Tender evaluation takes into account several criteria and applies fairness for all parties as the main principle involved. The evaluation is carried out by a panel of experts, after which the Tender Evaluation Committee - whose members are LBSL directors - approves and discusses the expert panel's preliminary decisions.

LBSL mainly takes into account the following criteria during the evaluation stage:

1. Quotation of the operator for the tender.
2. Ability to deliver quality services, complying with them as a minimum, at the required levels defined in the invitations to tender.
3. Staffing, taking into account the bidder's capacity to recruit, train and hold staff with an appropriate profile.
4. Premises, depot conditions and/or the capacity to acquire an appropriate depot.
5. Vehicles, taking into account vehicle type and additional features offered. This criterion also takes into consideration the bidder's capacity to maintain vehicles in an adequate condition.
6. Financial status that takes into consideration availability to fund capital expenditures and to cover operational expenditures throughout the term of the contract.
7. Schedules take into consideration compliance with route requirements.
8. Health and safety policy, taking into account the medical records required to ensure both health and safety of the staff [6].
9. Sustaining competition for tendered routes [6]. London Bus Services Limited will assess if the award of a new contract to one of the seven bus operators will exclude it from the market. In such a case, LBSL will request the operator to improve its bid as a way to promote competition.

In addition, LBSL tries to rotate operators in and out of the different routes in order to guarantee that one operator does not remain for a long period in the same route.

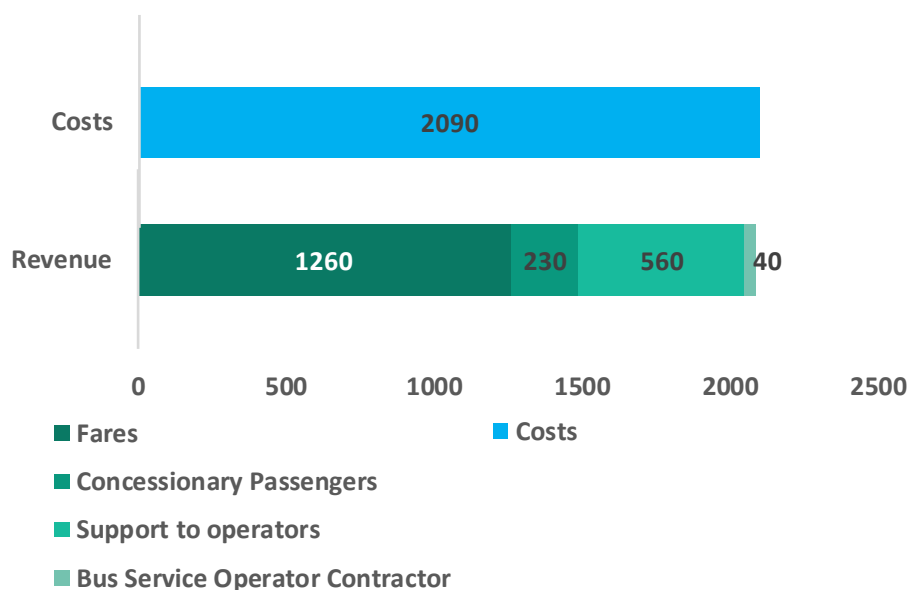
It is worth mentioning that there are several barriers of entry for new operators due to the minimum requirements of operator's experience. The main entry route is by purchasing an existing operator company, which implies high upfront costs.

## A.9. Revenue and Costs

The total revenue of London's bus system is mainly income from fares and three government financial supports. The following are the three types of bus system subsidies:

- The concessionary travel support is a subsidy to compensate reduced fares from concessionary passengers (the disabled, students, the elderly).
- Bus Service Operator Grant (BSOG) is a subsidy paid to operators by the Department of Transport. This scheme refunds a percentage of the tax levied on fossil fuels to operators. The amount each operator receives is based on the amount of fuel consumed in a given year.
- The public transport support is a subsidy from local authorities for running supported services.

The total revenue is used by the city to cover the total cost of the bus system. The following figure shows the contribution of each type of revenue to the whole cost.



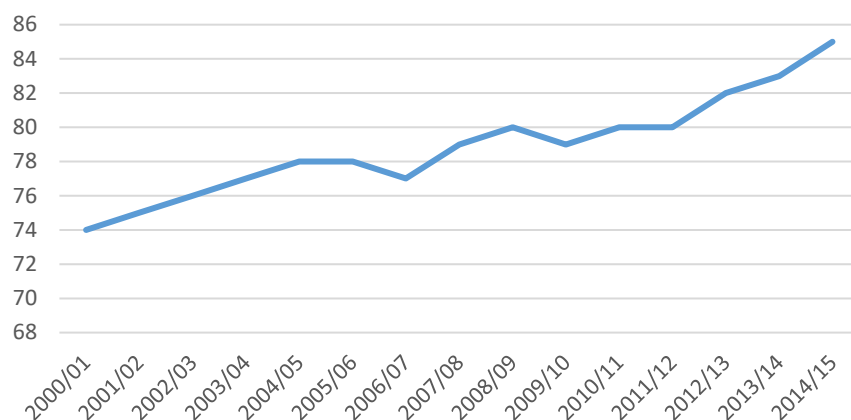
**FIGURE 3. COSTS VS. REVENUE (MILLION GBP)**  
SOURCE: MINISTRY OF TRANSPORT ENGLAND

The system costs include bus operator's remuneration paid by London Bus Service Limited. Remuneration to bus operators should cover the route operational costs, capital expenditures due to fleet investments and the operator's profit. The route operational costs take into account each route length, frequency, MPS and the type of vehicles used in the route.

On the other hand, there is a Green Bus Fund. The Green Bus Fund supports bus companies to promote the acquisition of low carbon buses in order to achieve environmental goals [15]. Since the creation of the fund, it has promoted the acquisition of 338 part-funded buses through a total grant of twenty two million pounds [16]. The income source of the fund is the London Government. The operators keep the fleet regardless of the extension of the contract. This embodies a risk for the government. Nevertheless, in recent years, budget for public transport subsidies have been reduced so authorities have promoted the use of cleaner technologies through the award of additional points to those operators that include hybrid and electric buses in their fleet.

## A.10. Results of Contract Implementation

London's quality incentive contracts and tendering methodology have improved the performance of bus operator and user satisfaction. The overall customer satisfaction level has risen since 2000, reaching its best results at 85% in the 2014-2015 London Customer Satisfaction Survey [17]. In the last 5 years, all of the 11 specific aspects of the customer satisfaction index<sup>4</sup> have shown improvements.

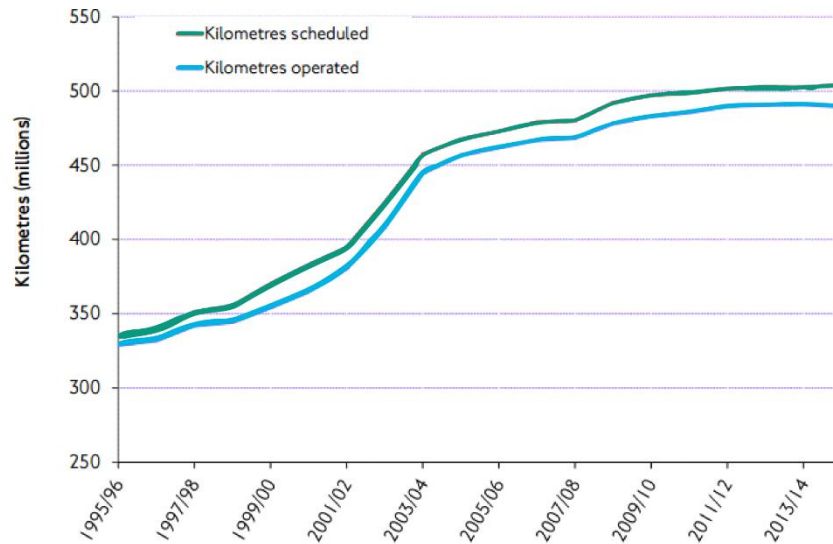


**FIGURE 4. OVERALL CUSTOMER SATISFACTION LEVEL FOR BUS SERVICES**  
SOURCE: TRANSPORT FOR LONDON. BUS CUSTOMER SATISFACTION REPORT [18]

In addition to the results on user satisfaction, the key indicators of operation also show the enhancement to the services that have taken place. The following results were achieved on some of the main indicators of performance.

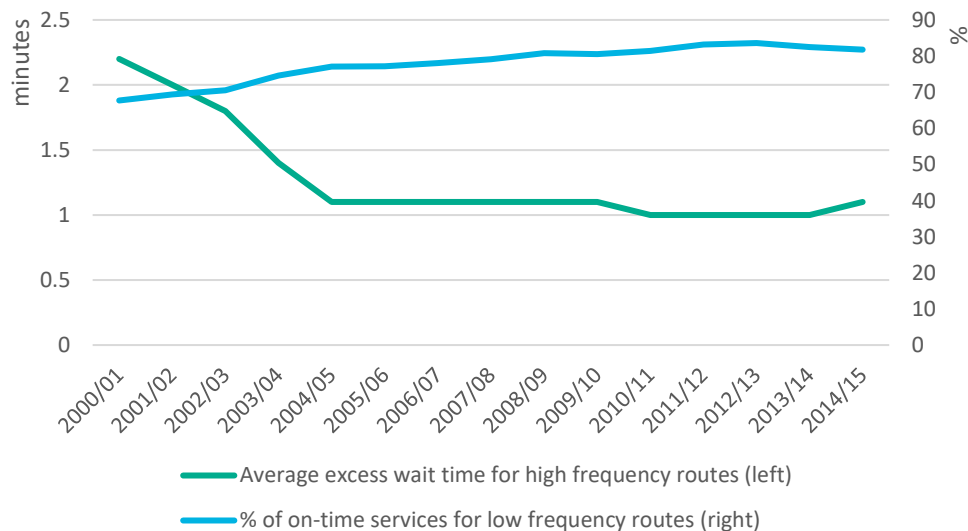
For 2014-2015, bus service supply had a good performance with 97.1% of the 504 million scheduled kilometers actually operated. Only 0.9% of the scheduled kilometers were lost due to causes under the operator's control, while another 2% of the scheduled kilometers were lost due to traffic congestion [3]. The following figure shows how scheduled kilometers have increased during the last 20 years due to a greater number of routes and higher frequencies, and how logged kilometers have been very close to the scheduled kilometers. This is evidence of the operators' efforts to comply with bus supply and the authority's initiative to increase routes and offer higher frequencies.

<sup>4</sup> Aspects of the customer satisfaction index: personal safety & security, crowding, reliability, information, state of repair of bus, cleanliness, bus stations, bus stops & shelters, smoothness of ride, staff behaviour and value for money.



**FIGURE 5. BUS SERVICE CONTRACTS: SCHEDULED AND OPERATED BUS KILOMETERS**  
 SOURCE: TRAVEL IN LONDON REPORT 2015 [3]

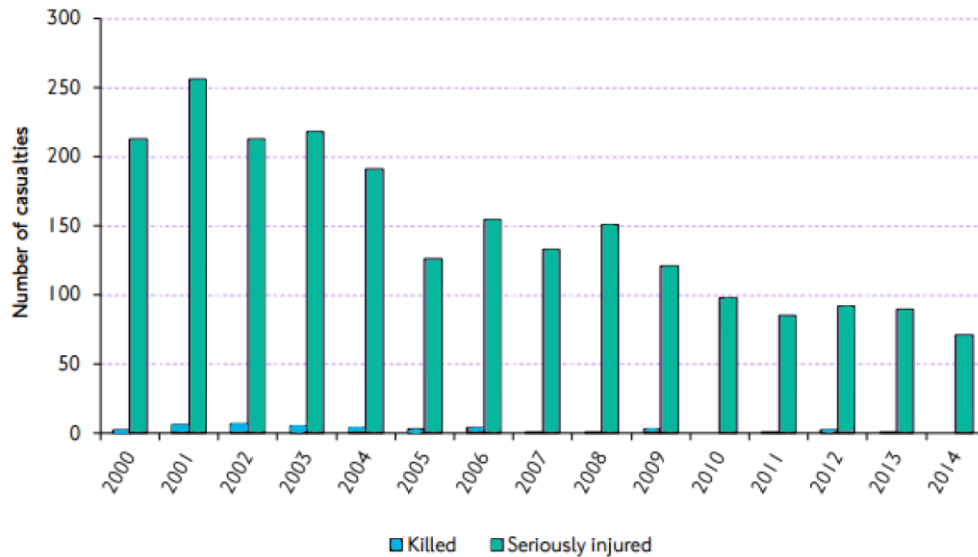
The Minimum Performance Standards scheme has promoted bus service reliability. In 2014-2015, the average excess waiting time for high frequency services was very good, with users having to wait just 1.1 minutes in excess of the schedule waiting time. This means that a user had to wait on average 6 minutes for a bus to arrive. On low frequency routes, the percentage of timetabled services on time<sup>5</sup> was 81.8% [3]. For lower frequency routes, reliability has seen a significant improvement after starting at the 67.7% levels in 2000.



**FIGURE 6. RELIABILITY FOR HIGH AND LOW FREQUENCY BUS SERVICES**  
 SOURCE: TRAVEL IN LONDON REPORT 2015 [3]

<sup>5</sup> Buses are defined as “on time” if departing between two and a half minutes before and five minutes after their scheduled departure times.

In regards to safety, overall casualties (killed or seriously injured) have a downward trend since 2001. The 71 casualties in 2014 were half of those in 2008. Regarding crimes reported in the bus network for 2014, there were 7.2 for every million journeys. The 2014 figure is the lowest crime registered in the network, and is half the number of events that took place in 2004. The improvement in safety is a combination of programs carried out by the local authorities, which include the installation of on-board cameras.

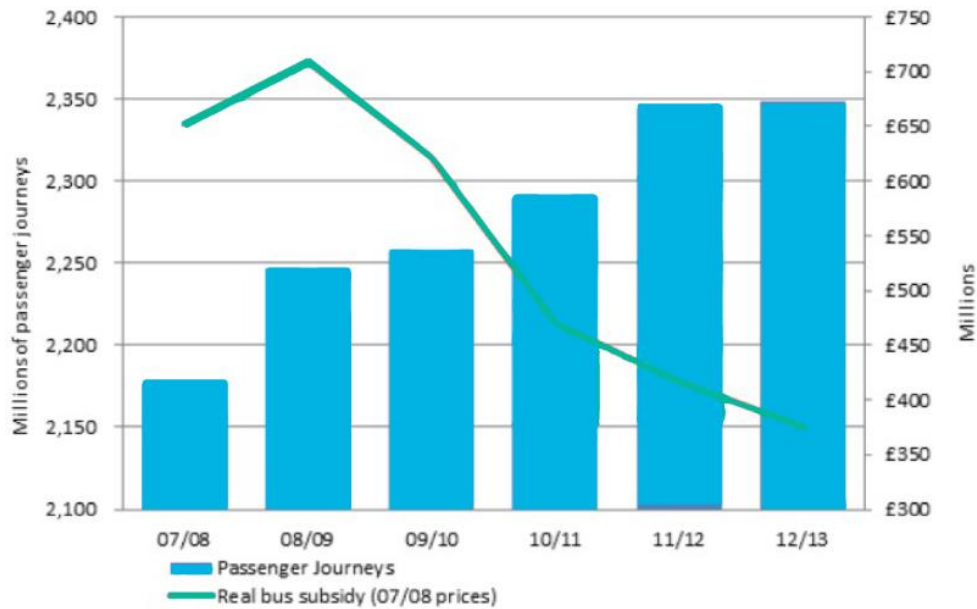


**FIGURE 7. NUMBER OF BUS/COACH OCCUPANTS KILLED OR SERIOUSLY INJURED IN LONDON**  
SOURCE: TRAVEL IN LONDON REPORT 2015 [3]

London authorities have promoted a system based on quality of service while keeping a fare that is still attractive for users. In addition, reduced fares are offered to certain groups like elders, disabled and students. In order to offer the service standards with current fares, the local government has had to provide subsidies to the system. Total direct subsidies to the bus system in London for 2014/15 were of GBP 422 million [19].

Although subsidies are still in place, they have dropped by 40% over the last five years [5]. The decrease in required subsidies is a result of the increase in demand for bus services and the reduction in operating costs attained through successive tendering processes.<sup>6</sup>

<sup>6</sup> The tendering process of bus routes started in 1985. Each route contract has a 5-year duration with up to a two-year extension, so several tenders for routes in operation have taken place.



**FIGURE 8. EVOLUTION OF BUS SYSTEM SUBSIDIES AND BUS DEMAND**  
 SOURCE: TRANSPORT FOR LONDON [19]

## A.11. Conclusions

London has been successful in promoting the use of public transport over the past 15 years. As a result, between 2000 and 2014, trips in public transport increased by 3.4 million while trips in private motorized vehicles decreased by 0.7 million. The bus system has become the mode of choice by users, carrying nearly half of the area's daily trips. This achievement in public transport ridership was due to a solid institutional organization, a clear strategic plan set by the Greater London Mayor and Council, a public transport concession model focused on quality of service and customer satisfaction and a fare policy that promotes social inclusion while seeking to increase public transport demand.

The bus concession focused on customer satisfaction has led to the implementation of quality incentive contracts for bus operators and a tendering process per route every five years. The tendering program is designed to assess the operator's suitability based on a multi-criteria evaluation, and it includes a prequalification stage. In addition, an expert panel is in charge of executing the evaluation of the final proposal based not just on price but also on the operator's ability to deliver quality services. Quality incentive contracts have aligned the operator's incentives with the authority's objectives. Concession contracts have clear definitions of roles and responsibilities for the authority and the bus operator; minimum technical requirements, and a set of quality indicators such as reliability, driver's performance, vehicle conditions and safety. The bus operator's level of compliance with the quality indicators has a direct impact on remuneration, with up to 15% in bonuses or 10% in penalties of the base remuneration.

Authority's monitoring has been key to the success of the contract model. The monitoring system includes a central fleet management system, on-board global positioning devices and on-board CCTV systems, among others. These systems together permit a real time supervision of the London buses, which promotes the fulfillment of the MPS defined by TfL.

It is worth mentioning that these results have been achieved through decades of implementation of enhancements to the system from the operation, legal and financial perspective.

## B. Bogota

Bogota has one of the biggest BRT networks (Transmilenio) around the globe and has become a point of reference for the implementation of BRT systems. Transmilenio has succeeded in improving travel time, reducing externalities, such as accidents and pollution, and contributing to containing the city's expansion. Implementation of the BRT has increased the development of areas surrounding the trunk lines, which has, in turn, promoted increased density and reduced dispersion of urban areas [20] [21]. In addition, Bogota is in the process of organizing a bus service that does not form part of the BRT.

Although the new bus services implemented in the city have improved the operational model of public transport, there are still areas for improvement under the contracts and adhering to the operational model. The following sections provide an overview of Bogota's bus and BRT systems and the main characteristics of the bus operation contracts.

### B.1. Public Transport Overview

Public transport in Bogota has several BRT lines and a complementary zonal bus service. The Integrated Public Transport System (*Sistema Integrado de Transporte Público*) or SITP is administered and regulated by a single public organization, Transmilenio S.A. In 2015, the entire SITP provided about 3.5 million trips each day.

#### SITP - BRT Service

Transmilenio is the BRT system that has been operating in Bogota for the last 16 years. Demand for the system was 2.3 million daily trips in 2015; it therefore accounted for 13.4% of the city's total trips and 62% of all trips in motorized public transport.

The Transmilenio BRT service is made up of 113 km of BRT corridors divided into 11 trunk lines. Although the service times vary between routes, the trunk routes provide service between 4:00 am and 11:00 pm. The system works with articulated buses (two sections of vehicles with a concertina-type rotating center to allow for sharp bends), each with a capacity of 160 passengers, and bi-articulated buses (two rotating centers) with a capacity of 270 passengers. The BRT system comprises 134 stations, 122 routes and approximately 2,024 buses.

The system has 913 feeder buses that transport users to/from the main stations to nearby locations not catered for by the trunk lines. There is no charge for the feeder service other than the fare for the trunk system and it operates like a regular bus system without exclusive lanes. Approximately half of the passengers use feeder buses to access the system [22].

#### SITP - Zonal Bus Service

The SITP zonal operation covers 1.2 million daily trips under the following service types:

- Urban services have been designed to cover areas where Transmilenio does not operate. Routes have significant length and origin/destination usually is on different zones of the city. They operate both on mixed and exclusive bus lanes.
- Complementary service transports passengers to and from nearby places of the trunk line stations. They operate on both mixed and exclusive bus lanes.
- Special service transport for users to and from peripheral areas where there is less demand or limited accessibility.

- The collector service includes short routes that feed the urban or complementary buses.
- These services are provided by 7,000 vehicles on 500 bus routes. These buses have a capacity of 90 and 60 passengers, and mini-buses with a capacity of 40 or 19 passengers. The zonal service also includes about 6,000 bus stops, usually with a sign detailing the available routes. Although operation times vary between zonal routes, operation hours are between 4:00 am and 11:00 pm on working days, and 5:00 am to 10:00 pm on holidays. The entire SITP fleet works under the integrated fare collection system.

### **Traditional bus system**

There are still routes operated by the traditional bus system that are in process of inclusion to the SITP system. As of 2015, 2.6 million trips were taken in the traditional bus system, where payment is still done with cash. It has no fleet management, planning or monitoring system like that of Transmilenio [23].

## **B.2. History of Bus Services and Organization**

Up until the late 90s, public transport in Bogota was based on a poorly regulated bus service. It developed around its three main actors: the District Mobility Department (*Secretaría Distrital de Movilidad*), the transport companies or unions, and the bus owners. The model was based on route operation permits issued by the transport authority to the transport companies or unions. The transport companies transferred these rights or authorizations to the bus owners in exchange for a fee. Permits were granted without any technical requirements, which led to issues of corruption regarding permits allocation.

This model had intrinsic disadvantages. First, revenue for the bus owners came solely from the trip fare, which had to cover drivers' wages, operating costs, the transport union fee and the bus owners' profit. The financial model created incentives for bus operators to compete in the market by maximizing the number of boarded passengers. However, this produced on-street competition, which reduced service quality and caused frequent accidents. In addition, there was no proper planning of routes or a firm authority to balance supply and demand along the different corridors, so bus owners were encouraged to operate more and more buses in order to increase their net profit. The result was excess supply of buses on profitable routes and coverage deficiencies in areas with less demand.

In 1999, the model started to change with the creation of Transmilenio S.A., a public transport authority responsible for the new BRT corridors, also called Transmilenio. The model included private companies responsible for the BRT system operation under regulations of public authorities. During the first phases of implementation, the former bus owners were encouraged to set up transport companies to operate as part of the new system. The tendering process was designed to give an advantage to the companies created by traditional bus owners. The companies that were awarded the BRT concessions were responsible for buying and operating the buses, subject to compliance with several technical and operational requirements.

Phase I was implemented from the year 2000 to 2002 with the construction of four main lines. The Phase II project was developed from 2003 to 2006 with the construction of three additional lines. However, at the end of this stage, only the bus owners whose routes were replaced by the Transmilenio trunk system migrated to the new operational model. The remaining bus owners and transport companies continued to face the same problems that originated decades ago.

In 2006, a Master Mobility plan was issued with a strategy to integrate the remaining routes and the vehicles into an articulated transport system. The result was the Integrated Public Transport System (SITP), which included the BRT trunk lines and a complementary zonal bus service. The SITP project included the implementation of fare integration and a coordinated fleet control system for the entire system.

As for the BRT system, the tendering process for SITP zonal services was designed to give advantages or preference to transport companies constituted by previous bus owners. The tendering process resulted in nine transport operation companies commissioned for the non-exclusive operation of 13 zones (plus a neutral zone covering the Central Business District). Seven companies succeeded in making the capital investments required for fleet renewal.

Several problems, including financial ones, have delayed completion of the transition phase. These resulted from several issues, such as: delays of the Phase III trunk implementation, internal governance disputes, fare collection incompatibilities with Phase I and Phase II technologies, and the slow adoption of the system by the users. As of today, the local administration has intervened two operators with the most serious financial problems. The remaining fleet is now under control of Transmilenio and the operational model has changed. However, the service model has not varied and these routes still face the old on-street competition problems.

### B.3. Institutional Organization

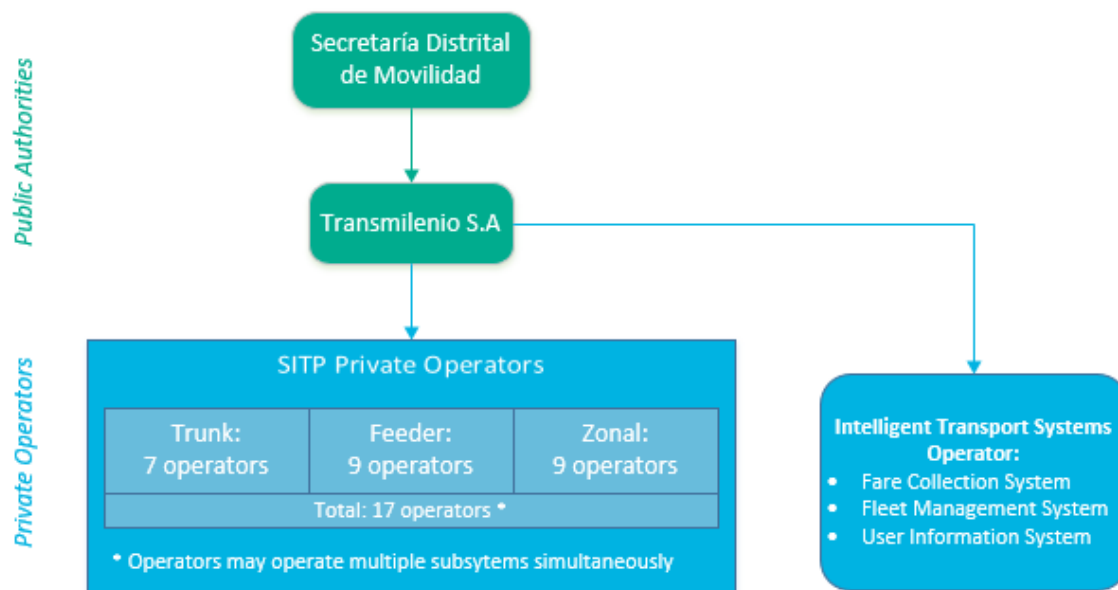


FIGURE 9. BOGOTÁ'S INSTITUTIONAL ORGANIZATION

- **District Mobility Department**

This is the foremost public mobility authority of Bogotá. It is responsible for developing mobility regulation and determining the general policies and strategies for the development of mobility in the short and long terms.

- **Transmilenio S.A.**

Transmilenio was created as the transport agency responsible for BRT network management. When the SITP was created, its scope of action was extended to manage the entire integrated transport system: trunk services, feeder services and zonal services. As a specialized authority, it is responsible for the following tasks:

- System design and definition of routes.
- Responsibility for all contractual arrangements with private partners.
- Development and execution of the bidding processes required to tender operation of the service.
- Management of the assets of the system that are not given in concession.
- Monitoring correct execution of the operation contracts, as well as verification of compliance of the service level agreements for each operation.
- Definition of transport planning, including the definition of routes, stops, frequencies and schedules.
- Backup control of the operators' fleet in the event of contingencies in which the operator is not able to control its own fleet.

- **Private Operators**

These are the companies commissioned to operate a bus fleet according to the operation requirements signed in the concession contracts. These transport operators can be classified according to the subsystem they operate as follows:

- Trunk operators: they are in charge of operation of the BRT buses on the trunk lines. Currently, there are 7 trunk operators for the three phases, thirteen lines of the trunk system and approximately 122 trunk routes.
- Feeder operators: they are in charge of the operation of regular buses on feeder routes in the trunk system located in strategic stations. Currently, there are 9 operators in charge of 15 feeder areas of the system and 110 feeder routes.
- Zonal operators: they are responsible for the operation of zonal buses distributed in the 13 areas of operation. At present, there are 9 zonal operators operating about 272 routes.

Due to the non-exclusive aspect of the concession contracts, transport operators won several concession contracts, which is why the entire system is operated only by 17 companies. The following table shows details of how the operation is distributed around the SITP for the current operators. It is notable that each concession required independent concession contracts.

TABLE 4. TRANSMILENIO AND SITP OPERATORS

	Transmilenio Phase 1		Transmilenio Phase 2		Transmilenio/SITP Phase 3		SITP
Operator	Trunk	Feeder	Trunk	Feeder	Trunk	Feeder	Zonal
Ciudad Móvil	✓						
Express del Futuro	✓						
SI99	✓						
Metrobús	✓						
Tranzit		✓					✓
Este es mi bus		✓		✓			✓
Suma		✓					✓
Gmovil		✓			✓	✓	✓
Consorcio Express		✓			✓	✓	✓
Masivo Capital		✓		✓			✓
Connexion Móvil			✓				
Somos K			✓				

	Transmilenio Phase 1		Transmilenio Phase 2		Transmilenio/SITP Phase 3		SITP
Transmasivo			✓				
Alcapital				✓			
ETIB				✓			✓
Coobus					✓	✓	✓
Egobus							✓

- **ITS Operator**

The SITP included an operator responsible for the Integrated Fare Collection, Fleet Management and User Information Systems (*Sistema Integrado de Recaudo, Control e Información al Usuario*), also known as SIRCI. The SIRCI system is a separate concession with its own tendering process. The company operating the SIRCI platform carried out the following general tasks:

- Design, sizing and provision of the technology platform, as well as the provision of adequate control facilities.
- Installation of the technology platform required in the SITP fleet and stations.
- Operation of the technology platform, excluding the Fleet Management System (responsible for the transport operators).
- Performance of the preventive and corrective maintenance of the technology platform.

## B.4. Regulatory Framework

The main regulation for the SITP is called Master Mobility Plan (*Plan Maestro de Movilidad*), a decree published by the District Mobility Department in 2006. The Plan involves short-term and long-term programs for the development of mobility in Bogotá. It also defines the importance of an integrated public transport system that has intermodal services, tariff integration, centralized regulation and a coordinated service plan. Accordingly, the SITP should include the existing and future Transmilenio BRT lines, and newer zonal services to complement the trunk service.

Additional national regulations such as Act 80 of 1993 and Act 1150 of 2007 define the conditions to guarantee efficiency and transparency of public-private partnerships and the tendering processes. This regulation works as a basis for all tendering processes, such as those used for the SITP and Transmilenio operation contracts.

## B.5. Bus Operation Contracts

### B.5.1 Type of Contract

Bus operation contracts are based on a concession model in which private companies are commissioned to operate certain corridors or areas of operation. Additionally, the non-exclusive operation of an area or corridor allows an operator to cover several areas, subject to compliance with independent technical requirements.

### B.5.2 Contract Duration

Because the system was implemented in several phases, the operators signed various contracts. The duration for each case is specified below.

- **Transmilenio Phase I and Phase II**

The contracts defined the following three (3) stages:

1. *Pre-operative stage*: from contract signature until the operation requirements are met.
2. *Regular operating stage*: the duration of this stage was undefined, although, it ends when the average use of the fleet reaches 850.000 kilometers or the stage has reached a maximum of fifteen (15) years.  
In order to measure the total number of kilometers operated, it was necessary to install high precision GPS systems on the fleet. This AVL system allows the calculation the number of operated and commercial kilometers, and provides a smaller level of deviation than a standard GPS system.
3. *Reversion stage*: between the date when the regular operating stage finishes and Transmilenio S.A. acknowledges that the assets provided by the administration have been returned.

During 2016, Transmilenio will be in the process of negotiating the end of the operating stage; it is having difficulties in determining the number of kilometers worked by the fleet.

- **SITP zonal and Phase III**

The contracts defined the following three (3) stages:

1. *Pre-operative stage*: from contract signature until the operating requirements are met. In the case of zones with a trunk system, a 100% of the trunk fleet must have been acquired in order to meet operational requirements. The contracts estimate a duration of 9 months.
2. *Operating stage*: this stage must have a duration of twenty four (24) years from the beginning of the operation. Such a long contract duration limits the possibility of improving contracts through lessons learned, but this resulted as a mechanism to mitigate the former bus operators' unwillingness to implement the new model.
  - *Transition stage*: during the initial five (5) years of operation, the concessionaire may operate part of its fleet without full compliance of the requirements.
3. *Reversion stage*: between the date when the operating stage is complete and Transmilenio S.A. acknowledges that the assets delivered for administration have been returned.

### B.5.3 Area Contracts

Bogota's bus operation is based on concessions of corridors for the BRT lines and concessions covering areas of the zonal services. For the zonal service, the city was divided into 13 zones and an additional neutral zone. One zone was defined as an area where the operator is responsible for the management of the routes within the area or originating in the area. Additionally, the thirteen zones were categorized in four trunk operation zones and nine non-trunk operation zones.

The 13 zones were created around a neutral zone, which is the city's Central Business District (CBD). At present, in the neutral zone there is still an oversupply of routes and improvement is needed in route optimization. There are two reasons for the excess supply: i) part of the current route design was inherited from the old routes that accessed the CBD and which had the highest concentration of demand and, ii) the SITP new contracts have created incentives for operators to access the neutral zone because remuneration is dependent on passengers boarded.

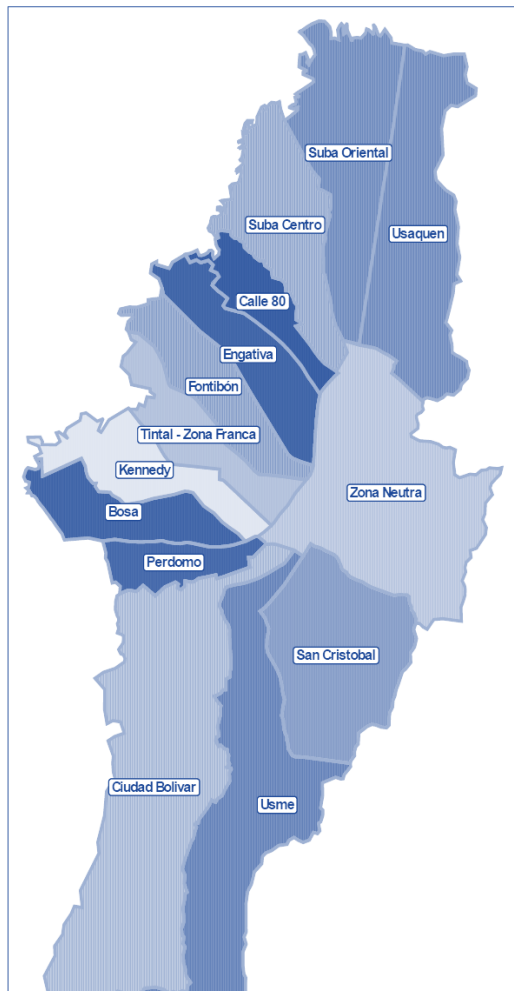


FIGURE 10. DESIGNATED ZONES FOR THE SITP  
SOURCE: TRANSMILENIO S.A.[24]

Currently Transmilenio S.A is making changes to route design in order to reduce inefficiency.

## B.5.4 Service Quality Indicators and Penalties

The operating contracts include a Service Level Agreement with technical clauses that the operator must fulfill. [25] The Service Level Agreement includes the following categories:

- **Operational Services:** Indexes are measured to create incentives on how close the service scheduled is to the actual service offered. The following indicators are calculated:

TABLE 5. OPERATIONAL PERFORMANCE INDEXES

Indicator Name	Description	Target value
<b>Dispatch compliance</b>	Percentage of buses actually dispatched in a month based on programmed dispatches.  A penalty is applicable if this index is below 95%, and if this occurs continually for 6 months, it may result in an early expiration of the contract.	100%
<b>Reliability index</b>	Percentage of services actually on time (variation of less than 50% of the programmed service) and programmed services.  A penalty is applicable if the index is lower than 70%. Additionally, if the index is lower than 90% for six consecutive months, it may result in an early expiration of the contract.	100%

The indices above are calculated every month based on the schedules and information collected from the SIRCI.

- **Maintenance:** The number of mechanical failures per vehicle is measured each month with information from the SIRCI platform. The quality control of this index is made in order to reduce any mechanical failures of the vehicles. A penalty is applicable if the index is above 0.08; however Transmilenio S.A. may change this value according to the actual needs of the service.
- **Environment:** This is intended to reduce pollution caused by diesel and natural gas powered vehicles. It is measured every six months with a pollution emission index acquired with an environmental control procedure that approves the environmental performance of the vehicles. A penalty is applied if more than 5% of the fleet fails the environmental control procedure.
- **User Satisfaction:** In order to measure user perception of the transport service, user surveys are carried out every three months<sup>7</sup> and are targeted to different user segments according to gender, age, education level and income, among others. A minimum level of user satisfaction is required. A

<sup>7</sup>An executive summary of the 2014 customer satisfaction survey is published in Transmilenio's webpage. The URL for this summary is provided in reference number [136].

penalty will be applied if user satisfaction is below 60%. If the operator fails to comply with the user satisfaction level on three consecutive occasions, an early termination of the contract may be applied.

- **Safety:** Indicator measures show that the operator is able to meet the passenger safety requirements. The indicator is shown by the number of events per kilometer that take place every month based on records of the SIRCI platform. The index defines three types of events: an accident resulting in serious material damage and seriously injured people; an incident where there are moderate damages and minor injuries, and a mishap where there are minor material damages. The index is calculated taking into account the severity of each event. A penalty is applicable if the index is below 0.4 events per vehicle, and if this occurs for six consecutive months, it may result in the early termination of the contract. However, Transmilenio S.A. may amend the penalty rules at any time.

The following table summarizes the indicators used to assess quality of service in Transmilenio, which are included in the operators' contracts.

**TABLE 6. BOGOTA'S PERFORMANCE INDEXES**

Indicator Name	Description	Target value
<b>Dispatch compliance</b>	Percentage of buses effectively dispatched in a month based on the programmed dispatches	100%
<b>Reliability index</b>	Percentage of services effectively on time (deviation lower than 50% of the programmed service) and programmed services	100%
<b>Mechanical failure</b>	Mechanical failure per vehicle per month	0
<b>Pollution emission</b>	Percentage of buses that failed the <i>opacimeter</i> test	0%
<b>Safety index</b>	Number of events per kilometer that take place every month	0

As shown above, only only six (6) indicators that represent the average performance of the service measure the entire operation quality. However, average indicators may not capture high cost inefficiencies and data variance. As a whole, the SITP may not include enough quality clauses to guarantee good quality service when compared with other cities such as London. Instead, the SITP only seeks an "average" service quality.

### B.5.5 Incentives and Penalties

The trunk operators of the system can receive additional revenue if their operation achieves certain quality levels. The bonus revenue is granted to an operator if his total performance index is above 80%. The total performance index is a weighted average of three performance indicators and it is calculated with the following formula:

$$\begin{aligned} \text{Operator total performance index} \\ = 20\% \text{ Regularity Index} + 15\% \text{ Punctuality index} + 65\% \text{ User satisf index} \end{aligned}$$

Where:

- **Regularity index:** measures the regularity of the service provided according to the theoretical programming of the service and the service actually provided. It's included in the final operator score if it is above 90%.
- **Reliability index:** measures adherence to route schedule, comparing the service programming to the service actually provided. It's included in the final operator score if it is above 80%.
- **User satisfaction index:** measures user perception of the service with periodical surveys. It's included in the final operator score if it is above 30%.

The funds for bonus payments come from savings kept from the penalties applied to operators in a single period. The money available is distributed among the operators that were awarded a bonus in proportion to their final quality score.

If no penalty was applied within a period, no money will be available for bonus revenue. However, if no operator deserves bonus revenue, the available money obtained from penalties is held over for the next period.

Penalties associated with each of the performance indicators were presented in the previous section on Quality Incentive Clauses.

### B.5.6 Technology and Fleet Requirements

The SITP defined the technical requirements vehicles must meet in order to receive an authorization for operation. Although vehicle types differ, all of them must meet a common set of characteristics in order to be compatible with the BRT network stations and a minimum set of technical standards [26]. As an example, the following categories were defined for the bi-articulated trunk buses:

- Transmission of the vehicle.
- Acceleration capacity for peak load.
- Vehicle suspension, in this case, a pneumatic suspension was required.
- Speed regulator to limit the speed of the vehicle according to the local regulations.
- Vehicle autonomy to guarantee continuous operation for an entire day.
- Design characteristics:
  - Seat distribution, including special seats for vulnerable population: e.g. pregnant women, senior citizens.

- Space distribution to guarantee the access of two wheelchairs.
  - Total vehicle capacity (260 passengers).
  - Driver seat location and visibility.
  - Internal materials to guarantee the materials are washable, self-extinguishable, non-toxic and wear-resistant.
  - Seat and vehicle ergonomics, dimension ranges and materials used.
  - Thermal isolation for the engine area.
  - Mechanical ventilation system to improve passenger comfort.
  - Sensor and alarm system for fuel levels, oil pressure, tire pressure, brake system pressure.
  - Digital tachograph to record speed history, running time, stop time, distance driven; the data must be recorded for at least 24 hours.
  - Information panels to show routes, stops, and additional information.
  - Maximum weight for each axle.
  - Emergency exits, doors and sun roofs than can be opened manually and from a central trigger on the driver's panel; and emergency windows compliant with a local fragmentation standard.
  - External and internal lighting system compliant with the local standards.
  - Vehicles compliant with the local environmental standards to prevent abnormal pollution emissions.
  - Voice transmission and localization unit in order to communicate with the Central System.
- Adjustments required for the installation of SIRCI equipment:
    - Odometer needed to capture the distance travelled needed by the Fleet Management System. It must be compliant with environmental and vibration standards.
    - Space reserved to install a logical unit of certain dimensions with the appropriate wiring.
    - Reinforcement of the roof needed to install the GPS and communication antennas.

## B.6. Roles and responsibilities [27]

Each area of operation was tendered with the following tasks for each operator:

- Provide the required fleet of buses following a set of technical specifications and replace it when needed.
- Perform the fleet maintenance programs required to comply with the Service Level Agreement specified in the concession contract.
- Allow the execution of regular evaluations from the public authorities in order to determine the status of the vehicles.
- Define the vehicle scheduling for each route.
- Provide the bus depots in the case of the zonal service and carry out the required maintenance activities.
- Hire the required personnel and drivers to operate the bus fleet.
- Provide the transport service with the bus fleet.
- Train drivers in the duties of operation of transport equipment, communications, safety, contingency plans and traffic rules.
- Perform environmental control programs to guarantee a non-polluting operation according to the local regulation.

The authority is in charge of the following tasks:

- Definition of the transportation planning, including the definition of routes, stops, frequencies and schedules for operation.
- Monitoring the correct execution of the operation contracts.
- Verification of compliance with the Service Level Agreement for each operation.
- Backup control of the operators' fleet in case of contingencies where the operator is unable to control its own fleet.
- Calculation of the technical fare.
- Determine agent's remuneration based on the technical fare.
- Market services.

## **B.7. Risk allocation**

The SITP contracts define a risk matrix that assigns risks between the authority and the bus operator [28]. This matrix includes a mitigation policy, the entity responsible for the risk, the estimated probability of occurrence and its impact. This section describes the most important risks for the SITP.

### **Demand risk**

In zonal operation, demand risk is shared between the zonal operators and Transmilenio S.A. The zonal service bus operators' remuneration depends on the number of passengers that paid for their trip. During the tendering process, operators could have mitigated the risk with a correct financial structure that creates a balance between demand dependent remuneration and kilometers logged remuneration. However, as the demand component of remuneration included a tendered offer, only the operators taking a high risk of the demand component were awarded a concession.

For trunk operation of Phase II, the operators and the authority share demand risk since total funds available for payment are determined by ridership. Revenue and costs section explains how demand risk has been allocated.

### **Regulatory risks**

Several regulatory risks may affect the system, including changes to user fares that do not cover the technical fare. Fare risk is assigned to the public authority and the city, and although it is defined as a low probability risk, this situation has occurred repeatedly during the last administrations.

Risks related to environmental, wage and tax regulations are assigned to the operator.

### **Operation risks**

Operators must cover any costs that exceed those estimated for the technical fare calculation.

Technical fare

adjustments are expected to mitigate the risk of operation overruns.

### **Implementation risks**

Transmilenio S.A. must compensate the transport operators for possible income reduction due to delays in the implementation of the system, infrastructure construction or technology installation.

## B.8. Tendering Process

Both SITP and Transmilenio Phases I and II tendering processes were designed to give preferential benefits to the bus owners who previously operated the intervened area or corridor. This resulted in several requirements and evaluations in the terms of reference favoring these operators.

- **Enabling requirements:** such requirements included previous local and international experience for the bidding companies and a minimum of financial capacity.
- **Technical requirements:** a technical score was defined including the size of the fleet offered, the number of participating local bus owners and the environmental and efficiency requirements for the fleet.
- **Economic offer:** the participating companies offered the required costs or factors that adjust their remuneration. The economic offer defined a high percentage of the total score granted to a participating company.

The tendering process was held by Transmilenio S.A. and had the following stages:

1. Transmilenio S.A. published the terms of reference.
2. If required, companies could present observations to the terms and conditions defined for the operation.
3. Updating of terms of reference. Transmilenio S.A. evaluated the observations and decided what should be included in the tender documents.
4. Companies presented their proposals.
5. Transmilenio S.A. evaluated the proposal and a score was calculated for each bidder based on technical proposal and the quotation.
6. The concession was awarded to the best bidder.

Monitoring Authority Transmilenio S.A. is the authority in charge of monitoring the correct execution of the concession contracts. In the case of the transport operators, they are required to meet a Service Level Agreement measuring features such as: user satisfaction, safety management, operational service efficiency, maintenance and environmental compliance. Each parameter is measured according to well-defined criteria with the definition of six (6) indicators. The SIRCI technological platform is used to calculate the information of four (4) indicators. The remaining two (2) indices are calculated by polls or using technical tests outsourced by Transmilenio S.A.

Due to the reduced number of indicators and availability of information from the SIRCI platform, Transmilenio S.A. doesn't require many resources to monitor the operators. In addition, because Transmilenio S.A. controls the Trust Fund payment orders, they are totally capable of applying the penalties to the remuneration available for the operators.

## B.9. Revenue and costs

The 3 phases of the Transmilenio BRT system and the zonal SITP services were structured to be self-sufficient and to cover the total operating costs. The following section aims to explain how bus system costs are calculated and how bus operator remuneration has evolved under the two different contracts.

Remuneration of the agents responsible for system operation are explained for Phases I and II of the BRT and SITP contracts.

## **Phase I and Phase II**[29]

### **Agents to be paid**

The contracts of the system consider the participation and remuneration of the following core entities:

- Trunk bus operators
- Feeder bus operators
- Single fare collection operator
- Trust fund operator
- Transport Authority (Transmilenio S.A.)

### **Main features of the tariff structure**

The tariff structure relies on the calculation of a technical fare, which is the average revenue per ticket sold that is needed to cover revenue of all of the system's service providers (bus operators, fare collectors, trust agent, planning agency). The technical fare should cover the following costs of the system:

1. Remuneration of bus operators for every passenger on board. This amount is calculated as the product of the cost per kilometer offered by each trunk operator on its tender proposal by a factor determined by the authority. The factor was defined during the tendering process and is used to transform a cost per kilometer into a cost per passenger.
2. Remuneration per passenger for feeder operators.
3. Remuneration per ticket sold for fare collection operator.
4. Remuneration per passenger that goes to Transmilenio S.A., in order to cover planning and management costs of bus operations. This cost is estimated as 3% of the technical fare.
5. Remuneration per passenger for the trust fund operator, which is a percentage of the technical fare.

Based on the costs presented above, the initial definition of the technical fare is highly dependent on the kilometers logged by each operator. Nevertheless, the model includes two ways in which operators also bear part of the demand risk. First, the monthly adjustment of the technical fare is designed to transfer changes in ridership to bus operators. Second, the operator's remuneration scheme is also dependent on the number of passengers boarded (See section d).

The monthly adjustment of the technical fare was defined in order to cover changes in the different variables. The monthly adjustment factor considers the following variables:

- i. Change in trunk operator costs which are made up of:
  - Change in the cost per kilometer for the trunk operators according to the official cost change of fuel, tires, oil, lubricant, wages, maintenance and fixed costs. The weight of each element is defined in the contract according to parameters such as, current fuel efficiency, change of tires, maintenance intervals, etc.
  - Percentage change of the Index of Passengers per Kilometer (IPK).
  - Share of trunk operator costs from the total technical fare.
- ii. Change in feeder operator costs consisting of:
  - Adjustment of the cost per passenger using the feeder system. Feeder costs must not exceed 20% of the technical fare.

- Adjustment of passengers using the feeder system.
- Share of feeder costs from the total technical fare.

### iii. Change in fare collection costs

The main feature of the technical fare adjustment factor is that it is inversely proportional to the IPK system. Thus, if demand increases the technical fare will decrease and, if there is a drop in demand, the operator will be compensated with a higher technical fare. However, the potential impact of the IPK adjustment is limited to a floor and ceiling between 4.75 and 5.8 passengers/km. This means that the operator will share the demand risk only if the IPK is below the lower limit or above the upper limit.[30]

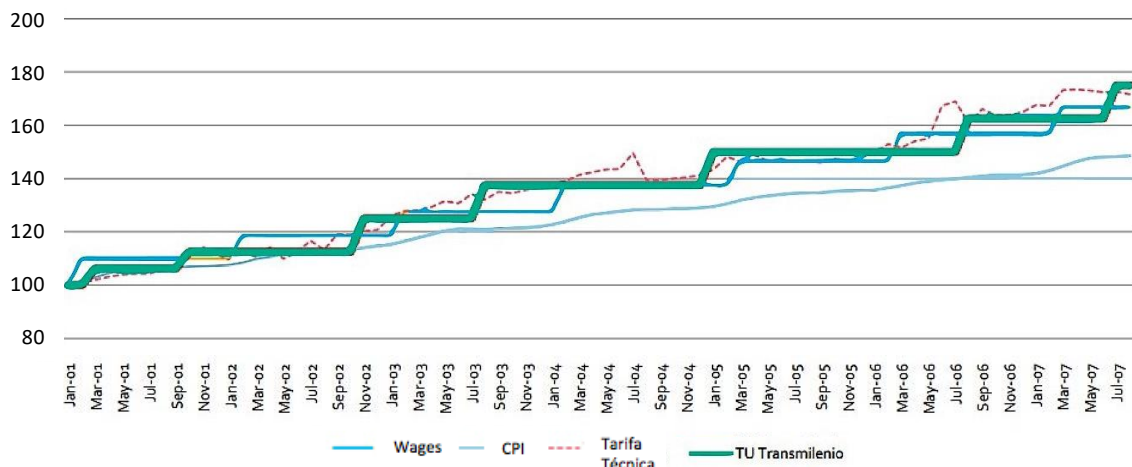
The formulas used to calculate the technical fare and its monthly adjustment are explained in

Annex 1.

### Tariff Policy

The user fare is determined by decision of the Mayor of Bogota. It is based on the current value of the technical fare and should be rounded up to find the user fare. The difference between the technical fare and the user fare goes into a contingency trust to cover demand fluctuations. Nevertheless, the Mayor may determine that the user fare should be lower than the technical fare. In such a case, the contingency trust should be used to compensate for this difference. If the contingency trust does not have enough funds to compensate the difference, the system should be provided with external public funds in form of subsidies.

Figure 11 shows how user fares remained constant during longer periods, while the technical fare was updated on a monthly basis. This figure helps to identify that during several months between 2001 and 2007, the user fare was higher than the technical fare and the additional revenue could be saved. These funds were later used to compensate for those months when revenue was not able to cover the operational costs.



**FIGURE 11. TECHNICAL FARE VS. USER FARE**  
SOURCE: TRANSMILENIO S.A.

### Remuneration of Phase I and II operators

The total income available to pay bus operators in a period is determined by the technical fare, the number of trips in the period and the payment priority scheme. Remuneration structure establishes that bus operators are the last actors to be paid. The procedure to calculate an operator's remuneration for a period starts by determining the total funds required to cover the system agent's revenue. The total required revenue is the product of paid trips times the technical fare. From the total required revenue, the feeder operators, the fare collector, the transport authority and the trust fund operator receive payment first. The remaining revenue of the period is available for the trunk operators. The following formula is used to calculate revenue available to cover the trunk operator's income:

$$\text{Trunk Operators Income} = PP * TT_{TM} - R_{feeder} - R_{fare collector} - R_A - R_T$$

Where:

$PP$  = Paid passengers

$TT_{TM}$  = Technical fare

$R_{feeder}$  = Remuneration to feeder operators

$R_{fare collector}$  = Remuneration to the fare collector

$R_A$  = Remuneration to the transport authority (Transmilenio S.A.)

$R_T$  = Remuneration to the trust fund operator

The total income for trunk operators is distributed among the trunk operators, taking into account each trunk operator's share of the total kilometers logged and average speed for the period. The formula used to calculate revenue distribution is explained in

#### Annex 1.

An additional feature of the remuneration structure is that trunk operators share demand risk since the total required revenue for payment depends on the passenger per kilometer index and because they are the last to be paid residually. The model defines a lower bound for the IPK below which the operator assumes revenue loss and an upper bound above which the operator will keep the additional income due to higher ridership.

The BRT system has been successful and demand has been higher than initially expected, so the IPK has remained above the upper bound defined in the contracts. The additional revenue due to demand upside has been gathered by the trunk operators with hardly any improvements in the quality of service [30].

### SITP and Phase III [27]

## Actors to be paid

Due to the interoperability of the SITP, the contracts take into consideration that the new system should have full tariff integration that includes the previous Phases I and II trunk and feeder operators. Based on this principle, the agents whose revenue must be determined, include:

- SITP zonal operators.
- SITP trunk operators (Phase III).
- SITP SIRCI operator (fare collector).
- SITP trust fund operator.
- Transport Authority (Transmilenio S.A.).
- Phases I and II trunk bus operators who decided to be remunerated according to the previous model (in accordance with Phase I and II contracts).
- Phases I and II trunk bus operators who decided to be remunerated according to the newer SITP remuneration model.
- Phases I and II feeder bus operators who decided to be remunerated according to the previous remuneration model (according to Phases I and II contracts).
- Phase I and II feeder bus operators who decided to be remunerated according to the newer SITP remuneration model.
- Phases I and II fare collection operator
- Phases I and II trust fund operator

## Technical fare

A new technical fare was defined for the SITP contracts, which included the Phase I and II technical fares. This technical fare aims to determine the revenue per trip that is required to pay all the system agents. The technical fare for the SITP calculation takes the following costs into account:

- i. Remuneration of Phases I and II trunk operators. This amount is calculated as the product of the Phases I and II technical fares times the number of passengers on the Phases I and II trunk lines.
- ii. Remuneration of SITP trunk operators including Phases I and II trunk operators who decided to be remunerated according to the SITP methodology.
- iii. Remuneration to SITP zonal operators.
- iv. Remuneration to SITP feeder operators, including Phases I and II feeder operators who decided to be remunerated according to the SITP methodology.
- v. Remuneration to the SIRCI concessionaire. Initially, a revenue for the Phases I and II fare collection concessionaire was included, but currently there is only one concessionaire for both SITP and the Phases I and II trunk lines.
- vi. Remuneration for Transmilenio S.A. per passenger, in order to cover the planning and management costs of bus operations. This cost is estimated as 3% of the technical fare.
- vii. Remuneration for the SITP trust fund operator per passenger.
- viii. Remuneration to acquire and adapt properties and use them as depots and vehicle repair facilities.

From this set of costs, the following deduction is applied:

- i. Tariff discounts from the Phases I and II operators for users connected by SITP services.

The result is the total costs of the system, which are divided by the number of passengers in the SITP in order to obtain the system cost per trip.

### Remuneration procedure for SITP actors

The remuneration procedure for the SITP has the following additional features and steps:

- All revenue is collected in a common account.
- Phases I and II income is unaltered according to  $TT_{TM}$ . The income originated from the operation of Phases I and II subsystem goes from the common account to the Phases I and II trust fund.
- A new SITP trust fund was created and remuneration for the SITP and Phase III actors is transferred to it from the common account.
- The Tariff Stabilization Trust was created to cover fluctuations of the technical fare that could lead to a change in user fare. The tariff stabilization fund works in a similar way as the contingency trust fund of Phases I and II [24].
- A portion of the income is reserved to acquire and adapt properties needed for the operation of the SITP zonal subsystem.

Under this new payment priority model, Phases I and II bus operators are paid first. While the SITP trunk, zonal and feeder operators are paid from remaining revenue and funds in the tariff stabilization trust.

New formulas were defined to calculate revenue for the new trunk operator of Phase III of Transmilenio. Remuneration of the new trunk operators is solely based on the fixed and variable costs of operating the fleet and they do not share demand risk. Transmilenio realized that sharing demand risk with trunk operators did not improve quality of service and calculating demand for each trunk operator was very complex; therefore, Phase III contracts do not include demand within the remuneration model. The following elements are taken into account to calculate trunk operators' remuneration:

- The number and types of vehicles in operation
- A fixed cost per vehicle per month.
- A bid offer of the cost per kilometer travelled by the bus fleet.
- The number of kilometers travelled by the bus fleet.
- A quality factor  $f(Q)_{trunk}$  that determines the possible percentage penalties for the remuneration of the trunk operators.

On the other hand, a new formula to pay zonal operators was created. Under the new zonal remuneration ridership is used to calculate income, so operators bear demand risk and have incentives to control evasion and promote the system use. The zonal operators' remuneration is based on:

- A fixed cost per kilometer travelled by the bus fleet.
- The number of kilometers travelled by the bus fleet.
- A fixed cost per vehicle each month.
- The number and types of vehicles in operation.
- A tendered value of the cost per paid passenger.
- The number of paid passengers using the operator service.
- A quality factor  $f(Q)_{zonal}$  that determines possible percentage penalties for the remuneration of the zonal operators.

In both cases, a quality factor  $f(Q)$  was included as an incentive for operators to improve key indicators, such as reliability. However, the maximum penalty that may be applied is equivalent to 3% of the total remuneration. Due to the insignificance of the penalty, the operators are able to decrease their service quality without affecting their remuneration.

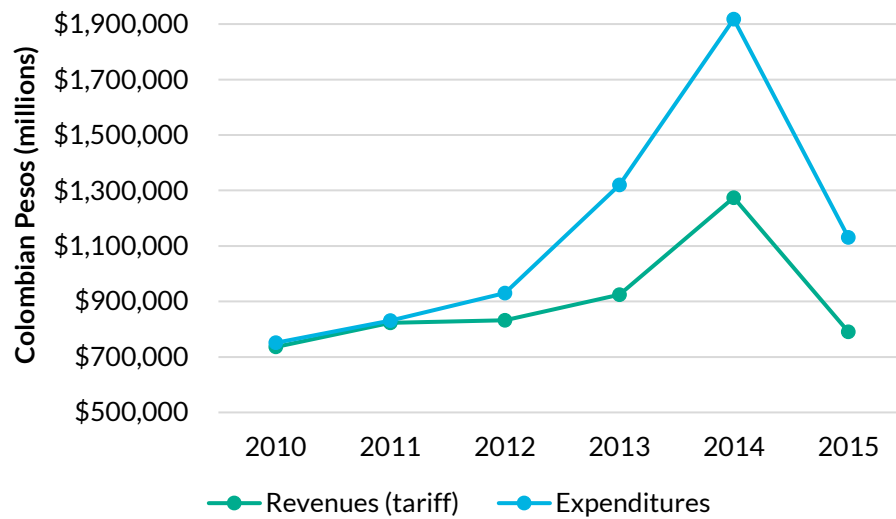
Both zonal and trunk operation remuneration formulas are adjusted monthly with parameters like the official cost change of assets (tires, fuel, lubricants) and the Consumer Price Index. In addition, the SITP remuneration model includes periodic revisions of the fixed costs so that they are frequently updated according to the current market situation. This procedure guarantees that the efficiencies achieved by technological changes are appropriately reflected in costs and that no excess revenue will go to operators.

### **Tariff policy**

The tariff policy was designed for the user fare to cover the technical fare. The user fare can only be modified by an act of the Mayor of Bogota. The last administrations of the city have decided to override the technical fare calculation in order to avoid an increase in the user fare. This situation has caused the user fare to remain constant for several years, while the technical fare has continued to increase according to the adjustment formulas shown above. Therefore, to comply with the remuneration obligations under the contracts, the city has provided subsidies for the SITP operation. In addition, recent administrations decided to reduce the user fare during off-peak hours as an incentive to reduce the demand on peak hours. However, the demand turned out to be inelastic and the policy ineffective. [30] In contrast, this policy generated a greater need for external public resources to cover the remuneration obligations with the transport operators.

## **B.10. Results of Contract implementation**

Transmilenio and the SITP were intended to be financially self-sufficient with their main income source coming from passenger payments. However, in recent years, the expenditures used to remunerate the operators have been higher than the revenues obtained from the user fare. This situation was mainly caused by reductions in the user fare (regardless of the technical fare calculations) and lower demand in the SITP.



**FIGURE 12. REVENUES AND EXPENDITURES OF THE SYSTEM**  
SOURCE: EL TIEMPO [31]

These differences between revenues and expenditures have been covered by the city as unexpected subsidies and, therefore, the main objective of self-sufficiency has not been achieved, especially in the most recent years with the implementation of the SITP.

Regarding user satisfaction, the design of the system does not assign any significant importance to this variable. In November 2014, overall user satisfaction was about 57.6%, while the minimum acceptable in the contracts was 30%. Such low importance of this variable may have caused an undesirable reduction in the service quality of the operators, as it may be more profitable to reduce costs by reducing service quality rather than keeping up good service quality.

## B.11. Conclusions

Bogota began a process of public transport reform in the late nineties. Since then, the city has changed from a poorly regulated bus service to the creation of a BRT system (Transmilenio) which has become a point of reference for BRT implementations worldwide. In addition, an Integrated Public Transport System (SITP) was set up to organize the complementary bus zonal services and to implement fare integration and fleet control over the entire system.

The new model's early stages included the creation of Transmilenio S.A. as the public agency responsible for the integrated public transport system and the organization of previous bus operators in transport companies. Under the new institutional organization, BRT corridors and zonal services were allocated through tendering processes and contracts were designed to set a clear framework for the bus operator's responsibilities and remuneration.

One of the key components of the new BRT concession contracts was the definition of a technical fare, which is the average revenue per ticket sold that is needed to cover remuneration of all of the system's service providers. The technical fare provided a transparent and adjustable methodology to remunerate the operators and a mechanism to allocate risk between agents responsible for system operation. However, Phases I and II technical fares had limitations that were found just after the BRT corridors started to operate. First, the technical fare adjustment formula did not take into account

operational cost reductions due to improvements in technology (e.g. fuel consumption efficiencies). Although this became an incentive for operators to implement new technologies in order to reduce costs, users could not benefit from these efficiencies through lower fares. Second, the technical fare adjustment formula was unable to achieve efficient distribution of additional revenue generated from the increase in demand. The contracts did not allow the authority to obtain the benefits of scale economies due to the upside on demand, and the additional revenue went to bus operators.

The SITP implementation has brought several improvements:

- Fare integration between the BRT and the traditional bus system has been achieved and there is an automatic fare collection system that only accepts smart cards.
- The creation of bus operating companies and the new remuneration model has deterred on-street competition.
- Service quality has improved under the new operational model and with the new or refurbished bus fleet.

Nevertheless, the SITP zonal service implementation has experienced several drawbacks since two concessionaries have not complied with their contract obligations due to financial problems. In addition, ridership has been affected by lack of user information and problems with full fare integration because of technological incompatibilities among the fare collection operators. As a result, the city has provided significant subsidies to cover the downside of demand.

The new SITP contracts have included positive clauses of previous contracts, such as the technical fare methodology, while amending problems similar to cost reduction due to increased efficiencies in new technologies. However, the new contracts may have room for improvement with its service quality clauses and incentives, because it can be more profitable for operators to cover penalties than to bear the costs of operational improvement.

## C. Mexico City

The government of Mexico City has succeeded in implementing a contract model that has improved the bus service operation in the Metropolitan Area of Mexico (Mexico City's Metropolitan Area), which was mainly enhanced by organizing the unregulated bus transportation that included the creation of six BRT corridors. The transport system's improvement of the organization was accomplished by transforming owner-operators into transportation companies. The transportation companies joined the regulated bus system through concessions based on gross contracts. For each corridor, a negotiation is made between the operators and Metrobús, which concludes with the selection of the corridor's company operators. A committee for each corridor is created once the contracts have been awarded, and the committee is composed of Metrobús, SEMOVI (Mobility Department), and members of the operating companies. The creation of a committee has improved relations between the service operators and the city, encouraging owner-operators to join the new model.

The contract model allowed for the implementation of a deduction scheme in the corridors, which has ameliorated the operation of the city's bus system. Thus, the operators have stronger incentives to fulfill the operational guidelines to avoid deductions. The contract model has also established new allocation of risks. In particular, it has transferred the demand risk to the city, which eliminated on-street competition in the corridors. Additionally, the contract model structured the enforcement of the bus companies, which was executed by defining the performance indicators and specific monitoring tasks for the Authority.

### C.1. Public Transport Overview

The Metropolitan Area of Mexico includes Mexico City and 60 adjacent municipalities with a total of 20 million inhabitants. Mexico City itself is composed of 16 boroughs [32] and the density of the metropolitan area is 2.6 thousand people per square kilometer [32].

Daily trips in the Metropolitan Area of Mexico stand at 21.3 million with the following modal split: 14.5 million daily trips are made on public transport; 6.4 million made in private transport including motorcycle and vehicle motor modes, and 400,000 daily trips made by bicycle [33], [34], [35]. 67% of daily public transport trips are done in bus-based systems. The following is the trip breakdown by public transport system.

**TABLE 7. DAILY TRIPS MADE ON MEXICO CITY'S TRANSPORT SYSTEMS**

Transport Systems	Daily average trips (millions)	Percentage
Public transport systems	14.5	100%
Heavy Train	4.4	30.3%

Transport Systems	Daily average trips (millions)	Percentage
<b>BRT</b>	1.2	8.3%
<b>Light Train</b>	0.09	0.6%
<b>Bicycle</b>	0.03	0.2%
<b>Trolleybus</b>	0.20	1.4%
<b>Bus</b>	8.6	59.2%

SOURCE: SEMOVI, EMBARQ AND SYSTEMS WEB PAGES [33], [34], [35].

### Bus Service

There are three bus-based systems in Mexico: BRT, the Passenger Transport Network (*Red de Transporte de Pasajeros*) or RTP, and the traditional bus transport system. The BRT has a trunk and feeder fleet. The trunk fleet operates on 7 lines. The BRT, the light and heavy train systems have an integrated fare collection system that users can access with an interoperable card.

The RTP system operates some 94 different routes in the peripheral areas that connect to the heavy train. The RTP has a fleet that operates 18.5 hours a day, from 4:00 am to 10:30 pm [36]. Additionally, it provides night services that operate from 12:00 am to 5:00 am [37] and an exclusive fleet for people with disabilities.

In turn, the traditional bus system operates mostly under an owner-operator model where there is no strong enforcement of performance standards on the routes and no technological platform to do so. The bus system is not included in the integrated fare collection system and passengers pay for trips in cash when boarding. The traditional bus transport system is currently going through a restructuring process, changing from an owner-operator model to an organized system. The organization of the system is carried out by creating companies that group the bus operators.

## C.2. History of Bus Services and Organization

The Transport and Road Department (*Secretaría de Transportes y Vialidad*) or SETRAVI, was the decentralized entity operating public transport in the city in 1995. This entity awarded the city routes under individual concessions. Thus, the operation permit was directly granted to the owners of the vehicles providing the service. This model was known as owner-operator, a vehicle solely associated with the person to whom the route was awarded. This model continues to be applied today along about 95% of the traditional bus routes. This causes the so-called on-street competition, where

drivers operate to maximize their remuneration by picking up as many passengers as possible, which is often detrimental to service because the operation does not seek the benefit or convenience of users.

To deal with this situation, the corridor concession program began in 2005. The purpose of the program is to eliminate the owner-operator model by replacing the individual concessions with collective concessions that are assigned to transportation companies. Currently, there are 13 traditional bus corridors and 7 BRT corridors. The creation of each corridor has mainly involved: i) the creation of a company that brings together old bus drivers; ii) replacement of the fleet with modern buses with increased capacity and Euro 4 technology; iii) the bus drivers' remuneration was changed to a fixed salary, and iv) implementation of a fleet management system on some corridors. In the case of remuneration and specific provisions, there may be variations in the concession contracts.

### C.3. Institutional Organization

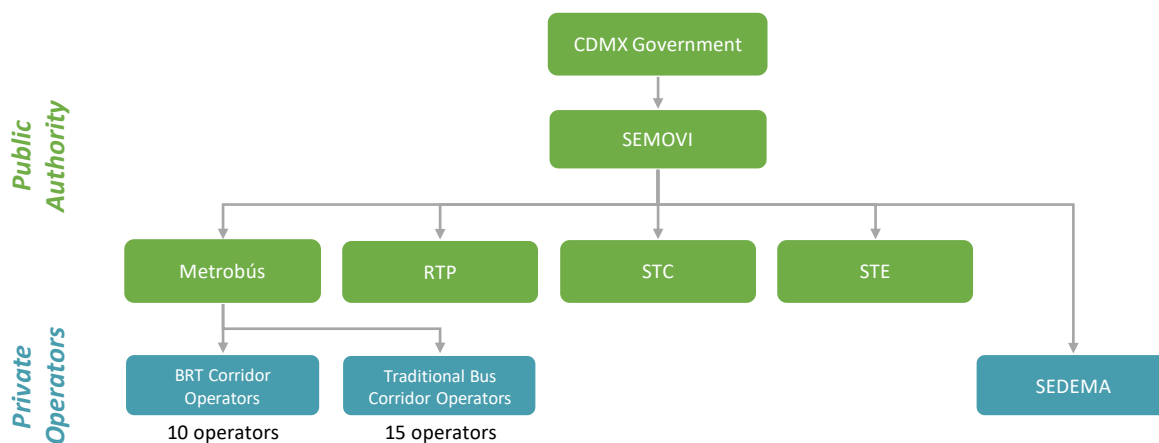


FIGURE 13. INSTITUTIONAL DIAGRAM<sup>8</sup>

- **Mexico City Government**

The government of Mexico City is in charge of setting the regulatory mobility framework, which is based on the overriding principles of security, accessibility, efficiency, quality, equality and multimodality, among others.

- **Mobility Department (SEMOVI)**

SEMOVI is a division of the government of Mexico City, which acts as an entity responsible for the regulation and supervision of all institutions and companies involved in mobility in Mexico City. In particular, it is in charge of granting corridor concessions to transport companies.

- **Collective Transport System (STC)**

STC (*Sistema de Transporte Colectivo*) is a decentralized public agency. It is responsible for the construction, maintenance and operation of the heavy train, and it is also in charge of the heavy train fare collection and the administration of the clearinghouse that manages the transactions between the heavy train, the light train and the BRT.

<sup>8</sup> In the diagram, Metrobús includes the committee of the operating companies. The directives of the committee include a Metrobús and a SEMOVI member.

- **Electric Transport Services (STE)**

STE (*Servicio de Transportes Eléctricos*) is a decentralized public agency in charge of the operation of the light rail and trolley, as well as the study, design, construction, and - where appropriate -, the operation of new lines of electric transport in Mexico City [38].

- **Passenger Transport Network (RTP)**

RTP (*Red de Transporte de Pasajeros*) is a decentralized public agency in charge of the provision of radial public transport mainly in peripheral and poor areas of Mexico City. It is also responsible for connecting peripheral areas with heavy train, light train and trolley [39] operations.

- **Environment Department (SEDEMA)**

SEDEMA (*Secretaría Del Medio Ambiente*) is the division of the Mexico City government in charge of the bicycle public transport system supply, operation and maintenance.

- **Metrobús**

Metrobús is a decentralized public agency in charge of planning, management and control of the Public Transportation Corridor system of Mexico City.

- **Committee of the operating companies**

The committee is made up of SEMOVI, Metrobús and the representatives of service operators. The committee's main objectives are to improve customer service levels; adjust service programming to the corridor's demand; increase revenue and reduce operational costs; give feedback of the service planning; review the results of the operation periodically, and quantify fleet kilometers [40].

## C.4. Regulatory Framework

The Mobility Act (MA) of 2014 (which is the fourth version of the first one published in 1942) establishes that the design and implementation of mobility projects must be undertaken according to the overriding principles of security, sustainability, accessibility, quality, equality, multimodality (integration of transport modes) and technological innovation, among others. The MA also stipulates the creation of a Mobility Fund for project financing. It also establishes the different types of tariff, including full fares for general users and preferential fares for concessionary passengers [41]. With regard to the concession of bus corridors, the MA establishes the directives of bus corridors procurement, implementation and operation.

According to the MA, SEMOVI's functions are: i) grant concessions, permits and authorizations related with passenger services transportation; ii) carry out or approve studies that support the need to grant new concessions for the provision of public transport of passengers; iii) approve the establishment of new systems, transportation routes, and modifications of existing ones; iv) order the temporary or permanent suspension, revocation, cancellation or termination of concessions and permits; v) to perform monitoring, surveillance and control of passenger services in Mexico City; vi) impose penalties for failure to comply with the regulations; vii) resolve disputes between concessionaires, among others [42].

The MA also establishes that those interested in obtaining a concession for passenger transportation services must provide proof of their financial capacity, which includes financial solvency and availability of resources with which to provide the service [42].

## C.5. Bus Operation Contracts

### C.5.1 Type of Contract

The bus service operators are under a gross-cost contract. The transport operators are paid a periodical sum of money that depends on the kilometers driven (and for some corridors, the respective demand). The authority retains all the corridors revenue through a trust fund. The contracts include deductions for non-compliance with the rules of operations. The latter include service contracts, systems infrastructure and service users' requirements, among other things. Some contracts incorporate bonuses given to operators in recognition of their performance indicators evaluation. Likewise, most of the contracts' lifetime is fixed at ten years. The contract duration definition is based on buses' useful life.

### C.5.2 Service Allocation

Each concession contract is based on the allocation of a route, a group of routes or a BRT corridor. Where a BRT corridor is a section of road or contiguous roads served by a bus route or multiple bus routes that have a minimum length of dedicated bus lanes.

### C.5.3 Quality of Service Clauses

There is a set of performance indicators that Metrobús evaluates periodically (typically quarterly). These indicators are evaluated for each corridor operator. The performance indicators are: service reliability; bus availability; fleet mileage; routes frequency; occurrence of failures, and accidents. These performance indicators are measured by supervisors who evaluate service regulation and fleet maintenance, the Operating Companies Assessment Committee, and the information published by the Department of Public Security and SEMOVI. The evaluation of performance indicators is the main input to calculate the operator's quality bonuses (for the contracts that include bonuses). Additionally, the evaluation is taken into consideration to extend operators' contracts.

### C.5.4 Technical/Technological Requirements

Fleet requirements are defined taking into account the security, comfort, efficiency and maintenance of the fleet as overriding principles. Fleet requirements include: brakes, steering, suspension, interior and exterior lights, exterior painting, glasses, mirrors and emergency equipment, among others.

The fleet is periodically subjected to mechanical and physical revision. There are also random inspections of the fleet to enforce the fulfillment of operation requirements. When a bus fails to comply with the operational requirements, there is a 15-day period to remedy non-compliant vehicles. If after 15 days the bus continues to fail, the operator is fined.

With regard to on-board equipment, it includes fare collection, user information and fleet management devices on the Metrobús. The operator or a third party, which is either the fare collection operator or the technology provider, is responsible for the installation and maintenance.

### C.5.5 Bus Operation Remuneration

The bus operation remuneration is a function of the fleet mileage and, for some corridors, the system's demand. Regarding the corridors that only take into consideration mileage, the bus remuneration is equivalent to the driven kilometers multiplied by the contractual agreed payment per kilometer. In the case of corridors that consider demand, there is a fixed associated payment per kilometer for each demand interval. If the corridor demand is at the lowest interval, the operator is remunerated according to a fixed price per kilometer.

For both types of remuneration, the payment per kilometer is adjusted annually based on the weighted average consumer price index and annual diesel increment.

The base remuneration is subject to deductions in accordance to the compliance of the system operation (See section on penalties). The operator is also subject to bonuses depending on the evaluation of the performance indicators (See Quality of Service Clauses).

In addition, the operator receives a monthly fee to amortize capital investments. The fee is equivalent to a percentage of the fleet capital investment distributed through the contract lifetime (for some corridors this is 80%). The operator covers the remaining percentage.

### C.5.6 Payment Structure

Revenue is collected on units and deposited in the trust fund. There is a clear definition of the prioritization of payments. The following is the order of payments:

- i) Trust fund fees: this is a percentage of the fund's resources.
- ii) Fleet credit payment: this is a fixed periodical imbursement to operators to repay the fleet debt.
- iii) Fees for buses that operate on corridors with tolls: a sum paid to cover toll costs.
- iv) Fare collection and support services: these incorporate external top-up network, security transport services and technology platform maintenance.
- v) Operator payments: the remuneration according to the corresponding contract.
- vi) Metrobús payment: this is a sum paid to Metrobús for fulfilling its duties (see Roles and Responsibilities).
- vii) Bonus pool: the remainder goes to this pool.

### C.5.7 Penalties and Deductions

There are two types of deductions: behavioral (BD) and system deductions (SD). The former are directly attributable to drivers' performance. The deductions depend on the recurrence of non-compliance. It is typical that there is a formal notification for the first non-fulfillment. For the second and following non-compliances, a monetary deduction is applied to operators. The deductions increase as both recurrence and severity do.

The following are the main grounds for deductions with regard to service contracts:

**TABLE 8. DEDUCTIONS DUE TO SERVICE**

Number	Description	Type of deduction
1	To give insufficient time to users to board or leave the buses	SD
2	To park buses outside authorized places	SD
3	To skip a route station	SD
4	To modify a route without authorization	BD
5	To operate out of the authorized schedule or to operate unauthorized services	SD
6	To allow boarding and alighting of passengers in unauthorized areas	SD
7	To deliberately delay operation of the service	SD
8	To pass buses on the same route without authorization	SD
9	To abandon the bus without justification	BD

There are deductions relating to system infrastructure. The following are the main grounds for these:

**TABLE 9. DEDUCTIONS DUE TO INFRASTRUCTURE**

Number	Description	Type of deduction
1	Dirty or poor condition areas	SD
2	Destination of areas for different use than originally intended	SD
3	Security deficiencies (lack of signage, poor lighting, lack of emergency equipment, among others)	SD
4	Blocked access for reasons attributable to the operator	SD
5	Poor maintenance mainly of electrical installations	SD

As far as user service is concerned, the receipt of service complaints is directly managed by Metrobús. When necessary, Metrobús redirects complaints to bus operators. The operators have a fixed term within which to resolve the complaints (typically 5 days). If the operator exceeds the lapse of time, it is subject to deductions depending on the severity of the complaint. If after a lapse of time (usually 1 month), regardless of whether the complaint has been resolved or not, and there are new complaints of the same kind, the operator is subject to a higher deduction. There are also deductions on the grounds of causes attributable to drivers and buses.

## C.6. Roles and Responsibilities

Mexico City's bus system operation receives a pre-defined allocation of responsibilities between the operators and Metrobús. On the one hand, Metrobús is responsible for corridor supervision and enforcement, as well as for defining fares, schedules and timetables. Additionally, Metrobús evaluates operators' performance regularly. The following are responsibilities of Metrobús:

- Help the service providers technically in planning their strategies.
- Issue operation policies and monitor corridors.
- Set the corridors standards of operation.
- Set corridor fares.
- Permanently control each vehicle operating in the system of corridors.
- Supervise the adequate operation and maintenance of the system of corridors, in particular to evaluate performance indicators.
- Coordinate the implementation of new fare collection systems [40].
- Define timetables and schedule.
- Support the fleet purchase process.

Operators are in charge of managing the day to day operation and supervision of corridors. They are also responsible for fleet maintenance and the provision of the suitable staff. Furthermore, operators

are responsible for operating in compliance with the parameters set by Metrobús. Operator responsibilities include:

- Manage the day to day operation of corridors.
- Provide day to day supervision of corridors.
- Abide by the operation rules specified in the contractual agreement, in particular operating according to the timetables and schedules fixed by Metrobús.
- Provide adequate staff to fulfill contractual requirements.
- Operate with adequate vehicles in accordance with the fleet requirements set forth in the contractual agreement.
- Maintenance of the fleet.
- Provide Metrobús with the detailed reports needed for the administration and operation of the system, as well as to verify fulfillment of operational requirements.
- Guarantee the availability of the system for monitoring and supervision.
- Deposit revenue from fares on the trust funds.

## C.7. Risk Allocation

### Demand risk

Demand risk allocation varies between concession contracts. For most of the operators, the remuneration is a function of the fleet mileage and demand risk is allocated to SEMOVI. For some other operators, the remuneration depends on the fleet mileage and the corridor demand so that SEMOVI and the operators share demand risk. In such a case, the risk allocated to the operators is limited as the operators' remuneration discretely changes as a function of demand (see Bus Operation Remuneration).

### Operational risk

Operational risk is transferred to operators. Bus operators are responsible for fleet daily operation and maintenance. The operators are subject to deductions for non-compliance with operational requirements. Under some contracts, operators receive performance bonuses, which promote fulfillment of operational requirements. Operators bear the risk of changes in operational costs beyond the ones that are due to inflation.

### Regulatory risk

Since the fixed price per kilometer paid to operators is adjusted yearly in respect of fuel increase and inflation, all changes on taxes on fuel will be covered by SEMOVI. Risks related to environmental, wage and tax regulations are born by the operator.

### Implementation risk

Under most of the contracts, the operators provide fleet, depots, mechanical workshops and gas stations. There is an implementation risk for operators that breach the contract agreement.

## C.8. Corridor Distribution

The first step in a corridor organization is to perform a study to analyze the current transport systems in the corridor, deepening on the operational and organizational scheme, and corridor supply and demand. Once the results of the study support the necessity for a transport operation service concession, the selection of the operator begins. In the following paragraphs, there is a more detailed description of the phases of the process.

**Technical studies:** the technical study identifies the main transport systems and fleet size. It also incorporates the operational and organizational characteristics of the main services in the corridor. Furthermore, there is a quantification of the corridor's supply and demand and an analysis of

operational efficiency. The study also calculates pollution emissions. Finally, it determines the new operational scheme, including fleet and service contract specifications, and the number of concessions needed for the corridor. Depending on the corridor involved, there are additional aspects in the technical study.

**Operator selection:** There is no formal tendering process for the selection of operators; the selection of the transport service providers is based on the existing operators along the corridor and the participation of each one in the entire corridor fleet and its demand. It is likely that a transport service provider is awarded a concession when it already operates (a route in) the corridor and has a significant participation in the corridor's fleet and demand.

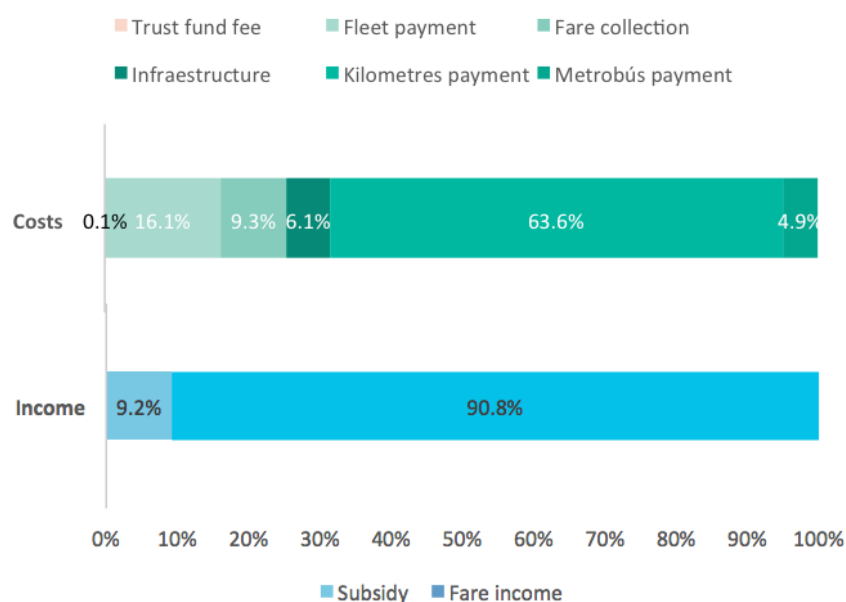
**Contract agreement:** Once an operator has been selected, there is a contractual agreement between SEMOVI and the operator. The contractual agreement defines the operator's rights and obligations. It also specifies operation and fleet requirements and a remuneration model, among other aspects.

**Contract extension:** Extension and the duration of the contracts are limited to the initial contract lifetime. The award of contract extensions takes into account the operators performance during the contract's initial lifetime, the persistence of the necessity of the operator services and a second evaluation based on its economical, technical, legal and administrative capacity. The performance evolution takes into account compliance with operational rules and performance indicators through the contract lifetime.

## C.9. Revenue and Costs

Bus operation costs are mainly concentrated in the kilometer payment to operators. This payment is quantified to cover the operators' operational costs.

The system's revenue has two components: the fare system income, which is a function of the fare transport tariffs and the number of users; the second component is a government subsidy.

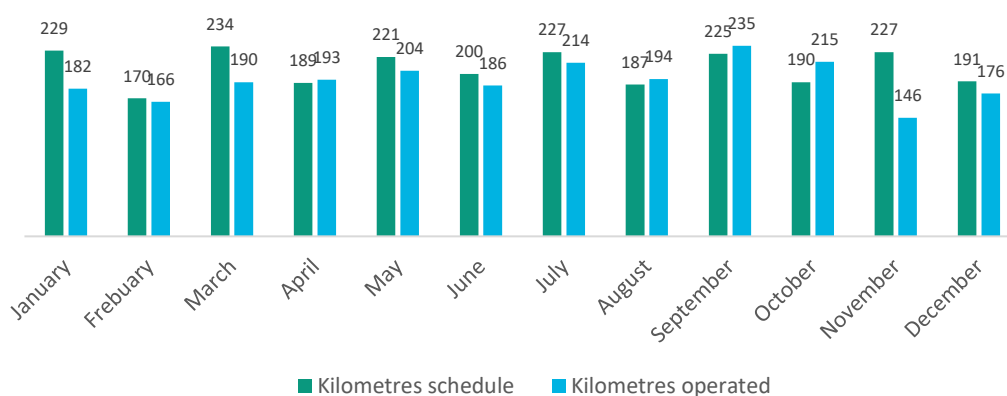


**FIGURE 14. CORRIDOR INCOME AND COSTS FOR 2014**  
SOURCE: METROBÚS [43]

## C.10. Results of Contract Implementation

This section focuses on the corridors' performance results, because corridors have clearly defined performance indicators and monitoring processes and there is no such information for the other bus-based systems.

The Metrobús remuneration model promotes compliance with scheduled kilometers. The kilometer payment based remuneration model includes a strong incentive for the operator to cover the required kilometers. In 2014 there was 92.4% compliance with scheduled kilometers.



**FIGURE 15. BUS SERVICE CONTRACTS, SCHEDULED VS. OPERATED BUS KILOMETERS IN 2014**  
SOURCE: METROBÚS [43]

The corridor implemented in 2015 was successful and has been expanded by 5 additional corridors. The corridors' demand increased from 137 million passengers in 2010 to 260 million passengers in 2014 [44]. The corridors fleet was also increased from 2013 to 2015 by 24.1%. By the end of 2015, the fleet size was 468 buses, including articulated and bi-articulated buses.

**TABLE 10. FLEET SIZE FROM 2013 TO 2015**

Bus type	2013	2014	2015
Bus	54	54	55
Articulated	296	350	362
Bi-articulated	27	27	51
Total	377	431	468

SOURCE: METROBÚS [44]

## C.11. Conclusions

There is still work to be done to complete the transition from the old owner-operator bus model to the organized bus company model. In spite of this, the Metropolitan Area of Mexico has achieved positive results regarding the expansion of the organized bus company model. These positive achievements include growth in demand during the last decade, improvement of the service and fleet renovation. The quality of the traditional bus system has progressed due to authority monitoring of the services and the new remuneration model.

Transition to the organized bus company model was boosted by the creation of a Committee per corridor, which has become a valuable channel of communication between Metrobús and the operators. Therefore, the Committee created space not only for the close supervision of the system, but also for strengthening the reliability of the operators in the corridors model.

The corridors' remuneration model is based on a fixed remuneration per kilometer<sup>9</sup> operated, performance deductions and quality bonuses<sup>10</sup>. The fixed remuneration per kilometer includes an incentive for scheduled kilometer compliance. This has materialized in over 90% coverage of the scheduled kilometers. In addition, this type of remuneration discourages the on-street competition that directly affected mobility and the users' experience in recent years. On the other hand, performance penalties promote operation according to the required specifications. It is worth noting that, despite the existence of deductions, their application is flexible, because operators are first notified of the failure and then fined. Quality bonuses have become an incentive for operators to improve service reliability and therefore the provision of better service quality.

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<sup>9</sup> Remuneration as a function of the corridors' demand is only included in certain contracts.

<sup>10</sup> Quality bonuses are only included in certain contracts.

## D. Stockholm

Stockholm County, the most important of the 21 Swedish counties, is known for its innovative methods to improve its public transport. Its methods have made the County a pioneer in the use of clean energies for public transport and the design of incentives to improve service quality. In the last decade, the County has succeeded in reducing its emissions and increased the perceived service quality of public transport. With a great deal of support from the regional government, highly experienced, specialized transport companies currently operate public transport.

### D.1. Public Transport Overview

Stockholm County, also known as Greater Stockholm, is a metropolitan area surrounding the city of Stockholm itself. It includes the city of Stockholm with a population of 1.37 million inhabitants and a total of 26 municipalities with an estimated metropolitan population of 2.23 million in 2015. Its metropolitan area is approximately 6,519.3 km<sup>2</sup> with a very low density of 340 inhabitants/sq km. The public transport of the County is composed of several land based and seaborne based modes of transport. Land transport provides 2.78 million boardings on a typical winter day, the season of peak demand. The subway (metro) is one of the main transport systems and is made up of three lines and has approximately 1.2 million boardings on a weekday in winter. The bus network has routes that interconnect the entire County with 1.12 million trips on a winter weekday. Also, the 4 lines of commuter railroad interconnect the city of Stockholm with some of the most distant municipalities in the County as well as the international airport. The commuter railroad provides approximately 299,000 trips on a weekday in winter. While the light rail and tramlines provide 156,000 trips on a weekday in winter [45]. Additional services such as boats or special services for disabled people are provided by public companies owned by the Stockholm County Council.

Stockholm public transport is provided through procurements with the entire land transport operated by private companies. It is also known for its environmental sustainability, with an approximate 87% fleet of vehicles using alternative fuels producing reduced emissions [45].

### D.2. History of Bus Services and Organization

Storstockholms Lokaltrafik, commonly referred to as SL or Greater Stockholm Local Transit Authority is a council owned company with a current role of Transport Authority for land public transport. Up to 1988, SL was the only transport operator for bus and Metro transport systems. In the same year, a national act allowed the transport authorities to deregulate the respective operation and place them under a private operator competition scheme.

Hence, in 1991, SL started several tendering processes to commission the city's public transport operation to several private companies. By 1993, the land transport operation was gradually commissioned to private operators under the regulation and control of SL. The bus operation contracts were valid until 2001 as gross-cost contracts, also referred to as production contracts, under which remuneration was based only on the distance covered by the service. Subsequently, in 2001, SL started to establish remuneration rules according to the quality and efficiency of the services in order to improve quality and reduce operational costs [46]. Currently, 6 private companies are operating public bus routes, an underground Metro, commuter trains, light rail and trams [47].

### D.3. Institutional Organization

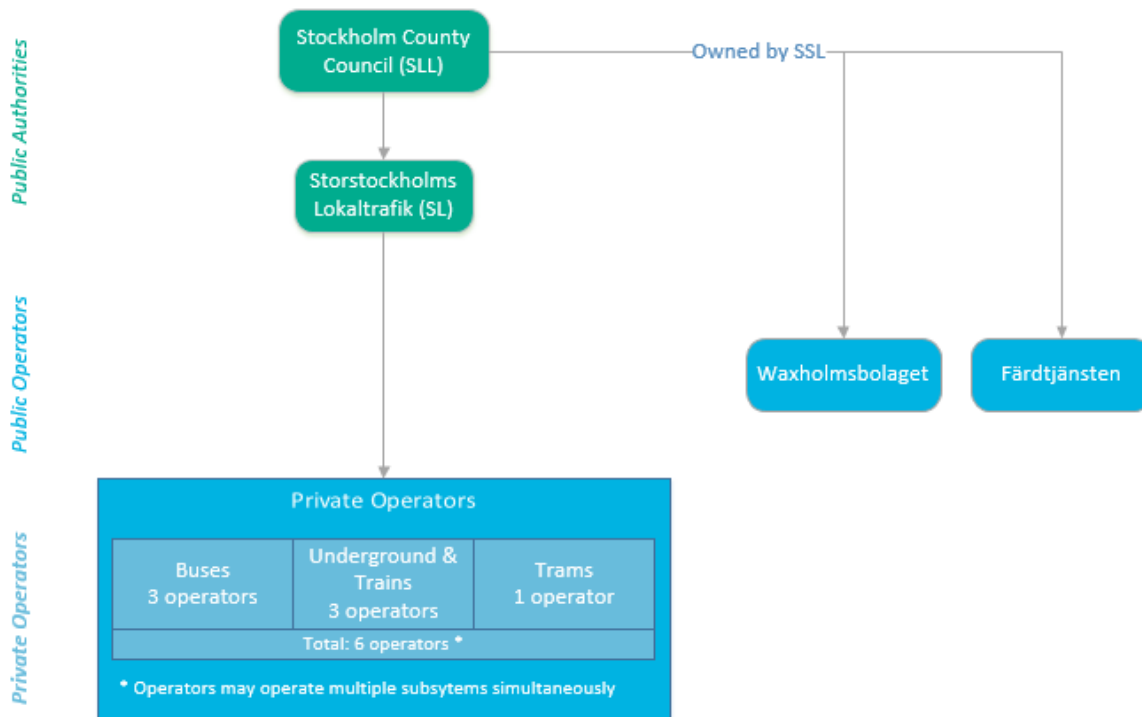


FIGURE 16. INSTITUTIONAL ORGANIZATION OF PUBLIC TRANSPORT IN STOCKHOLM

#### **Stockholm County Council (Stockholms läns landstig or SLL)**

SLL is a public institution responsible for public healthcare and public transport in Stockholm County. It is also responsible for the execution of regional development policies and cultural subsidies. For public transport, it is the highest authority in the County, and is responsible for supervision of the specialized Transport Authority Storstockholms Lokaltrafik (SL) and public operators Waxholmsbolaget and Färdtjänsten [48].

- **Storstockholms Lokaltrafik (SL)**

SL used to be the public transport company of Greater Stockholm, but now acts as a regulation company that controls private transport operators. It is in charge of planning and commissioning land public transport, as well as determining ticket prices, timetables and the duration of contracts. It also owns the infrastructure used in the railroad systems, as well as the bus service depots and workshops.

- **Public operators**

Waxholmsbolaget and Färdtjänsten are public transport operating companies owned by Stockholm County Council. Waxholmsbolaget is in charge of the operation of maritime based transport in the County. While Färdtjänsten is in charge of land transport services for the disabled and those with restricted mobility.

- **Private Operators**

Currently, 6 companies are in charge of the operation of all the public transport services in Stockholm.

**TABLE 11. TRANSPORT OPERATORS IN STOCKHOLM COUNTY**

Operator	Bus	Light Rail	Underground	Commuter Trains	Tramways
Keolis	✓				
Nobina	✓				
Arriva	✓	✓			
MTR			✓		
Stockholmståg				✓	
Stockholms spårvägar					✓

SOURCE: STOCKHOLM COUNTY COUNCIL [47]

The bus operators are in charge of providing the bus fleet, performing regular preventive and corrective maintenance and operating the routes under the concession, while the operators of railroad systems are only in charge of operating the service.

#### D.4. Regulatory Framework

As a member of the European Union, Sweden is required to comply with the legislation issued by the European Commission, the executive body of the European Union. These regulations usually include high-level rules to be adopted by the domestic law of each country. The following legislations have facilitated better public service in Stockholm.

##### **Regulation No.1370/2007 for public transport services by rail and road [49]**

In 2007, the European Commission officially published Regulation No. 1370/2007 governing regulations for public rail and road transport services. In December 2009, the regulation came into force and now has mandatory compliance status for all the members of the European Union.

Regulation No. 1370/2007 determines the types of public service contracts that can only be carried out by a transport authority, defines several mandatory rules for public transport contracts and the requirements for compensation of service. The following are the main clauses covered by Regulation 1370/2007 in each category:

#### Mandatory content of public service contracts:

- A clear definition of the obligations of public service operators.
- The duration of bus service contracts shall be limited to 10 years, given that longer periods can lead to market foreclosure and reduce the benefits of competitive pressure. Contracts could be extended by a maximum of 50% of their original duration if there are high capital investments that need to be amortized.
- However, contracts may have a longer duration if there is an exceptional infrastructure that requires an extended amortization period and as long as the contract is awarded through a competitive tendering process. In this case, the public service contract should be submitted to the European Commission with the arguments that justify its longer duration and with parameters to calculate remuneration in a way that prevents overcompensation.
- Allocation of costs related to the provision of services, including staff; energy; infrastructure charges; maintenance and repair of public transport vehicles; rolling stock and the facilities needed for the operation of passenger transport services; fixed costs and an appropriate return on capital.
- Allocation of revenue from fares which may be kept by the public service operator, repaid to the competent authority or shared between the two.
- Compliance with the national regulations governing the safeguarding of employees' rights in the event of transfers to newer transport operators.
- If the bus service operator has to comply with quality standards, they must be included in the terms of reference and the contract.
- Restrictions regarding the possible duties that may or may not be carried out by a sub-contractor.

#### Award of public service contracts:

- Awarding public service contracts should be through competitive tendering. Direct contracts may be used when they are an emergency measure to attend a disruption of services, concern transport by rail –except metro or tramway, or their average annual value is below a specific threshold.
- In the case of public service contracts based on a competitive tendering procedure, they must be open to all operators, be fair and follow the principles of transparency and non-discrimination.
- Authorities must publish potential public service contracts to be granted one year before the invitation to tender is launched or a direct award takes place.

Regulation No. 1370/2007 has allowed SL to include several conditions in the concession contracts. Although Stockholm has always included quality clauses for the service, the regulations have been especially useful in guaranteeing work rights of staff previously working in the service [50]. In this case, the contracts include clauses requiring the minimum conditions of workers transferred from a previous contractor to be honored. Additionally, general working conditions are required, as well as action plans in order to continuously improve the working environment.

#### **Directive 2014/23/EU on the award of concession contracts [51]**

On February 23, 2014, the European Parliament and the Council of the European Union issued the Directive 2014/23/EU on the award of concession contracts. This Directive does not apply to concessions for public passenger transport services, but it is applicable to concessions to build infrastructure for railroads, automated systems, tramways, trolley buses or cable cars. It provides a

legal framework for the award of concessions whose value is equal or greater than EUR 5,186,000. The Directive has been included in this regulatory framework section as a reference for guidelines and best practices in the design of concession contracts.

According to the OECD [52], the following main clauses are taken into consideration:

- The Directive clarifies that service concessions are contracts of pecuniary interest under one or more contracting authorities or entities, entrusting the provision and the management of services to one or more economic operators. The right to exploit the services implies that the operating risk is transferred to the concessionaire. Hence, a concession by definition does not guarantee that an operator will be able to recoup the investments made in order to provide the services required, costs incurred in operating the works or providing the services under the concession.
- In cases of mixed concessions where the contract involves services concession items as well as those of a supplies concession, the main subject of the contract must be determined according to the estimated value of the respective services or supplies, with the higher value of the main subject matter.
- Contracts under which the contractor is remunerated on the basis of regulated tariffs that are calculated in such a way as to cover all the costs and investments borne by the contractor for providing the service that does not qualify as a concession but rather as a public contract.
- The duration of a concession must be limited in order to prevent market closure and restricting competition. Therefore, for concessions lasting more than five years, the maximum duration of the concession must not exceed the estimated time that a concessionaire could reasonably be expected to take in order to recoup the investments.
- To ensure basic transparency and efficiency, the contracting authorities are obligated to follow strict time limits for the receipt and response of requests during the tendering process. They are also required to publish their intention to award a concession in the official journal of the European Union.
- Unsuccessful bidders must be given the opportunity to challenge any decision taken during a concession award procedure and they thereby enjoy the minimum guarantees set out in European remedies directives.
- The concession contracts must provide the mechanisms that allow the modifications of a concession contract during its execution, as they typically involve long-term complex technical and financial arrangements that are often subject to changing circumstances. The following requirements are defined:
  - The concession contract must foresee the possibility of additions or modifications.
  - The modifications must not exceed 10% of the initial contract value.
  - The additions must not exceed 50% of the initial contract value.

## **D.5. Bus Operation Contracts**

### **D.5.1 Type of Contract**

The competition scheme for public transport in Sweden is mainly used for local authorities. In the case of Stockholm, SL is the Transport Authority in charge of all tendering processes. At present there are several types of contracts: gross cost without incentives, gross-cost with low value incentives, and gross-cost with high value incentives.

With regard to the gross-cost contracts without incentives, a fixed amount per kilometer is paid to the operator regardless of any performance criteria. This was the main type of contract used during the 90s. Today, about 41% of the vehicles in operation follow this model.

In the case of gross-cost contracts with incentives, a fixed base amount is paid per kilometer to the operator and an additional amount is paid according to the compliance of several technical and operational criteria. Since 2002, this is the main type of contract used in the County. About 59% of the vehicles in operation follow this model, where 45% consists of low value incentives (lower than 25% of the total remuneration), and 14% consists of high value incentives (higher than 25% of the total remuneration). The latter case includes the most recent contracts for several routes, where the remuneration occurs according to the number of verified paying passengers. The percentage of incentive remuneration according to demand may vary from 25% to 100% of the total remuneration. High value incentives contracts are a new approach to contractual arrangements compared with settled gross-cost contracts. [46]

### D.5.2 Free Optimization Contracts

SL operation contracts are usually large and assign commissioning of the operation to more than 300 buses for a single company each time [46]. Each contract is intended to cover the operation needed for an area; usually routes to and from the center of the city of Stockholm. The contracts require the operator to include planning and optimization of the services for the area assigned, so that the Transport Authority does not mandate the operation of a specific number of routes or compliance with a timetable. The duration of the contracts has varied in recent years, nevertheless the contracts always consider the possibility of an extension in cases in which the Transport Authority considers beneficial. The duration of current contracts may be from 8 to 10 years for buses, plus an additional duration of 2 to 4 years [53].

### D.5.3 Quality of Service Clauses

Currently, all the contracts for bus operation in Stockholm include incentives and penalties for operation as a component for remuneration [54]. SL defines a series of service quality criteria seeking improvements in the service provided as follows:

- Customer satisfaction: a bonus paid when more than 80% of the passengers are satisfied with the service
- Cleanliness
- Driver qualification
- Punctuality: a bonus is paid if the number of late departures is below 4% of the programmed departures
- Compliance to schedules: a penalty formula is applied for the early or delayed departures of the vehicles. The difference (measured in minutes) from the programmed departure and the actual departure is used to apply a penalty on the remuneration per passenger for the operator

These criteria are measured with the following methods:

- **Passenger surveys:** used to measure customer satisfaction twice a year. About 20,000 interviews are conducted each year. The passengers are questioned on the following aspects: punctuality, conduct of personnel, driving performance, cleanliness of vehicle, cleanliness of bus stops, quality of information about delays and cancellations.

- **Randomized quality controls:** made by the so-called “mystery shoppers,” specialized hired personnel that use the service like any passenger. They randomly measure cleanliness of the vehicles, presence of litter, presence of graffiti, cleanliness of bus stops, graffiti at bus stops, correct information signs inside the vehicles, driver friendliness and knowledge of the transport system, compliance with timetables (early or late departures).
- **Cancelled departures report:** an official report must be sent from each contractor to SL. For each reported cancellation, the operator must pay a fine. If SL detects via the fleet control system that a cancellation was not reported, a significantly higher fine must be paid.
- **Passenger complaints:** these are collected continuously by telephone or e-mail and are categorized by status of bus stops or terminals, status of the vehicles, conduct of personnel, quality of the traffic, cancelled and delayed trips.

## D.6. Roles and Responsibilities

Contractors are assigned the following duties for the most recent VBP contracts [53]:

- *Analysis, planning and local marketing of the services:* the entire design of the services, including routes and marketing are commissioned to the operator, which means that it is fully responsible for guaranteeing service quality and services optimization.
- *Operation of services:* including the definition and management of timetables and departures, allocation of resources by assigning drivers to vehicles and vehicles to routes as well as optimization of empty kilometers.
- *Bus acquisition and financing:* operators must make the initial investments needed to operate the services. Such investments are mainly used for bus acquisition, and are usually required at the start of the contract. Due to the usual size of the contracts, the operators (and their strategic partners) must have significant financial muscle.
- *Bus maintenance:* preventive and corrective maintenance to guarantee the correct operation of vehicles, such as regular replacement of components of the vehicle components, as well as replacement of parts required due to damages.
- *Maintenance of depots and bus shelters:* although depots and bus shelters are provided by the County, the contractor must perform the maintenance needed to guarantee the operation and to prevent decay of infrastructure.

## D.7. Technology Requirements

Stockholm authorities have defined aggressive plans to guarantee sustainable and clean mobility in the city. In the case of buses, the city has a plan for the total fleet of buses to work with clean technologies by 2030. The operators are currently mandated to fulfill strict requirements to guarantee compliance with the city’s sustainability goals. They are required to use alternative fuels or biofuels, such as biogas or ethanol-based fuels in order to reduce emissions, especially  $CO_2$  and  $NO_x$ . In addition, they are required to comply with noise emission levels generated by the bus fleet [55].

The contracts usually specify detailed requirements, such as the use of biogas, a particular type of fabric for seats or the color of the handholds, instead of establishing the objectives that contracts must comply with and optimize. For example, specification of the use of biogas powered vehicles has limited the contractors to using other types of clean and more cost efficient fuels. The inclusion of numerous non-standard requirements for the vehicles in a specific contract has caused an increase in operational costs [56].

## D.8. Risk Allocation

The operation contracts from SL allocate the risk indirectly by assigning several responsibilities to the contractors. Due to the evolution of contracts to high incentive based remuneration, several risks have been transferred to the contractors. The risks below are those of the most recent operation contracts awarded:

- **Demand risk:** Remuneration in incentive contracts is mainly based on user demand. The VBP (Verified Paid Passengers) contracts transfer the demand risk partially or entirely to the transport operators by remunerating them according to the number of paid passengers on board. SL, as well as the national authorities, has decided that an increase in demand is aligned with the city's interests, as it may reduce congestion and emissions. Therefore, SL transfers the entire responsibility to plan the routes and timetables to the contractors in order for them control to mitigate the demand risk [53].
- **Regulation risk:** according to the European regulation, concession contracts may be modified during the operation period by up to 10% of the amount of the contract. The contractors must assume this risk in the event that the authority considers that the contract value must be reduced [51].
- **Operation risk:** during the tendering process, bidders provide a bid price per passenger based on their estimations of operation costs and expected profit. In case the operational costs differ from the estimates of the successful bidder, it must assume risks that may affect their remuneration.
- **Implementation risk:** the operation contracts are intended to seek innovative solutions from the transport operators. As the operators are also in charge of the planning of services, the implementation risk is assigned to them. As the possible delays in implementation may affect demand directly and hence the remuneration, risk is allocated to the contractors.

## D.9. Bus Operation Remuneration

Due to the transition in the remuneration models started in the early 2000s, the most recent operation contracts contain a heavy remuneration component based on paid passengers (VBP). The following table summarizes some of the latest operation contracts, and the contribution of Verified Paid Passengers and kilometers logged (shared production remuneration) to total remuneration.

TABLE 12. REMUNERATION FOR SEVERAL OPERATION CONTRACTS

Contract	Area	Type	VBP share of remuneration	Share of Production remuneration	Starting date
E19B	Norrtälje	Bus	50%	50%	June 2011
E20	Norrort	Bus, tram	100%	0%	August 2012 / January 2013

<b>E21</b>	Innercity / Lidingö	Tram	25%	75%	December 2014
<b>E22</b>	Innercity / Lidingö	Bus	50%	50%	August 2014
<b>E23</b>	Handen, Tyresö and Nynäshamn	Bus	100%	0%	2015
<b>E27/28</b>	Södertälje and Järfälla	Bus	50%	50%	2016

SOURCE: SUPERINCENTIVE CONTRACTS, 2016 [46]

SL defined a new remuneration model in order to improve operation efficiency and increase service quality. This efficiency can only be achieved if the operators are able to introduce the necessary innovations to maximize their profit according to the paid passenger and improve service quality.

Remuneration is also adjusted over time according to an indexation of operational costs to inflation or to other price indices. For instance, adjusting remuneration may compensate changes in fuel or salaries.

## D.10. Tendering Process

The tendering processes in Sweden are defined by the following standard stages [57]:

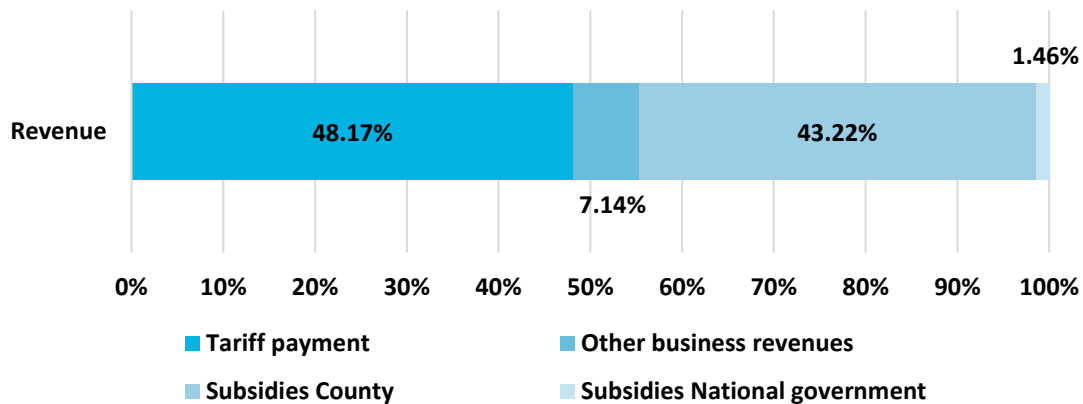
- 1. Planning:** the contracting authority determines the needs that justify the implementation of a tendering process. The authority may take several months to carry out investigations, gather data, and determine the conditions of the market and the needs of both users and the regions.
- 2. Preparation of tender documents:** in this stage the authority designs the specifications and documents needed for the tendering process, such as a draft contract or the tender forms. The documents always contain the following basic information:
  - Purpose of the contract, or a description of what is to be procured.
  - Formal requirements of the proposals, the deadlines for submission of the proposals; language required for the proposals, and the currency that must be used for the bid price.
  - Methods for presenting questions during the process.
  - Requirements for bidders, such as their financial and technical capabilities.
  - Technical and functional requirements for the service to be purchased, including service quality clauses.
  - Commercial terms regarding conditions of payment for the provision of the service and payment adjustments during the term of the contract period.
  - Preparation of the tender documents is an internal phase and bidders are not allowed to participate at this stage. Tender documents must always comply with the following

principles established by European and national law: non-discrimination, equal treatment, transparency, proportionality, and mutual recognition.

3. **Advertising and offer period:** once the tender documents are completed, the authority publishes them in public media (national or international), seeking easy access to the process and transparent participation. In the case of transport procurements, the tender documents are published in European public media, in order to seek the participation of European companies. The interested suppliers may post questions during a period of time and the answers to such questions must also be published. A deadline is defined for bidders to submit their proposal.
4. **Opening the proposals:** once the deadlines for presentation of the proposals have been met, the authority proceeds to open the bids. A preliminary rejection is performed in case any proposal submitted does not meet the requirements of the bidding process.
5. **Evaluation of proposals:** the authority proceeds to qualify the suppliers and examine whether the proposals meet the standards of the service. Such process is strictly confidential.
6. **Award decision:** the authority may choose the winning tender according to its compliance with the technical requirements and the economic proposal. A certain score is granted to each technical requirement, as well as the economic proposal. The overall score determines which bidder may be awarded. All bidders are informed of the decision as well as the score of each proposal.
7. **Signing of the Contract:** the contract is signed with the successful bidder. It is usually based on the tender documents as they contain all the technical information the contractor must comply with during the operational period of the contract. In the event the contractor replaces the operations of a previous contractor, the authority participates in the process of taking over the business and helping the new contractor in a transition that guarantees the work rights of the previous employees.
8. **Follow-up:** the contracting authority participates as a monitoring entity capable of evaluating the operational requirements of the agreement. This stage takes place during the entire operation period of the contract, in order to guarantee compliance with the requirements. The authority works in partnership with the tax office in order to determine compliance with the contractor's fulfillment of its fiscal duties. At the end of the operational period of the contract, an extensive assessment is performed in order to determine the possibility of a contract extension. The documentation created during this assessment is especially useful for the subsequent procurement processes in cases where there is re-tendering of the operation contracted.

## D.11. Revenue and Costs

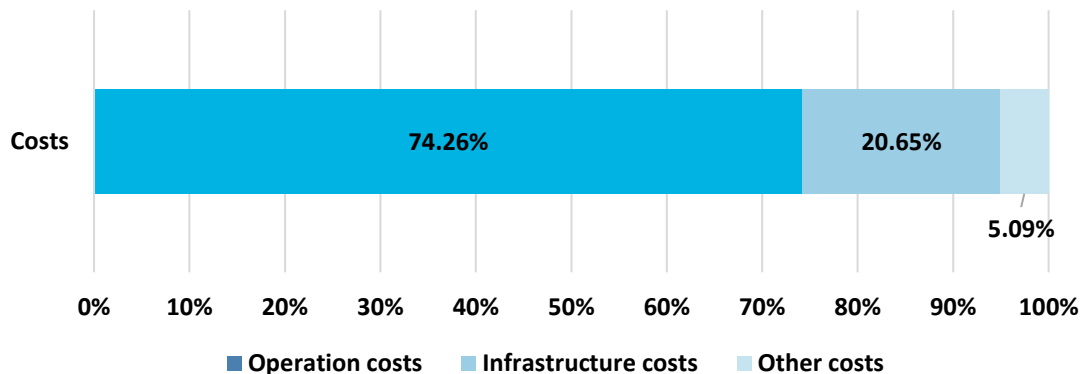
SL, as a subsidiary company of SLL, takes control of the revenue originated from the land public transport. The tariff payment represents only about 48% of the total revenue of the public transport. Therefore, a significant percentage of subsidies is needed from the County and the national government. Subsidies account for 44% of the transport system's total income.



**FIGURE 17. TOTAL REVENUE OF PUBLIC TRANSPORT IN STOCKHOLM, 2013**

SOURCE: STORSTOCKHOLM LOKALTRAFIK ANNUAL REPORT 2013 [45]

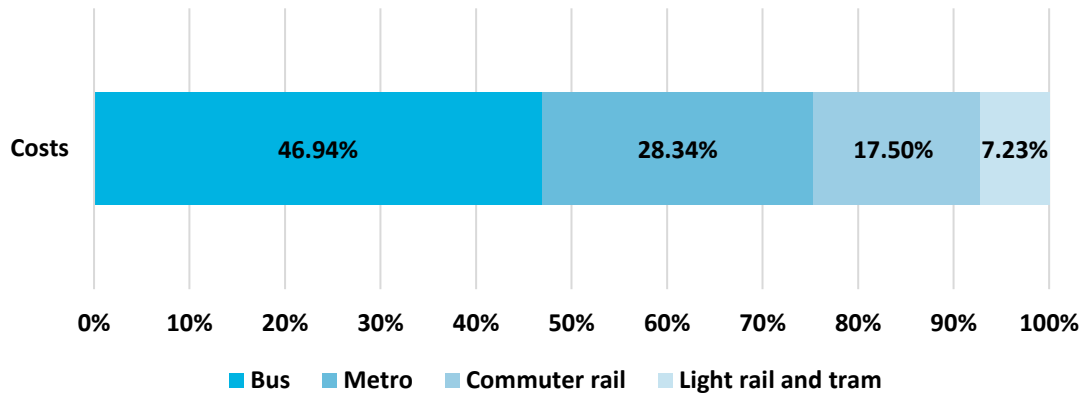
On the other hand, the periodic revenue is distributed among the total costs of the public transport, mainly constituted by the costs needed to remunerate the operating companies. Due to the significant difference between the operational costs (74%) and the revenue obtained directly from the tariff payment (48%), the Transport Authority must cover the remaining costs via the subsidies provided by the County. It is worth noting that the remuneration obligations acquired by SL in the operation contracts must be fulfilled regardless of the actual income from tariff payments. Hence, the subsidies provided must always be adjusted in order to cover the operational costs. However, the latest operation contracts with remuneration incentives according to paid passengers mitigate the demand risk and transfer it to the contractors.



**FIGURE 18. TOTAL COSTS OF PUBLIC TRANSPORT IN STOCKHOLM, 2014**

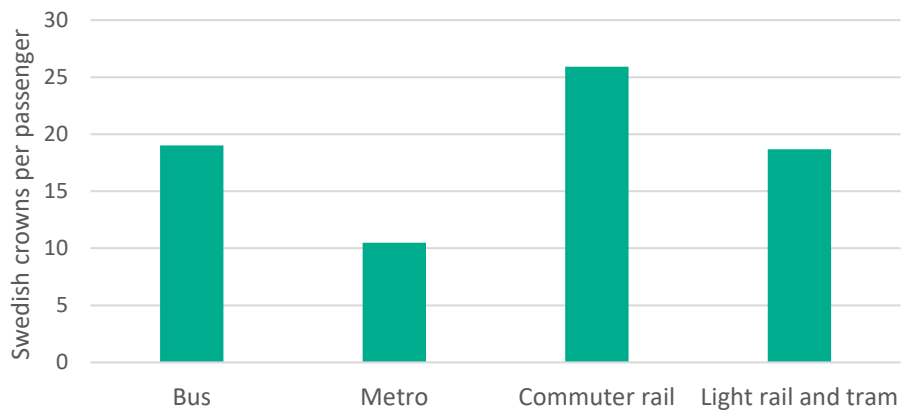
SOURCE: TRAFIKANALYS [58]

The operating costs are distributed among the different modes of transport. The bus network takes almost 47% of the total operating costs, making it by far the mode that requires most resources. However, the investments made in 2014 by SL in infrastructure and maintenance were nearly three times more in the metro system than in the bus system.



**FIGURE 19. COSTS PER TRANSPORT MODE IN 2013**  
 SOURCE: STORSTOCKHOLM LOKALTRAFIK ANNUAL REPORT 2013 [45]

Nevertheless, taking the operational cost per passenger into consideration, the bus system is the second most expensive land mode of transport in the County. This is mainly because the operational costs include the capital costs of the bus fleet, significantly higher due to the very strict technical requirements.

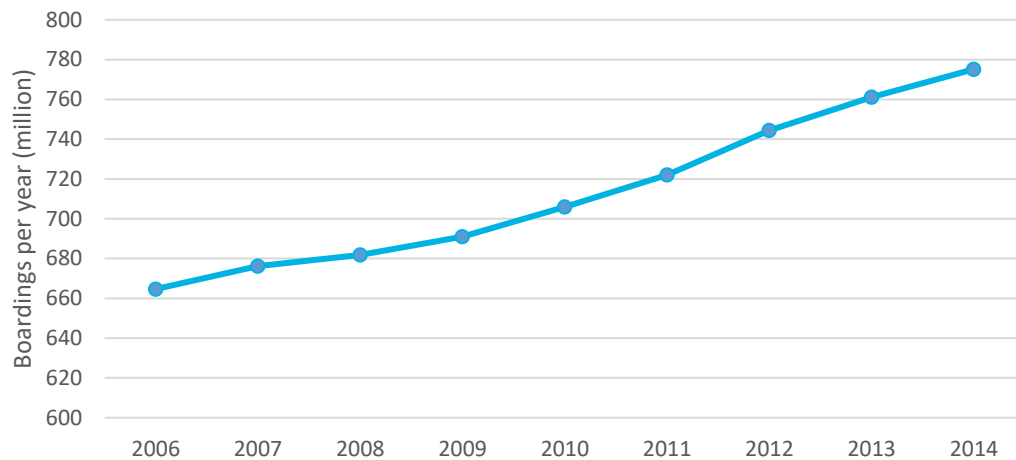


**FIGURE 20. COSTS PER PASSENGER FOR DIFFERENT TRANSPORT MODES**  
 SOURCE: STORSTOCKHOLM LOKALTRAFIK ANNUAL REPORT 2013 [45]

## D.12. Results of Contract Implementation

### Doubled public transport by 2020

One of the main objectives of the County and the nation is to reduce emissions and the use of clean energies. The Swedish parliament and government have determined that this objective can be partially achieved by increasing the demand for public transport and reducing the demand of individual vehicles. Therefore, in 2006, one of the national objectives was to duplicate the public transport demand by 2020 [59].



**FIGURE 21. PUBLIC TRANSPORT DEMAND IN STOCKHOLM**  
SOURCE: TRAFIKANALYS [58]

The overall growth of public transport has been 16.62% [58] between 2006 and 2014, against a 14.59% growth of population [60]. With an average annual growth of 2% of the demand for public transport, it would be expected to achieve only a 30% increase by 2020. Therefore, there is no strong evidence that the growth of public transport demand is mainly due to transport policies implemented by the County in the most recent years.

#### **Buses powered by alternative fuels**

The most recent operation contracts include strict environmental requirements for the bus fleet in order to achieve the goal of zero greenhouse emissions by 2050 [55]. The contracts have consistently allowed the adoption of clean energies for the buses in the County. Such improvement is evidenced by a yearly increase of the bus fleet using clean or alternative fuels. By 2011, 71% of the fleet used clean fuels. In comparison, by 2013, 87% of the fleet used clean fuels [45]. It evidences a significant improvement that will lead in the coming years to a fleet 100% powered by alternative fuels.

#### **Reduction of operation costs in buses**

The most recent VBP contracts were intended to reduce the operational costs of the operators. Nevertheless, the costs have increased for all the operation contracts between 2011 and 2013. The costs for the VBP contracts have increased 10% while those for the production contracts increased to 34% [53]. While this may be considered an improvement based on production contracts, several operators consider that the excessive technical requirements have caused an unnecessary increase in operational costs. The use of non-standard requirements for buses implies additional maintenance costs that could be reduced in case the contracts only included functional requirements [56].

#### **Increase in quality**

The VBP (incentive based) contracts, have achieved an improvement of the perceived quality from the passengers. The first contract with high VBP remuneration has shown a significant increase in perceived service quality. Before the start of the contract, the perceived quality was below 79%, while 3 years later, it had increased to 88% [53].

## D.13. Conclusions

Stockholm County has succeeded in developing high quality, efficient public transport. The national regulations that led to the participation of private operators in the 90s allowed it to transfer operational responsibilities to specialized transport companies. Meanwhile, SL evolved as a strong Transport Authority, able to define and control several transport operation contracts.

The strategy started in 2002, allowed for improvements to be made in the operational costs while increasing service quality. The VBP contracts made it possible to transfer service quality duties to the operators. In addition, the remuneration model based on boarded passengers and quality incentives has improved the benefits of the operators and the County by aligning the operators' interests with those of the County. However, the VBP contracts have also required to transfer certain responsibilities that are usually the Transport Authority's, such as route planning. Such transfer of responsibilities may only be possible if the operators are broadly experienced and the contracts allow them to participate in a wide range of services.

The use of clean technologies and service quality has undoubtedly improved over time, although the excessive amount of specific requirements under each contract has forced the operators to stick to specific technologies and reduce the opportunities available to optimize operational costs.

In short, the innovative methods applied in Stockholm County have allowed the authorities to acquire the knowledge they need to improve the public transport service and enhance the satisfaction and quality of life of their citizens.

## E. Uberlandia

Uberlandia has achieved a fully organized bus operation under area concession contracts and the implementation of one BRT line. It is one of the smallest cities in Latin America with a BRT line in operation, since the urban area population is just 700,000 inhabitants.

New bus concession contracts were designed in 2009 in order to achieve 100% accessibility, improve quality of service, implement new technologies for transport (GPS, fleet management) and strengthen fleet requirements (maximum vehicle age, maximum average age, emissions). The new area contracts were allocated to three bus operators, which have so far been successful in the provision of services. Two of the main results of success of the new bus system are wider service coverage and a complete fleet with proper access for the disabled [61] [62].

### E.1. Public Transport Overview

Uberlandia is the second largest city in the state of Minas Gerais and is located on the western region of the state known as *Triângulo Mineiro*. According to 2015 estimates, the city had a population of 662,362 people and a density of 160.95 people/km<sup>2</sup> in an area of 4,115.2 km<sup>2</sup> divided in four districts, however its urban density is 2,681 inhabitants/km<sup>2</sup> [63] [64].

As of 2014, 177,700 daily trips were made on public transport (about 33% of trips), 176,600 trips on private transport (32.4% of trips), 168,500 trips on non-motorized modes (31.3% of trips), and 12,400 trips on informal passenger transport (2.3% of trips) [65] [66]. Public transport is organized in the Integrated Transport System or SIT (*Sistema Integrado de Transporte*), which comprises different bus routes and a BRT corridor [66]. Since the new operators started to provide bus services, annual trips went up from 60 million in 2009 to 64 million in 2014 (See Figure 22).

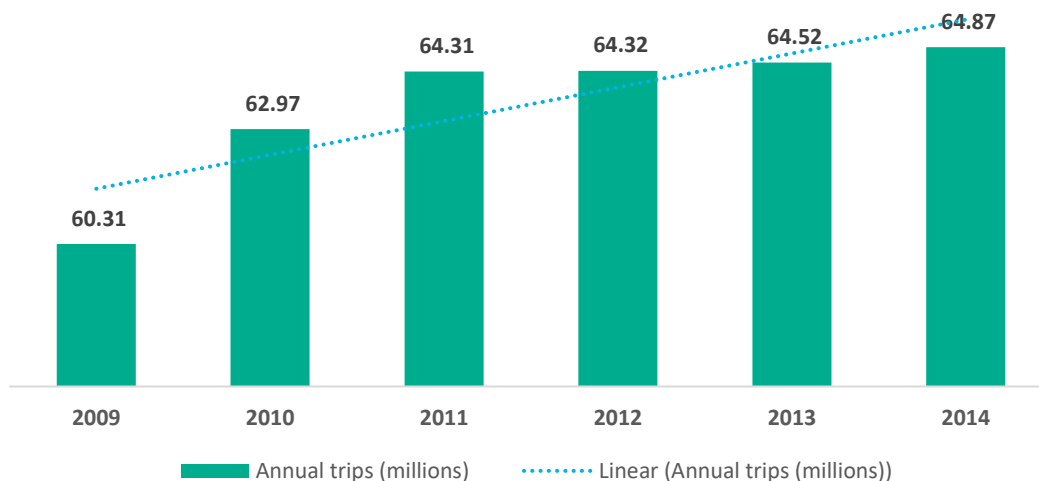


FIGURE 22. ANNUAL TRIPS IN PUBLIC TRANSPORT (1997-2014)  
SOURCE: SETTRAN [66]

Other public transport systems include free of charge personalized transport for disabled people, financed by the local Government and run by the same operators as the SIT.

- **SIT - Bus Service**

The integrated transport system started operation on July 5, 1997. Its main objective was to allow passengers to transfer between different bus routes with the payment of a single fare. Initially, the system consisted of five integration terminals (four peripheral terminals and one central terminal

located in the CBD) where passengers changed from one bus to another. Currently, the system includes the BRT corridor and there are four types of routes (*linhas*):

- Trunk routes (*linhas troncais*) that communicate peripheral terminals with the central terminal and vice versa.
- Inter-neighborhood routes (*linhas interbairros*) that communicate two adjacent peripheral terminals.
- Feeder routes (*linhas alimentadoras*) that take people to/from the different terminals to/from close locations.
- Radial routes (*linhas radiais*) that transport people from the most distant regions to the CBD.

The system operates seven days a week from 5 am to midnight. Means of payment are cash and the Supersit contactless card. Cash payments are received by collectors (*cobradores*) on board buses or at ticket offices at the bus terminals. The *cobradores* are responsible for collecting the cash payments and verifying the identity of people using discount or exemption Supersit cards. The fare is R\$ 3.5 (approx. US \$0.93) for a general user paying either with cash or Supersit, and R\$ 1.75 for students paying by Supersit. People over 65 are exempt from payment and people between 60 and 64 are granted two free journeys per day by presenting their Supersit when entering the system [66] [67].

The BRT system is a 7.5 km corridor going along João Naves de Ávila Avenue, one of the most important streets in the city, from Santa Luzia Terminal to the Central Terminal. It is a small system compared with more developed systems such as the Bogota Transmilenio, which has 100 km of corridors (See

Bogotá). The system has 13 closed stations, three of them allowing passengers to transfer to other SIT bus routes. The first BRT corridor was implemented in 2006 [66] and system expansion is expected in the coming years with the construction of additional BRT lines.

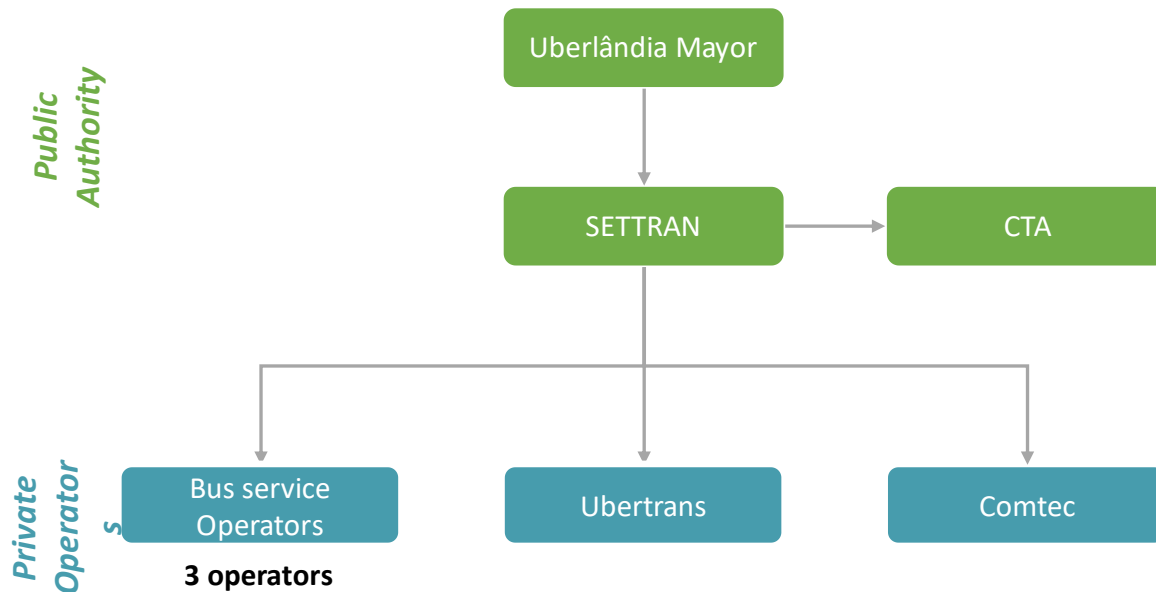
## E.2. History of Bus Services and Organization

Before SIT went into operation, independent public companies developed public transport in Uberlândia and people were required to pay a full fare for each bus they traveled in. The most remarkable events in Uberlândia's bus system history are mentioned below [66] [68]:

- In 1992, the Transit and Transport Authority or SETTRAN (*Secretaria Municipal de Trânsito e Transportes*) was created. SETTRAN was responsible for managing the city's transit and transport systems.
- In 1994, the Uberlândia Master Plan was created and established the implementation of an integrated transport system.
- In 1997, SIT became operational. The new five integration terminals allowed passengers to transfer between buses paying only a single fare.
- In 2000, the project of the first BRT corridor was developed. The same year, SETTRAN implemented the Department of Area Traffic Control or CTA (*Controle de Tráfego em Área*), responsible for computerized traffic management.
- In 2001, radial routes were integrated to SIT and allowed passengers to transfer from radial routes to SIT routes at the Central Terminal.
- In 2003, exclusive bus lanes on mixed traffic were implemented starting with a 1 km lane on João Pinheiro Avenue.
- In 2006, the first BRT corridor of the city became operational. The system connected the Central Terminal with Santa Luzia Terminal, located in the southeastern region of the city.
- In 2006, the 1994 Uberlândia Master Plan was revised and updated according to new urban regulations [69].
- In 2009, the current bus operators signed concession contracts for the SIT operation.

## E.3. Institutional Organization

The transport authorities (the Mayor and SETTRAN) and private operators form the institutional organization of the SIT. The authorities fix the transport policies and fares, plan routes and provide bus stops, stations and terminals. Three operators are in charge of the bus operation and fare collection, while there is an operator responsible for managing the terminals. Figure 23 shows the institutional organization of Uberlândia's transport system.



**FIGURE 23. UBERLÂNDIA'S SIT INSTITUTIONAL ORGANIZATION**  
SOURCE: SETTRAN [66]

The role of each of the transport institutions or companies is described below.

- **Mayor**

The Mayor of Uberlândia is responsible for fixing the fares as well as implementing transit and transport policies.

- **SETTRAN**

SETTRAN is the entity designated by the Mayor to manage the mobility in the city. SETTRAN is responsible for carrying out technical studies in order to perform route planning, including the modification or creation of new lines in the system. It also studies the fare cost, according to a defined methodology and formula, for the Mayor to fix the fare for the public. As the transport authority, SETTRAN supervises the service provided by the bus operators and enforces compliance with the respective contract.

- **CTA**

CTA is a department inside SETTRAN in charge of managing the traffic light system according to the traffic conditions. CTA is able to gather information on traffic, such as traffic volume or events on the roads by means of a set of sensors installed at the intersections [70] [71]. CTA is also responsible for gathering the operational information of the fleet, such as kilometers operated, IPK, operational fleet, among other statistics, as well as publishing reports on SETTRAN website for public access.

- **Ubertrans**

Ubertrans is the Bus Operators Association and is the company responsible for collecting fares. It also sells the Supersit electronic cards, with exception of student cards.

- **Comtec**

Comtec is a private operator in charge of managing the terminals and guaranteeing their commercial exploitation, which includes renting the shopping areas. For example, the Central Terminal incorporates a mall, which Comtec manages.

- **Bus Service Operators**

Three private companies run the bus operation. These operators are responsible for providing high quality service, own depots and vehicles (leasing is also permitted) in compliance with contract requirements.

## **E.4. Regulatory Framework**

The Uberlandia Master Plan was revised and updated in October 2006 and is responsible for guiding the planning and development of public transport in Uberlandia.

Municipal Act 9,279 of July 25, 2006, determines the organization of public transport in Uberlandia. In 2013, Act 9,279 was modified under Municipal Acts 11,601 of November 22; 11,668 of December 23; 11,673 of December 26; 11,677 and 11,678 of December 27. This Act determines the generalities of transport, such as the types of public transport modes available in Uberlandia, the responsibilities of SETTRAN as the Municipal Transport Authority, the principles that regulate public transport as a service for the population, and the priority of public transport over private and commercial transport. The Act also defines that collective public transport is only offered by bus and some more technical matters, such as the requirements to create a new bus route. Regarding legal issues, the Act establishes that the city can either directly operate the bus system or allow another organization to provide the service. It also defines the conditions for concessions to private operators of rights to run bus services within SIT, contract termination causes and penalties.

## **E.5. Bus Operation Contracts**

### **E.5.1 Type of Contract**

A concession contract is signed with each bus operator for a term of 10 years. The contracts used are net cost contracts, where the bus operators are responsible for fare collection and management of the system revenue [72]. If operators have a good performance during the initial period of the contract, the contracts can be extended for up to ten additional years.

### **E.5.2 Area Contracts**

Bus operation is based on concession contracts by areas covering both BRT and bus services. The city is divided into four regions, one neutral (the CBD) and three operational. The concession contracts were awarded over the operational regions to three private companies. Each company is responsible for running the routes in its region. All operators are allowed to enter the neutral region.

If it were necessary to create a bus route in two or more operational regions, only the operator whose region hosts the majority of the path would be granted the route. In the case of BRT, trunk routes two or more operational regions are allocated according to a demand impact study carried out by SETTRAN. The feeder routes can be assigned to the bus operator responsible for the region where the route mainly goes through [72].

### **E.5.3 Quality of Service Clauses**

The contract, which comprises the terms of reference, specifies some quality of service requirements. These requirements are [72]:

- In peak traffic hours, standing passengers per area must not exceed 7 pass/m<sup>2</sup>. In the event that 5% of the journeys made in a month on a particular route do not fulfill this condition, SETTRAN

will carry out a study for to develop a frequency or fleet modification for that route. In any event, the operator must cover at least 90% of the schedule for each route every month.

- At most, one journey every 4,000 km may be interrupted by vehicle malfunction.
- The fleet must be adapted to serve disabled people. 50% of the fleet must be adapted to start the operation. At least one adapted bus per route must be guaranteed. Subsequent fleet renewals must only be made with adapted vehicles.

In addition, SETTRAN guarantees that the walking distance to the closest bus stop must not exceed 500 m in areas with population density greater than 1000 inhab/km<sup>2</sup>.

### E.5.4 Technological Requirements

As a part of the fleet requirements, the bus operators must meet the NBR ISO 9001:2000 and ISO 14000 standards certifications<sup>11</sup> during the first 36 months following signature of the contract. The fleet must be owned by the operators or, at least leased. The average age of the fleet must be up to 5 years from the start, and during the contract, taking into account that no bus must be over 10 years. Regarding the fleet renewal, only new vehicles or vehicles purchased in the same year of renewal are accepted. Lastly, the operator must maintain a reserve fleet equivalent to 10% of the operational fleet [72] in depots.

Bus operators are also responsible for installing card readers and access barriers for the electronic fare collection system in the vehicles. The fleet must be equipped appropriately with devices for assistance to disabled persons in accordance with the accessibility clauses [72].

The operators are responsible for building depots and parking lots. There is no restriction regarding depots location, however it is the operators' responsibility to transport the fleet from depots to terminals at no additional cost. The operators are allowed to operate from provisional depots during the first 60 days of a contract [72].

## E.6. Roles and Responsibilities

SETTRAN is the transport authority responsible for enforcing contract compliance. Its responsibilities include [72]:

- Managing possible incidents in case any operator fails to offer the service. These incidents include strikes or public demonstrations, when the operator fails to implement a prompt solution.
- Setting fare policy.
- Revising and adjusting the fare when necessary in order to maintain the economic balance.
- Prevent illegal or informal transport services.
- Periodic inspections of fleet and road conditions.
- Promoting service improvement, system efficiency and fare affordability.
- Evaluating service improvement proposals.
- Promoting the use of new technologies in transport.
- Undertaking opinion surveys to evaluate the service quality.
- Approving advertising and information material for use by the operators before it is available to the public.
- Intervening in operations and canceling concessions, when applicable.
- Applying penalties to operators, when applicable.
- Guaranteeing the priority of public transport over private transport.

Operators are in charge of the system deployment and have the following responsibilities [72]:

- Executing all the services, controls and activities related to the concession according to principles of diligence and economy.

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<sup>11</sup> ISO 9001 is the quality management systems standard, while ISO 14000 covers environmental management.

- Providing any information required by SETTRAN in order to ease audit processes.
  - Maintaining a good financial situation and providing financial reports to SETTRAN. This also includes maintaining the minimum required conditions to be eligible in the tendering process.
  - Providing service management reports to SETTRAN and to the public.
  - Resolving the consequences of infringements of the contract.
  - Providing the infrastructure necessary to operate.
  - Renewing the fleet according to maximum and average age of fleet requirements.
  - Informing the public about changes in the operation due to exceptional situations.
- Contracting personnel (drivers and officers) for operation. This includes complying with Brazilian labor Law.

## E.7. Bus Operation Remuneration

Bus operation remuneration is calculated with the following formula:

$$Remuneration\ operator_i = Total\ revenue * \frac{Cost\ operator_i}{Total\ costs}$$

Where,

- 1) The total system revenue is all fare user income.
- 2) The cost of the operator is calculated as the product between kms logged and a cost per kilometer. The cost per kilometer is determined every time the total costs structure is updated.
- 3) The system total cost is the sum of all operators' individual costs.

There are no performance bonuses, but the contract does define non-compliance penalties.

According to regulation, the operator's remuneration should be fully covered by revenue collected from fares. Hence, income from fare must be sufficient to cover the costs associated with operation, including workforce, materials, vehicles and equipment, taxes, training programs, and other expenses. Therefore, the fare is annually revised taking into account the Consumer Price Index CPI, variations in the price of oil and variations in motor vehicle part prices. The fare will also be adjusted when the economic balance of the contract is affected. These events include average IPK of the system variations greater than 5%, variation of investment amounts related to fleet determined by the city, variation of any of the taxation rates, inclusion of new functionalities, new fare discounts, technological modifications, and implementation of a clearinghouse, among others. Since the operators are remunerated only via fares collected, it means the fare discounts and exemptions are financed by the users who do pay [72].

A company controlled by the bus operators executes fare collection and a clearinghouse is responsible for determining the remuneration for each operator [72]. A clearinghouse was implemented in 2013 under decree 14.320 of August 30, 2013 [73].

### Incentives and Penalties

All the penalties established in Act 9279 are applicable to the contract. There are five types of penalties defined in Act 9279: written notification, daily fine, vehicle bans, service intervention, and contract termination.

- The first penalty is a written notification, specifying the irregularities to be amended and the term to do so.
- If the operator does not correct the irregularities within the fixed term, it will be punished with a daily fine up to completion of the amendments. To determine the amount of the daily fine, there are five infraction categories; from I to V.

Table 13 shows the different categories of fines, their value and the applicable infringements.

**TABLE 13. DAILY FINE CATEGORIES AS DEFINED IN ACT 9279**

Penalty Category	Description
<p><b>Category I</b></p> <p><b>Daily</b></p> <p><b>R\$ 15 (US\$ 4) fine</b></p>	<ul style="list-style-type: none"> <li>a) Poor personal presentation or failing to identify the onboard personnel providing ID cards and uniforms.</li> <li>b) Failure to provide information to users.</li> <li>c) Failure to act according to accepted moral standards and good conduct.</li> <li>d) Failure to display notices and posters authorized by the transport authority.</li> <li>e) Failure to commence daily operation with vehicles in poor conditions of cleanliness.</li> <li>f) Driving at night with the lights off.</li> <li>g) Occupying passenger seats.</li> <li>h) Allowing two or more lines to board/alight the vehicle.</li> <li>i) Transit out of the exclusive lane (BRT corridor).</li> <li>j) Stop the vehicle separated from the edge of a sidewalk/station for boarding/alighting.</li> </ul>
<p><b>Category II</b></p> <p><b>Daily</b></p> <p><b>R\$ 60 (US\$ 16) fine</b></p>	<ul style="list-style-type: none"> <li>i. Allowing people under the effects of alcohol or drugs, infected with contagious diseases, holding an inflammable substance or behaving in such a way that public security or comfort are compromised in order to enter the system.</li> <li>ii. Failure to comply with provisions of internal or external visual programming of vehicles or with information not authorized by the Transport Authority.</li> <li>iii. Failure to comply with the provisions of art. 40, items I, II, III, IV, V, VII, IX, X, XI, XII, XIII and XIV, XVI, XVIII, XIX, XX, XXI, XXII and XXIV of the 9279 Act.</li> <li>iv. Use of vehicles with expired inspection certificate.</li> <li>v. Use of third-party vehicles without the authorization of the Transport Authority.</li> <li>vi. To transit spilling fuel or lubricants on public roads or in integration terminals.</li> <li>vii. To ingest any kind of food or drink while driving.</li> </ul>

Penalty Category	Description
	<ul style="list-style-type: none"> <li>viii. Failure to display internal or external mandatory messages or to display unauthorized messages in vehicles.</li> <li>ix. Drinking alcoholic beverages before or during working hours by personnel.</li> <li>x. Failure to comply with rules issued by the Management Authority.</li> <li>xi. Failure to comply with the Legal Regulations governing Traffic.</li> <li>xii. Failing to run a trip without reasonable justification.</li> <li>xiii. Failing to replace immediately a damaged vehicle in service or to refuse to transport passengers in the next scheduled bus at no charge. Failing to carry out fleet maintenance or supply fuel outside depots.</li> <li>xiv. Failing to comply with route starting times.</li> <li>xv. Failure to comply with the route specified by the Transport Authority.</li> <li>xvi. Allowing free boarding/alighting to users without proper identification or with irregular identification.</li> </ul>
<p><b>Category III</b></p> <p><b>Daily</b></p> <p><b>R\$ 120 (US\$ 32) fine</b></p>	<ul style="list-style-type: none"> <li>a) To operate a vehicle without the onboard equipment or with it violated.</li> <li>b) To maintain in service a person whose removal has been requested by the Transport Authority.</li> <li>c) To paralyze unjustifiably any of the services for which it is responsible (a fine for each journey not made).</li> <li>d) Failure to run a scheduled journey (a fine for each journey not made).</li> <li>e) To allow the operation personnel to keep a weapon of any kind inside the vehicle as well as at the end points and integration terminals.</li> <li>f) Failure to report any change in the company name within 30 days after the change was effective. To operate with non-exclusive fleet, equipment, offices, depots, parts and components, or personnel.</li> <li>g) Failure to cooperate with system enforcement of the Transport Authority.</li> <li>h) Keeping vehicles in poor working, maintenance or cleanliness conditions.</li> </ul>

Penalty Category	Description
	i) To operate vehicles producing smoke at levels above those permitted.
<b>Category IV</b>  <b>Daily</b>  <b>R\$ 240 (US\$ 64) fine</b>	a) Maintaining a vehicle in service whose renewal has been required by the Transport Authority. b) To operate a vehicle without the license granted by the Transport Authority. c) Prevent the monitoring of actions by the Transport Authority. d) Failure to present financial information to the Transport Authority or not to do so according to the Transport Authority requirements. To charge a fare different from the one fixed by the Mayor. e) To inadequately treat users and inspection officers. f) To defy or oppose supervisory action of the Transport Authority.
<b>Category V</b>  <b>Daily</b>  <b>R\$ 2,700 (US\$ 717) fine</b>	a) To implement, coordinate or lead any other passenger transport activity without the Transport Authority's consent. b) Failure to provide adapted vehicles for the transport of disabled persons. c) Failure to fulfill passenger requirements, electronic fare collection or operational data, or to provide them inappropriately or inconsistently with the reality determined by the Transport Authority. d) Failure to provide information or to comply with resolutions of the Transport Authority. e) Reducing the operation or reserve fleet without the consent of the Transport Authority. f) To misuse the GPS monitoring equipment or its components, without prejudice to compensation for damages.

SOURCE: ACT 9279 [74]

Other sanctions applied to bus operators include contract termination, service intervention or banned vehicle. Contract termination can occur due to:

- Failure to provide the required infrastructure on time.
- Partially or totally suspend the bus service without SETTRAN authorization.
- Commit the same serious infringement within a period of 20 days.
- Failure to maintain the enabling requirements stated during the tendering process.
- Entering in bankruptcy plea or legal dissolution proceedings.

- Improperly seizing fare collection incomes.
- Present incidents due to lack of fleet maintenance.

If a contract termination occurs, the operator must pay to the city a R\$ 500,000 (US\$ 135,900) fine.

The second category of sanction includes the prohibition of a vehicle to operate because it does not meet the safety requirements, has no license, the passenger counter device seal is tampered or on-board equipment is malfunctioning.

Finally, service intervention occurs when the operator commits a serious infringement that compromises service continuity.

## E.8. Risk Allocation

- **Demand risk:** Since the revenue directly depends on the number of passengers transported, the demand risk is on the bus operators' side. This risk is mitigated every time the user fare is adjusted, since the fare is defined so as to cover the system total costs. This means that operators bear the demand risk in the period between which there is a change in demand and the new fare is calculated.
- **Regulatory risk:** Regarding the regulatory risk (fare and taxation changes), the city will annually adjust the fare or when the taxation rates vary. The operators are exposed to regulatory risk during the period when the new fare is calculated.
- **Implementation risk:** it is shared between operators and the city. On the one hand, the city owns the physical infrastructure (terminals, bus stops, bus stations) and the contract establishes that, if any additional physical adaptation is needed, the city is responsible for providing it. On the other hand, the operators share the implementation risk since they are responsible for providing the depots before the system becomes operational.
- **Operation risk:** The concessionaries are responsible for contracting the personnel, purchasing the fleet and obtaining all other inputs required for bus operation.
- Risk derived from **fluctuation of materials prices** (oil, parts and components) is covered by fare variations.
- **Financial risk:** The operators must assume any financial risk due to changes in exchange rates, interest rates, among others.

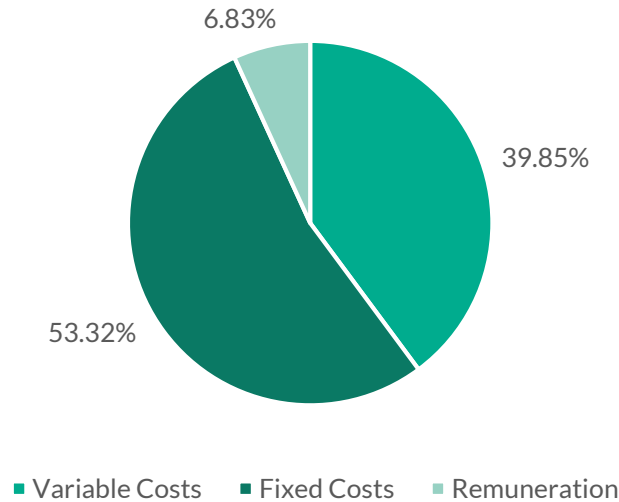
## E.9. Tendering Process

The Federal government defines the tendering rules through Federal Act 8,666 of June 21, 1993. Public competition (*Concorrência Pública*) is the tendering figure used for contracting the bus operation service in Uberlândia. Public competition is used for large contracts, that is, a contract whose value exceeds R\$ 1,500,000 (US\$ 407,000) for engineering projects, and R\$ 650,000 (US\$ 176,000) for other projects. The process is divided in two stages [75].

1. The first stage is a prequalification stage where each of the proposers must meet the minimum qualification requirements (financial, operational, experience, legal requirements) in order to be eligible [75].
2. In the second stage, the contracting party evaluates each proposer's technical and economic proposals to determine if the price and the development of the project are reasonable according to the terms of reference. Subsequently, proposers are evaluated and ranked according to evaluation criteria. These criteria can be the lowest price; the best technical proposal; the best-combined price and technical proposal, or the greatest offer [75]. The current concession contracts were granted based on a combination of the best technical proposal and the greatest offer criteria [76].

## E.10. Revenue and Costs

Figure 24 shows the costs structure of Uberlandia's SIT. The variable costs are mainly operational costs such as fuel, oil and spare parts. The fixed costs are mainly personnel and administrative expenses. Remuneration is the profit established by the fare calculation formula.



**FIGURE 24. BUS OPERATION COSTS FOR FARE CALCULATION**  
SOURCE: SETTRAN [77]

In the case of Uberlandia, total revenue and costs are the same amount since the fare is intended to cover the operator's costs and profit. This is a common method of fare calculation in Brazil. Generally, the expected return over investments is 12% [66]. The tradeoff of this method is a high fare for users (See Results of Contract Implementation).

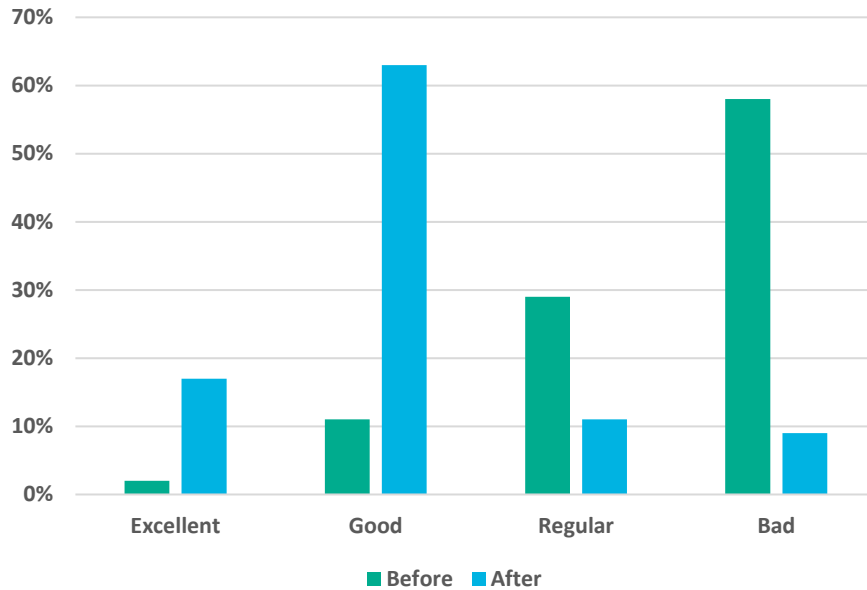
## E.11. Results of Contract Implementation

### Results for accessibility

Uberlandia has successfully become the first Brazilian city to have 100% accessible public transport for the disabled population [62]. It has created legislation and entities to guarantee accessibility for every project of public use. The city has also implemented a free of charge transport system with vans for population with difficulties to use the SIT. Other remarkable results include 300 exclusive parking spaces, 500 ramps in sidewalks and new leisure and education options thanks to infrastructure adaptations. It has also published an Accessibility Guidebook to contribute to the development of this issue in other cities [78]. Uberlandia received the Best Practice Award in Accessibility by UN Habitat in 2010 [79].

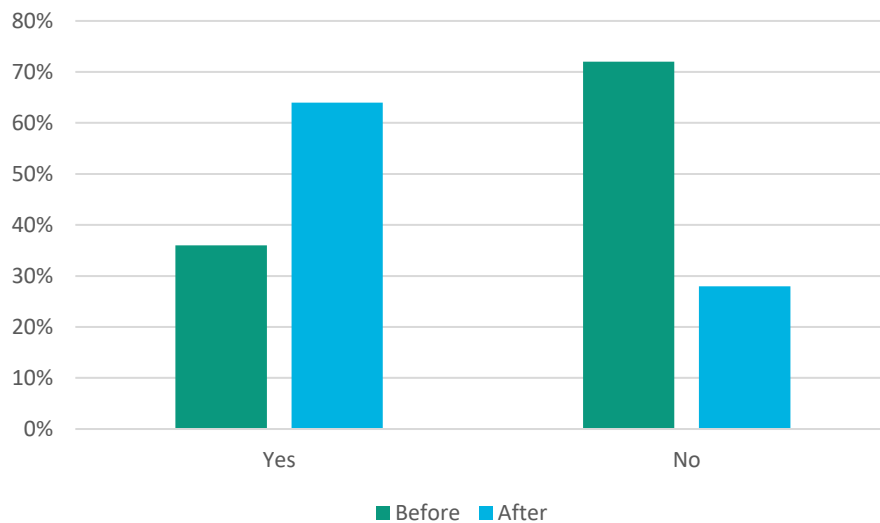
### Results on user satisfaction

For SIT users, the system has improved since the new concession contracts were implemented. The public perception about the service in general has considerably improved. Figure 25 shows the public perception before and after the new bus operators took control of the system.



**FIGURE 25. PUBLIC PERCEPTION BEFORE AND AFTER THE NEW CONTRACTS**  
SOURCE: UFU<sup>12</sup> [61]

The popularity of the system has dramatically improved. Routes offer also improved with the inclusion of a third operator. Figure 26 shows the public opinion about the routes offered in terms of number of vehicles.



**FIGURE 26. PUBLIC PERCEPTION ON ROUTES OFFERED IN TERMS OF NUMBER OF VEHICLES**  
SOURCE: UFU [61]

### Fleet renewal

Regarding fleet requirements, the city successfully decreased the average age of the fleet to 4 years [80]. This achievement is thanks to the contract, which states an average fleet age of up to 5 years [72], instead of 6 years as required by law [81].

<sup>12</sup> Uberlandia Federal University (*Universidade Federal de Uberlândia*)

### **Affordability**

Since the government does not co-finance the system via subsidies or taxes, the users pay the system improvements directly via fare. A single fare represents 0.4% of the minimum wage in Uberlandia [82]. Other Latin-American cities with similar or more extensive transport systems are Leon (0.33%), Mexico City (0.26%) and Lima (0.2%) [83]. Meaning that in the region, Uberlandia has significantly higher fares for its public transport and the affordability could be improved.

### **Penalties**

An important issue was identified during the SIT study: penalties are associated to an Official Act instead of being directly established in the contract. This is not considered a good practice due to the lack of flexibility and enforcement that SETTRAN, or any other Transport Authority, can have. In case an operator incurs in any fault and refuses paying the fine, the legal stage is more complex if the noncompliance is not contractual but more an Act violation. In general, Transport Authorities try to avoid legal issues.

In addition, the contract termination menace generally causes more inconveniences to the city rather than the operator and, in general, it is not persuasive when it comes to making the operators comply with contractual conditions.

## **E.12. Conclusions**

Uberlandia has pioneered the organization of bus public transport in small cities, becoming among the few small urban areas in Brazil with both a BRT and an organized regional service that complements the BRT routes. The city has been working in the SIT for 25 years since its conception in 1991.

The SIT design is based on a superior director plan that organized all the city aspects to grow in accordance with the population needs. This allowed an organized and parallel development of infrastructure and services.

The fact that the system is self-sustainable carries both pros and cons. The Municipality does not directly subsidize system operation and demand risk is completely delegated to the bus operators. This model has increased the fare and reduced incentives for public transport ridership. In addition, bus operators have incentives to maximize use of capacity and decrease comfort indicators since their income depends on the number of passenger boarding.

## F. Pasto

Pasto, officially San Juan de Pasto<sup>13</sup>, is the capital of Nariño Department in southern Colombia. Pasto is a small size city, which as of 2015 had a population of nearly 440,000 inhabitants. The city has an area of 1,181 km<sup>2</sup> and a density of 372.56 inhabitants/km<sup>2</sup> [84] [85].

Until 2009, the Pasto bus system worked under the owner-operator model. The prevailing model was the main reason for the old age of the fleet (over 10 years), the poor quality of the service, and the oversupply of routes over certain corridors.

In 2010, Pasto began the organization of public transport with the support of the national government through a program called Public Transport Strategic Systems (*Sistema Estratégico de Transporte Público*) or SETP. The Colombian government had created the SETP in 2008 in order to improve mobility and formalize public transport service in small and medium-sized cities. In 2010, Pasto became the first city in Colombia to implement the SETP.

The following sections aim to present a comparison of the institutional organization, the regulatory framework and service contracts, before and after the city's public transport transformation took place. In addition, a section is included to explain the key elements of the transition process.

### F.1. Public Transport Overview

#### F.1.1 Before Public Transport Transformation

Pasto's bus services worked under a system of affiliating companies, a common transport structure in several Latin American countries, including Brazil, Argentina and Chile. Under this model, the authority assigned routes and gave some rights to the affiliating companies. Vehicle owners had to enroll as associates of the affiliating company in order to operate a route. In exchange, the affiliating company charged its associates a rolling charge for the use of the routes and the provision of depots [86] [87].

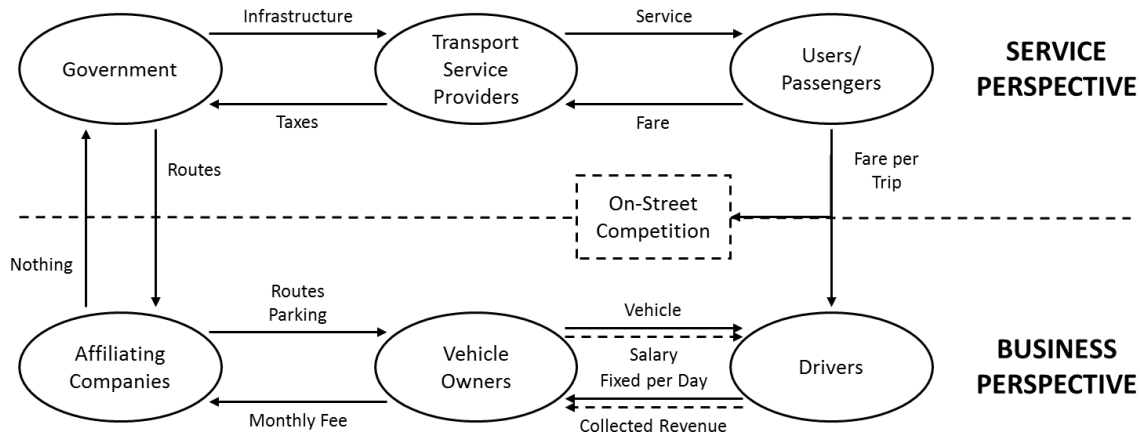
For their part, the vehicle owners either contracted drivers or rented the vehicles to them. In the first case, the drivers had to report the daily revenue to the owner while in the latter case the drivers paid a daily fixed amount to the owner. The bus owners' income came solely from the fare revenue and it was used to cover the operation costs, the investment amortization and the fees paid to the affiliating company. As a result, operation relied on the vehicle owners and the drivers, with little enforcement on quality standards from the authority or the affiliating company [86].

Finally, the government was responsible for providing the required infrastructure for the bus system (bus stops, traffic signaling, among others) to operate.

Figure 27 shows the main interactions between the stakeholders under the prevailing public transport system.

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<sup>13</sup> Pasto corresponds to San Juan de Pasto Municipality and 17 other districts (mostly rural) . However, for simplicity, Pasto will hereafter refer to San Juan de Pasto.



**FIGURE 27. BUS SYSTEM IN PASTO BEFORE THE TRANSFORMATION**  
 SOURCE: *ENGINEERING EDUCATION FOR SOCIAL JUSTICE* [87]

In Pasto, 4 affiliating companies were authorized to operate the bus system. In 2008, they gathered 480 bus owners that operated 503 registered buses. They were also responsible for covering the 185,000 trips that took place in the city.

The affiliating model had several drawbacks. First, the authority could allocate the same route to one or more companies. Since each operator had its own timetables, departures were not coordinated, causing on-street competition and bus frequencies to be unknown to users. Second, there were problems in route design with an oversupply of routes in some corridors that increased traffic congestion. The system included 26 routes, which covered long distances and 50% of them overlapped at some point, resulting in low (1.6) passengers per kilometer index. Third, the bus business was not profitable and vehicle owners tended to provide a poorer service quality where drivers were involved in practices such as dangerous driving. Fourth, the operators extended route lengths in an attempt to increase the number of boarded passengers. The result of all these inefficiencies in the system planning and operation was low occupation, which resulted in additional costs [88].

Another major problem was the fleet age. Some vehicles had been providing the transport service for 18 years. They had a higher number of failures, which decreased user safety and service reliability. This old fleet also contributed to the increase in polluting emissions. Finally, the local government did not have reliable mechanisms to enforce the bus system; therefore, any measure on paper could not be put into practice.

In conclusion, public transport did not properly respond to user needs, reducing the accessibility and undermining mobility in general. As a result, users preferred other transport modes like motorcycles or illegal services. According to La República newspaper, the annual number of motorcycles sold in Colombia increased 4 times between 2003 and 2013 and in 2015, the total number of motorcycles was twice the total amount of cars [89]. Pasto is the 17th largest city in terms of population in Colombia, yet it has become the third city by the number of registered motorcycles [90].

Regarding illegal transport, some people have started using shared taxis. They consist of a taxi driver providing collective transport services, the same way buses do, going along fixed routes and picking up people at any time. It is illegal in Colombia because taxi services were created as an individual transport solution and the shared taxi mode is considered an unfair competition behavior since buses are the vehicles designed to mobilize people with common paths.

A worse case of illegal public transport is the mototaxi. Due to the popularity of motorcycles in Colombia, this type of vehicles has also been used to provide individual transport services. Mototaxis are convenient for users since the travel time is shorter and the service frequency is higher than that of buses. However, they're less desirable since they register a higher frequency of accidents than

buses or taxis. According to reports, between January and March of 2009, 843 vehicles were involved in accidents in Pasto, 368 (43.7%) of those were motorcycles [91].

Table 14 shows how each transport mode shared the approximate 590,000 daily trips that were made in Pasto in 2006. About 180,000 daily trips were made on public transport while around 140,000 on private transport and 230,000 on non-motorized modes. In addition, approximately 30,000 daily trips were made on illegal transportation (mototaxi<sup>14</sup> and collective taxi).

**TABLE 14. DAILY TRIPS IN PASTO**

MODE	DAILY TRIPS	% OF TOTAL DAILY TRIPS
PUBLIC TRANSPORT	184,389	31.2%
PRIVATE TRANSPORT	146,461	24.8%
NON-MOTORIZED	230,250	39.0%
ILLEGAL	29,284	5.0%

SOURCE: CONPES DOCUMENT 3549 FROM 2008 [92]

Despite trips on public transport representing 51.2% of motorized trips, there's still room for improvement in quality of service.

## F.1.2 After Public Transport Transformation

So far, the system has experienced a comprehensive transformation. Currently, the system is in pre-operational stage. One of the most important outcomes of this transformation is the creation of organized private enterprises for bus operation.

Buses are still the only collective public transport mode, but service been organized and improved under the SETP initiative. Pasto is the most advanced city in Colombia that has implemented its SETP [92].

In order to implement the SETP, the Colombian government allowed the cities to choose between two options:

- Restructuring the prevailing public transport system, run by the current operators, in order to meet the SETP requirements, or
- Developing a tendering process in order to grant and provide public transport services with new operators.

Pasto decided to restructure the prevailing system, due to the importance of public transport as an economic activity and source of employment in the city. Since the public transport sector was heavily atomized and represented the source of income for many families, the Municipality decided to keep

<sup>14</sup> Mototaxi is an illegal mode of transport, which consists of providing taxi services on motorcycles.

the current bus owners as the service providers. In addition, this option avoided the procurement process and guaranteed the service continuity to the users.

Currently, the city has developed a route restructuring and the organization of the operators. The bus system includes 23 routes divided in 7 strategic routes and 16 complementary routes. The strategic routes go along main roads to downtown and their frequency is high, while the complementary routes provide service to transport people from suburban areas to downtown and the frequency is lower than the frequency of the strategic routes. As part of the route optimization plan, in the operational stage, the system is intended to have 8 strategic routes and 14 complementary routes [88] [93].

There is a temporary joint venture<sup>15</sup> called UT Ciudad Sorpresa, created by the four operators of the traditional system in charge of actually running buses on the routes. It is responsible for the system route planning and operation, and its responsibilities will be covered in detailed in the following section. The system operates seven days a week, from 5:30 am to 10:00 pm. Upon its completion, the SETP is expected to have the following features:

- Fleet Management System (FMS)
- Automatic Fare Collection System (AFC)
- Financial Manager
- Technological Partner
- Depots for Shelter and Maintenance

## F.2. Institutional Organization

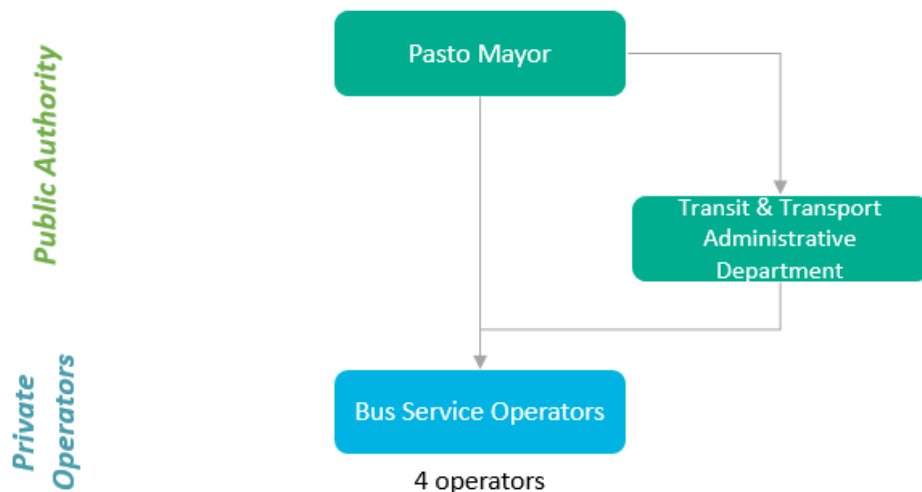
### F.2.1 Before Public Transport Transformation

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<sup>15</sup> Temporary joint venture is a translation from Spanish *Unión Temporal de Empresas*, which is a type of partnership used in Colombia. According to Act 80 of 1993, a Temporary joint venture is “when two or more parties jointly present a proposal for the award and execution of a contract with a public entity. The profits, losses, penalties and risks derived from the execution of the proposal or the contract will be distributed according to the shareholding of each member within the temporary joint venture.

Paragraph 1: The proposers will define the terms and extension of their participation in the proposal and its execution, which will not be modified without the contracting party (public entity) authorization.” [137]

Therefore, although the venture is said to be “temporary,” the extension of the partnership can be as long as the shareholders decide.



**FIGURE 28. PASTO'S INSTITUTIONAL ORGANIZATION BEFORE TRANSFORMATION**

SOURCE: PREPARED BY THE AUTHORS BASED ON OFFICIAL INFORMATION

Figure 28 shows the institutional organization of Pasto's public transport system before the transformation process. The role of each transport institution or company is described below.

- ***Pasto Mayor***

The Mayor was responsible for defining public transport strategy, transit and transport policies, approving and setting fare levels. He/she was also in charge of presenting the legislation needed, proposed by their Secretariats and Administrative Departments before the Council.

- ***Transit & Transport Administrative Department (TTAD)***

The TTAD was the organism entitled by the Mayor to design and implement actions; regulate and control traffic and public transport; manage traffic signaling, and guarantee the accessibility of public space used for mobility. The TTAD was responsible for carrying out technical studies to determine the fare cost and come up with projects aimed to improve mobility in the city. It supervised different transport services, such as bus and taxi, and developed control measures to prevent the use of illegal and informal public transport. In addition, it provided services such as traffic offenses management, issuance of driver licenses and vehicle operation permits.

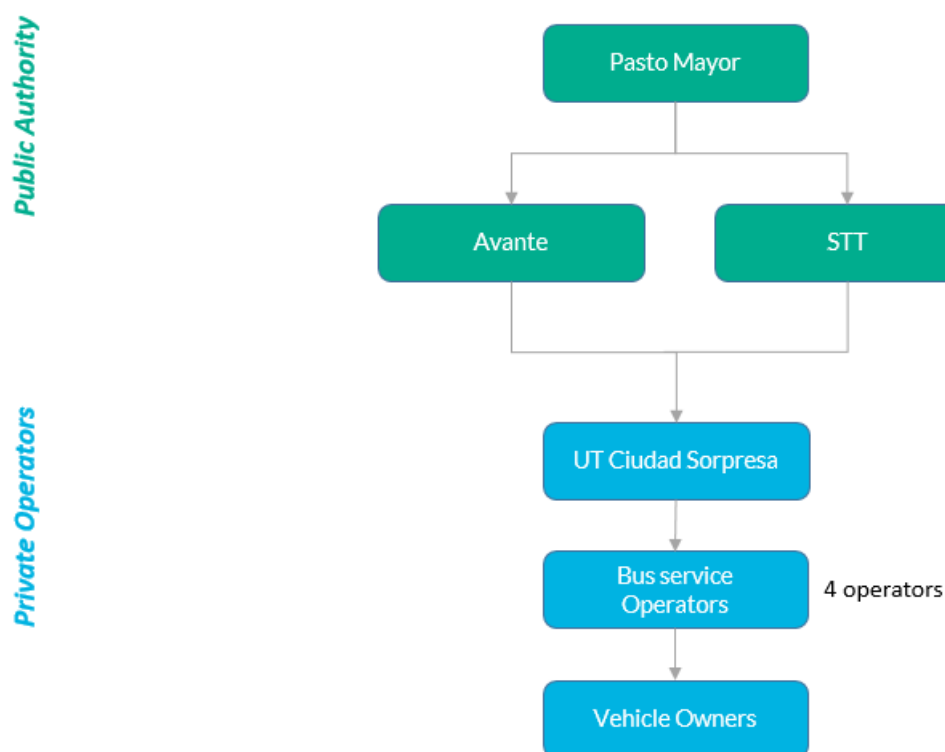
- ***Bus Service Operators***

Four private operators ran the bus service under the owner-operator model described above (See

Public Transport Overview). The drivers were directly responsible for providing the bus service in the assigned routes according to the frequencies defined by the bus operator. Each operator was autonomous regarding the route planning, even if some other operator also had the same route. Bus drivers were in charge of collecting the fare payment and each bus owner was responsible for revenue management and the driver wage. In some cases, the bus owner was the bus driver.

## F.2.2 After Public Transport Transformation

Hereafter, the roles of different entities during the current and final stages will be explained.



**FIGURE 29. PASTO'S SETP INSTITUTIONAL ORGANIZATION AFTER TRANSFORMATION**  
SOURCE: PREPARED BY THE AUTHORS BASED ON OFFICIAL INFORMATION

**Figure 29** shows the institutional organization for Pasto's SETP after the transformation process. The new structure includes two new organizations: Avante, the system manager, and Ciudad Sorpresa, created by the four old operators.

- **Pasto Mayor**

Regarding public transport, the Mayor's responsibilities have not changed. He/she is in charge of transit and transport policies, approving and setting fare levels and defining public transport strategy. He/she also has to guarantee the SETP project funds meeting the National Government requirements and, at the same time, manage the local budget. The Mayor's responsibilities will remain the same in the final stage.

- **Transit & Transport Secretariat of Pasto (STT)**

STT is the municipal authority in charge of the city's mobility. According to Agreement 10 of 2008, STT's general functions are the following [94]:

1. Design and implement regulation policies for traffic management and public and private transport in the city.
2. Authorize preventive and penalty measures in order to mitigate the impact produced by road works.
3. Implement plans, programs and projects aimed to prevent traffic accidents.
4. Be accountable for the locations and maintenance of road signs.
5. Enforce the legislation concerning transport, transit and environmental protection.
6. Contribute to the conscious use of public space and transport.
7. Register and manage the transit and transport information of the city.
8. Sanction traffic offenses according to the current transit and transport rules.
9. Enforce the payment of transit and transport fines.
10. Promote good behavior of citizens on the roads.

In addition, Decree 562 of 2015, which implements the SETP, delegates the following tasks to STT [95]:

1. Implement exclusive lanes for public transport, supported by technical studies.
2. Approve the contract between vehicles owners and the bus companies together with Avante.
3. Implement concessionary fares for particular groups of people, supported by technical studies.

The last three duties will be performed by STT once the system begins the operational stage. Additionally, STT will be responsible, if appropriate, for the extension of the operators' authorizations and for modification, deletion or addition of routes, supported by the corresponding technical studies.

- **Avante**

Avante is a decentralized public entity created to plan, coordinate, manage, develop and implement the SETP. Avante's main tasks are mentioned below [95]:

1. Manage and execute funding and human resources provided by the national government and the municipality aimed for the SETP implementation.
2. Plan the SETP operation.
3. Establish track and assess the compliance of service quality indicators and report to STT on this assessment, thus the latter can enforce compliance with the regulation. Currently, Avante is developing the SETP operation guidebook, which defines these indicators.
4. Provide and operate the FMS once it is implemented.
5. Provide and supervise the AFC system once it is implemented.
6. Provide depots, workshops, bus stops and Information Centers. Currently, operators are still responsible for the depots until Avante finishes these buildings.
7. Issue guidebooks and rules for the SETP operation.
8. Inform STT of any changes in route operations, supported by technical studies, in order to coordinate the supervision and control activities.
9. Design and implement the advertising campaign aimed for the SETP popularization.
10. Monitor operator performance.

Specifically, Avante supervises compliance of route timetables defined by the operators, minimum enabling conditions and, in general, service quality indicators. Inspectors currently perform this task based on information provided by the operators and directly gathered, but once the FMS is implemented, performance indicators will be calculated based on records generated by the system. In case an operator does not comply with its functions, Avante should inform STT about the irregularity. Operators will also be able to analyze the information gathered by the FMS; therefore, it is Avante's responsibility to provide the necessary infrastructure for this matter.

- **UT Ciudad Sorpresa**

As mentioned above, bus operators are now united as Ciudad Sorpresa, a temporary joint venture. Ciudad Sorpresa is composed of the four affiliating companies that had been operating the prevailing bus system. It represents all vehicle owners' interests before STT and Avante, and distributes the authorized routes between the four companies. Ciudad Sorpresa is directly responsible for the tasks involved with the operation. Once the SETP is fully operational, Ciudad Sorpresa's responsibilities will include:

- Integrated timetables scheduling: All 4 operators must be coordinated under a unique schedule to guarantee no oversupply. Ciudad Sorpresa defines shifts for drivers and vehicles according to labor law. When FMS is implemented, Ciudad Sorpresa will report their timetables to the system for Avante's approval.
- Fleet Maintenance: Ciudad Sorpresa is responsible for fleet preventive and corrective maintenance as well as its fuel provision, lubrication, cleaning, washing, parking and storage in Avante's depots. The conditions of each vehicle must be registered and available to STT. Vehicle owners currently perform this task.
- Fleet Renewal: In the pre-operational stage, Ciudad Sorpresa operates the old buses and progressive renewal will be done. As a result, the fleet will only be made up of new vehicles at the beginning of the final stage. New buses must meet Euro 4 standard. There are two vehicle typologies according to the types of routes to be run with the new vehicle (strategic and complementary).
- Be accountable for the penalties of the operators: Since the 4 companies operate as one, the temporary joint venture will assume the penalties, and the associated fines will be distributed between the 4 operators according to each one's participation percentage in the system.
- Operate the AFC system, once implemented by Avante.
- Hiring and training the drivers and the operational personnel. Driver contracts will be executed only in the final stage (during the pre-operational stage, vehicle owners are still in charge of hiring their drivers).
- The training process will be a priority in the final stage, since it guarantees a better service and diminishes the accident probability.

**Bus Service Operators & Vehicle Owners**

The 4 old bus operators are, by legislation, the authorized companies to run the system for the next 15 years (the term may be extended). The main condition to obtain these authorizations was the creation of a temporary joint venture; therefore, they are in charge of adopting Ciudad Sorpresa's decisions and informing the vehicle owners about these decisions.

### **F.3. Avante's Organizational Structure**

Avante's staff consists of the strategic, operational and technical areas. The strategic and operational structure is made up of [96]:

- One general manager
- One operations director
- One support engineer
- One electronic engineer
- One lawyer

In the first stage, a strategic and operations team came on board but some of its members did not have the experience or knowledge to carry out the implementation of the SETP. Therefore, Avante decided to put together a group of experts to be consulted during the structuring process, who should transfer their knowledge to the local staff. This expert team was made up of:

- One expert in finance and management
- One expert in technology oriented to transport

- One lawyer specialized in transport with experience in institutional organization

The technical team department is in charge of Intelligent Transport Systems - FMS and AFC - and includes:

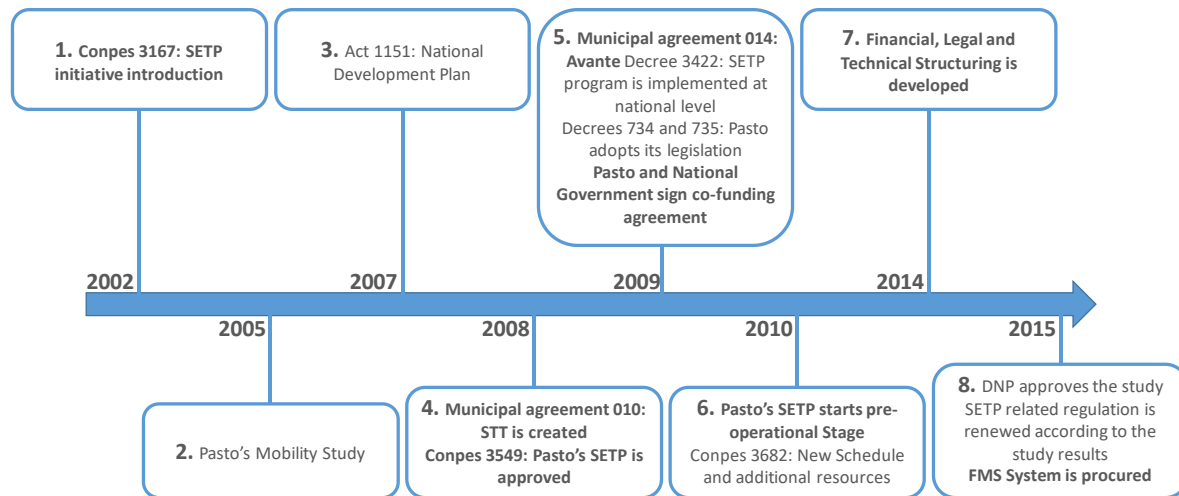
- Three technicians
- One administrative technician

The technical team has worked through the design and procurement stages of the FMS and AFC, and will monitor the current implementation of the FMS. Avante had to work on resource planning and training strategies, since the required technical profiles were not available in the local market. The company established two action plans: i) specific staff training provided by ITS vendors and ii) an agreement with Nariño University<sup>16</sup> was signed in order to develop the technical profile to support the public transport system.

It is important to highlight that regionalism is a characteristic of people from Pasto and an agreement to train the technical team with universities or companies not based in Pasto was likely to fail. People in Pasto preferred inexperienced locals being trained in Pasto rather than skilled people from other regions of the country. Consequently, a deep understanding of the population particularities is required since implementing any strategy involves a cultural aspect.

#### F.4. Regulatory Framework

This section aims to chronologically summarize the changes made to the public transport regulations in Pasto. Figure 30 shows the milestones in the city's recent history regarding public transport transformation and the changes to regulations that led to the current system.



**FIGURE 30. MAIN CHANGES TO THE PUBLIC TRANSPORT SYSTEM IN PASTO**

SOURCE: PREPARED BY THE AUTHORS BASED ON OFFICIAL INFORMATION

1. CONPES or National Council for Economic and Social Policy (*Consejo Nacional de Política Económica y Social*) is the highest authority of national planning in social and economic fields and it is responsible for the development and approval of social and economic policies such as public transport. The National Development Department or DNP (*Departamento Nacional de Planeación*)

<sup>16</sup> Nariño University is the most important education institute in Nariño Department, of which Pasto is the capital.

is CONPES' Executive Secretariat and it is responsible for coordinating and presenting projects before CONPES Committee. The DNP is in charge of approving technical studies before they are used by governmental entities [97].

The CONPES document 3167 of 2002 is the first official document that mentions public transport restructuring in Colombia. This document proposes the application of innovative technical and financial tools in order to improve productivity in Colombian cities. It recognizes the need to restructure public transport due to the number of trips this mode represents (as of 2002, 65%-80% of motorized trips) and the inefficiency of the owner-operator model. The document classifies different cities into small (less than 300,000 inhabitants), medium (between 300,000 and 600,000 inhabitants) and large (more than 600,000 inhabitants). It also makes adjusting signalization to the regulation, renewing the traffic light system, maintaining the infrastructure in optimal conditions and, locating and operating bus stops, a priority in the responsibilities of the city. The national government commits itself to financing 70% of the cost of technical studies, publishing the executed studies, supporting the infrastructure projects funding, among other tasks [98].

2. In 2005, Pasto conducted a mobility survey to determine how well the public transport service was seen in the city. This study recognized the necessity of a mobility plan for the city.
3. In 2007, the national government issued the National Development Plan for the 2006-2010 presidential period under the Act 1151 of 2007. The plan introduced, among other transport projects, the implementation of SETPs in medium cities, including Pasto, and the Government's support to this end.
4. Pasto's Agreement 010 of 2008 modified the Transit & Transport Administrative Department and created STT.

Based on the Act 1151 and the mobility study carried out in 2005, Pasto achieved the approval of its SETP through CONPES document 3549 of 2008, which established the technical, legal and financial requirements for the Government to co-fund the system. The main goals were the implementation of electronic fare collection, a fleet management system, exclusive lanes and a coordinated route planning between the bus operators. Some of the Government requirements for co-funding the project were:

- Ensuring the availability of the rest of the resources.<sup>17</sup>
  - Identifying and implementing mechanisms aimed to reduce the oversupply.
  - Adjusting the routes according to the technical studies developed for this matter.
  - Adopting legal and administrative mechanisms for an autonomous management of the resources.
5. In order to meet these requirements, the city created Avante as the entity in charge of implementing the SETP through Agreement 014 of 2009. In addition, the city procured the conceptual design of the system, which included a new route scheme and strategies to diminish the oversupply. Along with this study, Colombia's Ministry of Transport issued the Decree 3422 of 2009, which implemented SETPs at a national level; the city developed the necessary regulation to implement SETP meeting Decree 3422 requirements, taking into account the study results. Thus, Decrees 734 and 735 of 2009 were issued. The former modified the land use plan to include the SETP implementation so that the city growth was articulated with the public transport system. The latter implemented the SETP in the city, defining the main roles and

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<sup>17</sup> By using the city's annual budget or by finding another sponsor. These resources included both transport and public services infrastructure (electricity, aqueduct systems).

responsibilities as well as the implementation stages: pre-operational, Stage I and Stage II.

During 2009, resolutions were issued in order to include bus operators into the new system. The new route scheme, comprising strategic and complementary routes was implemented and operators were subject to the conceptual design results. For example, they created the temporary joint venture Ciudad Sorpresa to be authorized to perform their task. The pre-operational stage started in January 2010 [99].

In late 2009, Pasto and the national government signed the co-funding agreement for the SETP, which established the resources both parties would provide for the system implementation in the next years.<sup>18</sup> However, CONPES document 3682 of 2010, which evaluated the progress of the project, showed new road works and infrastructure were needed. Therefore, new deadlines were agreed and additional resources were included [99].

6. In 2012, along with a new Mayor,<sup>19</sup> a new technical team came to Avante. As a starting point, they had the CONPES document and the existing legislation. It is important to note that other medium cities were also developing their SETPs but Pasto was the city leading this initiative. CONPES Documents have also approved Santa Marta (November 2008), Armenia (2009), Popayán (2009) and Sincelejo (2010) SETPs.
7. In 2014, the financial, technical and legal structuring study was carried out. This study determined most of the responsibilities regarding infrastructure acquisition, modifications of the regulation and updating of the conceptual design. According to the study, if the AFC and FMS systems were covered by the tariff, users would have to pay a 42% higher fare, which would have led to the system failure. Then, the result was that the municipal government should purchase the technology.
8. This study was approved by DNP so Avante and the Mayor proceeded to issue a new series of regulations. Decree 562 of 2015 abolished Decree 735 of 2009 and implemented the SETP, including the new study results. Derived from Decree 562, resolution 964, 965 and 966 of 2015 were issued in order to revoke and reassign the operation authorizations to UT Ciudad Sorpresa under the new conditions. Currently, this is the applicable legislation to the system.

Among other provisions, Decree 562 establishes:

- The entities in charge of implementing and supervising the system are Avante and STT, respectively.
- The duration of the operation authorization is of 15 years, which may be extended according to the performance in the first term.
- UT Ciudad Sorpresa as the only company authorized to run the system and its additional responsibilities (see Institutional Organization).
- The other roles of the system such as the financial manager and the AFC system operator.

Resolution 964 establishes the operation hours and the strategic and complementary routes scheme, and specifies Ciudad Sorpresa and fiduciary's responsibilities, among others. Resolution 965 revokes the operation authorizations to the 4 traditional companies. Resolution 966 grants the operation authorization to UT Ciudad Sorpresa, including the AFC system operation, and allocates travel demand and fraud risks on the operators.

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<sup>18</sup> The country provided resources from 2011 to 2016, while the city did so between 2009 and 2016.

<sup>19</sup> A mayor is elected every four years. The new mayor started his term on January 1, 2012 and finished it on December 31, 2015.

Finally, Resolution 26 of 2015 issued by Avante summarizes the provisions of Decree 562 and its resolutions and establishes the action plan for the complete implementation of the system.

## F.5. Bus System Transformation<sup>20</sup>

### F.5.1 Definition of the authority's objectives under the new model

Taking into consideration the public transport background in the Colombian cities, the national government launched the SETP initiative. The CONPES 3549 of 2008 established the goals to be achieved by the transport restructuring in Pasto:

- To remove the oversupply of vehicles, reducing operational costs at the same time.
- To reduce the excessive investments in road works (caused by the traffic of unnecessary heavy vehicles) in order to use these resources to cover other needs.
- To implement a more suitable solution to the users' necessities. These necessities have been defined by Avante as follows:
  - To meet 100% demand coverage by optimizing or modifying the existing routes.
  - To redesign the routes scheme to reduce overlaps.
  - To repair and adapt the road infrastructure, including exclusive and preferential lanes for buses and cyclists, according to the needs.
  - To implement a technological system that allows for better supervision and the reduction of operational process times.
  - To renew the fleet.

### F.5.2 Definition of the operator's interests and main concerns under the new model

Bus operators had major concerns regarding the new SETP system, which can be summarized in the following main issues [96]:

- Before the institutional, legal and financial design of the SETP was finished, there was uncertainty of additional costs and requirements that the operators would have to comply with regarding fleet renewal, the FMS, the AFC and fleet maintenance. The operators had major concerns over these additional costs. The SETP design phase helped to clarify the operators' responsibilities, and define that the government would make investments in infrastructure and technology.
- The operators were worried that revenue from fares was not enough to cover the new obligations they had to meet to enhance service quality and new investments. The operators anticipated that the program to optimize routes would make bus services less attractive than illegal transport modes (mototaxi and shared cabs), therefore, reducing passengers demand. The main concern was that lower service frequencies would result in longer waiting times at bus stops, allowing illegal transport services to be offered. A study carried out in 2014 confirmed that people in Pasto did not like waiting for a bus. Hence if a mototaxi arrived before the bus, the user would prefer the illegal mode. Then, lower frequencies would cause the popularity of illegal services to increase. This problem was worsened by the fact that users did not like walking to a bus stop or standing during their trip.

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<sup>20</sup> Most of the information contained in this section was obtained in a personal interview with Jorge Cote, Avante's manager from January 2012 to December 2015. Mr. Cote was also CFO at Megabús, the Massive Transport System operator in Pereira, Colombia. He is a civil engineer from the National University of Colombia and finance specialist from Universidad Libre of Colombia.

- Finally, it was expected that competition from illegal transport modes would also deter the increase of fares. Since mototaxi had lower rates than the public bus system, fares could not be further increased without having an impact on the bus system demand.

## F.6. Steps followed for the system transformation

This section aims to highlight the major events in the evolving process from the owner-operator model to a formalized integrated public transport system from 2012 to present. Although Pasto's SETP was planned to run in 2009, the modifications in schedule and budget caused the project to start its final structuring in 2012, which matched the beginning of the new Mayor's term.

- The first challenge for the city was to reunite the technical team that would lead the SETP implementation. A manager, one operations director, two engineers and a lawyer were part of the strategic team as described in Avante's Organizational Structure. Except for the manager, who had worked in Pereira's BRT system, none of them had relevant experience in transport; therefore, despite being skilled professionals, they had to be trained. To do so, Avante put together a group of experts to consult during the structuring process [96].
- The next step was to approach the bus operators. This was the most challenging part of the process because, in general, the operators did not trust the government. Avante's strategy was to meet regularly with the operators in order to listen to their concerns and evaluate the project progress. The first meetings aimed to understand the operators' intentions, needs and expectations about the SETP. Avante's team focused on listening to the operators without foisting their idea [96].
- Operators were involved in the development of the terms of reference for the financial, technical and legal structuring study. They were interested in participating in the structuring process so that their concerns were taken into consideration, then, Avante decided to introduce the draft of the terms of reference to the operators in order for them to understand what the city aimed to achieve with the project. That presentation allowed Avante to know whether the operators agreed with the system or not.
- A key aspect that enhanced the negotiation process between the parties occurred after that presentation. Operators understood the project implied an important change to their modus operandi and needed to know how they would suit in the new system. Operators asked to have the results of the study when they were ready. However, Avante suggested that Ciudad Sorpresa should carry out its own restructuring study since the governmental approach to the system was substantially different from the operators', especially from the business perspective. Operators accepted the suggestion and contracted their own restructuring study that would prepare them for the paradigm change.
- While the studies were being carried out, Avante and Ciudad Sorpresa continued to strengthen their relationship, periodically reviewing the project state and analyzing new concerns that could arise. Avante also worked together with its consultant team in order for the study to be aligned with the entity's objectives [96].
- As the consultant firms delivered the studies, Avante organized an event with the operators' executives and both consulting firms. The main objective was to socialize and discuss the results each party had obtained in order to agree on the assumptions, operational features and financial conditions that would be used to build the project baseline. The main outcome of

this meeting was that both studies agreed on most of the topics analyzed, from the perspective of their own interest. The fact that the operators' consultant firm confirmed Avante's design led to a very close relationship between private and public sectors [96].

- Avante's study was submitted for DNP approval. However, since Pasto was the first among the cities in the SETP initiative to reach this stage of the project, DNP had not defined an evaluation methodology and the approval took around 6 months [96].
- In the meantime, Avante and the operators developed an action plan, which included fleet renewal, AFC and FMS systems implementation, deadlines for organizational changes, and the drafting of Decree 562.
- Finally, DNP approved the study; Avante and STT issued the definite regulation and the FMS tender process started.
- Currently, the FMS is being built and it is going to become operational in 2016.

One of the benefits for the vehicle owners was the fleet renewal plan. The bus fleet in Pasto is atomized with 503 vehicles scattered among 480 owners, which means vehicle owners could not access wholesale prices. The operators and Avante visited various bus manufacturers in order to estimate the costs of fleet renewal and to establish the physical characteristics of the new buses by regulation. Thanks to the joint effort of Avante and Ciudad Sorpresa, the operators obtained discounts up to 20% and negotiated additional services such as spare parts provision, personalized maintenance, and software for maintenance management. For example, a well-known tire manufacturer offered them a software to determine the tire wear and to program the tire's renewal more efficiently.

Additional benefits granted by the local government were the renewal fund and the low-rate loans. The fund resulted from an agreement between Avante and bus owners of seizing a percentage of the revenue of every owner who had not renewed his or her fleet and it was kept in the common account. In addition, the operators and the local government negotiated loans for fleet renewal with a rate of DTF21 - 3%, which was lower than 2015 inflation. This was a very strong incentive towards the purchase of a new fleet.

## **F.7. Comparison of key aspects of the public transport model**

This section presents key aspects of the routes concession, planning, revenue and supporting services. Table 15<sub>A</sub> shows the public transport business and operational model characteristics before the SETP was implemented. In addition Table 15<sub>B</sub> summarizes how the system is expected to work after the SETP is completed.

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<sup>21</sup> DTF (*Depósito a Término Fijo* or Fixed Term Deposit) is the average rate offered by banks in 90-days deposits in Colombia. In March 2016, the DTF had a 6.36% effective yield while inflation was a 6.48% effective yield.

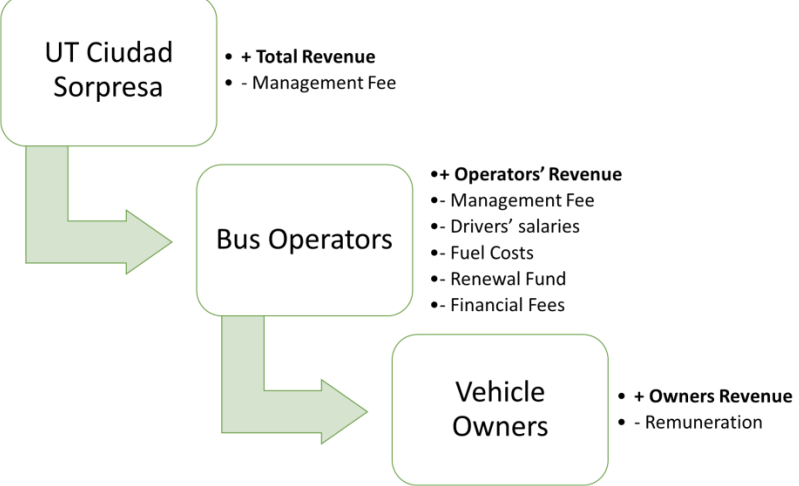
**TABLE 15A. MATRIX OF THE BUS SYSTEM IN PASTO BEFORE THE TRANSFORMATION PROCESS**

<b>CONCESSIONS</b>	
▪ <b>Type of allocation</b>	Allocation by routes or groups of routes. This criterion was defined in the terms of reference of each tender process.
▪ <b>Type of concession / Permits</b>	Operation Authorizations. The city granted the authorization to one or more companies for every route.
▪ <b>Concessions duration</b>	Undefined for authorizations granted before 2001. After 2011, the authorizations were granted for a period of 5 years.
▪ <b>Concessions extension</b>	Extensions were granted with the same duration as the original concession, five years.
▪ <b>Tendering process</b>	There was a tendering process each time the Government considered a new bus operator was required, supported by technical studies. The terms of reference determined the routes to be granted and the service quality levels required.
<b>SYSTEM PLANNING AND OPERATION</b>	
▪ <b>Transport Service Planning</b>	The local government defined the routes. The operating frequencies schedule was responsibility of the operators.
▪ <b>Transport Service Supervision</b>	Although TTAD was responsible for the supervision, under the owner-operator model there was not a strong enforcement of the operation.
▪ <b>Transport Service Evaluation</b>	There were no performance indicators or monitoring process determined.
<b>TARIFFS AND REMUNERATION</b>	
▪ <b>User Payment Method</b>	Cash
▪ <b>Revenue Management</b>	Revenue from fares was collected by each bus driver. Vehicle owners received the revenue from the drivers and they were responsible for paying the operational costs, including the monthly fee to the affiliating company.
▪ <b>Remuneration Model</b>	Remuneration to the affiliating companies was given by the monthly fee paid by bus owners.  The bus owners' remuneration was determined by revenue minus the fees they had to pay to the affiliating companies.
▪ <b>Tariff model</b>	There was an only fare tariff calculated by TTAD. Resolution 4350 of 1998 defined the tariff calculation methodology, and stated that user's fare had to cover the operating expenditures and the profit of vehicle owners.
<b>SUPPORTING SERVICES</b>	
▪ <b>Automated Fare Collection System</b>	The system had no technological collection system and no integrated fare.
▪ <b>Fleet Management System</b>	The system did not have a technological platform for fleet management.

TABLE 15B. MATRIX OF THE BUS SYSTEM IN PASTO AFTER THE TRANSFORMATION PROCESS

CONCESSIONS	
▪ <b>Type of allocation</b>	Allocation by routes or groups of routes.
▪ <b>Type of concession / Permits</b>	Operation Authorizations. The city grants UT Ciudad Sorpresa the joint venture made up of the 4 private bus companies and the autonomy to allocate the routes among the 4 operators.
▪ <b>Concessions duration</b>	15 years
▪ <b>Concessions extension</b>	Extension is possible. However, regulation does not define the maximum length of contract extension.
▪ <b>Tendering process</b>	There is no tendering process. The government only authorizes routes to Ciudad Sorpresa.
SYSTEM PLANNING AND OPERATION	
▪ <b>Transport Service Planning</b>	<p>Routes are defined by the conceptual design. STT can modify, remove or add new routes, supported by technical studies.</p> <p>UT Ciudad Sorpresa is in charge of setting schedules and frequencies. Avante approves the defined frequencies.</p>
▪ <b>Transport Service Supervision</b>	<p>Avante is responsible for supervising the operation.</p> <p>STT is in charge of penalizing offenders.</p>
▪ <b>Transport Service Evaluation</b>	<p>Avante is in charge of the definition and evaluation of the service quality indicators. There are two types of indicators:</p> <p><b>SETP Performance:</b></p> <p>These indicators measure the performance of all the participants involved. These indicators are:</p> <ul style="list-style-type: none"> <li>• Boarded passengers</li> <li>• Mileage</li> <li>• IPK</li> <li>• User Satisfaction. Satisfaction surveys take place every six months or every year and evaluate general opinion; service frequency; bus stops conditions; means of payment provision and topping up; operation hours and driver service.</li> </ul> <p><b>UT Ciudad Sorpresa Performance:</b></p> <p>These indicators measure the bus operators' functions. Some of these indicators are measured every month while others are measured periodically in just a sample of the fleet. The following are the main performance indicators that will be measured once the SETP is fully implemented:</p> <ul style="list-style-type: none"> <li>• Unauthorized publicity: The number of days the operators display unauthorized advertisement information in buses or depots. Maximum accepted: 0.06% of the evaluations/month.</li> </ul>

	<ul style="list-style-type: none"> <li>On-board sound equipment: The number of vehicles that implement unauthorized sound equipment. Maximum accepted: 0.06% of the operational fleet/month.</li> <li>Fuel or lubricants leakage: The number of times a vehicle is found to have a leakage. Maximum accepted: 0.1% of the evaluations/month.</li> <li>Electronic devices (mp3 players, cellphones) while driving: The number of times a driver is found using an electronic device while driving. Maximum accepted: 0.05% of the departures/month.</li> <li>Not to install the on-board equipment: The number of departures executed by vehicles without on-board equipment. Maximum accepted: 0.05% of departures /month.</li> <li>Not to stop in bus stops for boarding/alighting. Maximum accepted: 0.5% of departures/month.</li> <li>To park in unauthorized places. Maximum accepted: 0.5% of departures/month.</li> <li>Use an alternative path of the original route without Avante's authorization: The number of departures that don't go along the route as originally designed. Maximum accepted: 0.25% of departures/month. This indicator will be measured once the FMS is in place.</li> </ul>
<b>TARIFFS AND REMUNERATION</b>	
▪ <b>User payment Methods</b>	Cash until the Automatic Fare Collection system is implemented when smart cards will be used.
▪ <b>Revenue Management</b>	<p>While the AFC is not implemented, cash from fares is collected on each bus. Daily revenues are deposited to an account of UT Ciudad Sorpresa.</p> <p>Once the AFC is implemented, all revenue from smart card top ups will go to Ciudad Sorpresa's account.</p>
▪ <b>Remuneration Model</b>	<p>In the preoperational stage</p> <p>UT Ciudad Sorpresa receives all system revenue and distributes it between operators based on their market share every two weeks. Operators share is determined by the number of passengers boarded and the number of kilometers operated.</p> <p>Operators' revenue is used to cover management costs, bus drivers' salaries, fuel costs, and contributes to the fleet renewal fund and financial fees for loans to fleet renewal.</p> <p>Remuneration to bus owners is distributed after all the discounts mentioned above are made. Figure 31 summarizes the payment waterfall.</p> <p style="text-align: center;"><b>FIGURE 31. PAYMENT PRIORITY IN PRE-OPERATIONAL STAGE</b></p>

	 <p>SOURCE: PREPARED BY THE AUTHORS</p> <p><b>Operational stage</b></p> <p>The objective is that once the fare collection system is implemented, vehicle owners receive a monthly rent from the bus operators. A financial manager will manage the final remuneration model. The renewal fund is a programmed saving mechanism aimed to support vehicle owners to renew the fleet.</p>
<p>▪ <b>Tariff model</b></p>	<p>There is an only fare tariff calculated by STT. Resolution 4350 of 1998 defines the tariff calculation methodology, and states that revenue from fare must cover operating expenditures and the bus operator's profit.</p>
<p><b>SUPPORTING SERVICES</b></p>	
<p>▪ <b>Automated Fare Collection System</b></p>	<p>The system will be accessible only with contactless card. So far, the operators manually collect the fares in a common account and they are paid in cash.</p>
<p>▪ <b>Fleet Management System</b></p>	<p>Operators have access to the platform in order to submit the planned frequencies for Avante's approval and to track their performance.</p> <p>Avante operates the FMS and supervises the compliance of operators.</p>

## F.8. Risk Allocation

The purpose of this section is to contrast the risk allocation before restructuring the transport system and after the SETP implementation is completed. To this end, four categories of risk are studied: evasion risk, demand risk, implementation risk and operational risk.

Before – Owner Operator Model	After – SETP
<b>EVASION RISK</b>	
<ul style="list-style-type: none"> <li>- Under the owner-operator model drivers dealt with the evasion risk and they had to control payment of every boarded passenger. Vehicle owners bore that risk as well, since their remuneration was based on the carried passengers. In addition, the vehicle owner could not control whether the driver allowed illegal boarding at a lower fare or not.</li> </ul>	<ul style="list-style-type: none"> <li>- Bus operators are responsible to control evasion on buses.</li> <li>- Moreover, in the preoperational stage bus operators assume evasion risk since their remuneration is based on carried passengers.</li> </ul>
<b>DEMAND RISK</b>	
<ul style="list-style-type: none"> <li>- Under the owner-operator model, demand risk was allocated in the vehicle owners because their remuneration directly depended on the passengers carried.</li> </ul>	<ul style="list-style-type: none"> <li>- In the pre-operational stage, bus operators bear demand risk since their remuneration is calculated after discounting all operational costs to total revenue.</li> </ul> <p>Once the AFC is implemented, bus operators will continue to bear demand risk. Nevertheless, mechanisms will be placed to monitor differences between collected revenue and system costs, in order to define necessary adjustments to fares.</p>
<b>OPERATION RISK</b>	
<ul style="list-style-type: none"> <li>- Vehicle owners were responsible for the fleet's daily operation and maintenance.</li> </ul>	<ul style="list-style-type: none"> <li>- Each bus operator is responsible for the operation and maintenance of the rented vehicles.</li> </ul>
<b>IMPLEMENTATION RISK</b>	
<ul style="list-style-type: none"> <li>- There was no significant implementation risk, since infrastructure and auxiliary services were rather limited.</li> </ul>	<ul style="list-style-type: none"> <li>- The government and the operators share implementation risk. Drawbacks in the SETP project execution may affect the system demand and the operator's remuneration.</li> </ul> <p>On the other hand, the government has most of the risk on the implementation of the supporting services and it will assume any overruns in costs. In addition, the government will have to manage failures to achieve the program objectives.</p>

## F.9. Lessons Learned and Conclusions

Pasto is the first medium city in Colombia to organize its public transport system so that the operators are enterprises that execute an efficient planning of their resources. The regulations require minimum service quality indicators, specific vehicles typology, trained personnel and defining specific roles and responsibilities for the stakeholders.

In addition, Pasto achieved a transparent cooperation between the authority (Avante) and bus operators, which is one of the most challenging tasks in a large-scale transformation. Pasto found a methodology that showed the operators the benefits of an organized system by thoroughly following the progress of the project and taking into consideration their concerns, instead of imposing the rules. In consequence, Pasto managed to advance faster than the other cities of the SETP initiative.

A key factor in Pasto's experience was the involvement of the Mayor during the process. The Mayor worked together with Avante and the bus operators to achieve a system that met the needs of the stakeholders. The mayor was responsible for arranging additional funding for the project, accompanying the operators in meetings with banks, national government and other financial institutions. It could be said that administrative officers should always have a role of accompanying the bus operators during the process to promote transparency and confidence.

Of course, there is still room for improvement. Local government and Avante must make a greater effort to turn regulation and plans into results. The fight against illegal transport must be enforced in order to guarantee the investments in public transport are producing the expected results. Furthermore, it is important to involve the users more, since they are the key actors in the system and the evaluators of the project's success.

Another issue to be improved is the way operators are organized. Currently, the 4 operators within Ciudad Sorpresa allocate routes and remuneration among them. So there is no strong legal mechanism that guarantees that stronger operators will not manipulate the market and run the best routes.

So far, the implementation of the restructured routes and the traffic light system, the construction of the Fleet Management System and the road works show remarkable results in terms of infrastructure and technology because nowadays, Pasto has one of the most modern infrastructures in Colombia [100].

Finally, the system has achieved the objectives intended by the national government following an action plan with clear steps. Yet, the complete transformation will take some additional years. Time is a restriction for this type of projects since political, commercial or social factors are hard to coordinate.

## G. León

León de los Aldama, or simply León, is Mexico's fifth largest city. León's Metropolitan Area, which consists of León and three other municipalities, has 1.6 million inhabitants and a density of 6,600 people per km<sup>2</sup>. An interesting fact is that its urban area grows 10% faster than the population (4%), causing travel times and average distances to increase [101].

León is an example of a successful transformation of public transport, since the city moved from a traditional owner-operator model to an integrated public transport system, which allowed it to enhance the service contracts. The transformation process started with a change in the institutional structure and the implementation of a fare collection system. These reforms brought transparency to the city and facilitated the process of implementing an integrated public transport system.

Regarding the institutional structure, certain roles and responsibilities that belonged to the state of Guanajuato were transferred to the Municipality of León. In addition, strong regulatory framework adjustments conferred the Municipality of León the responsibility to control and monitor public transport. The result of the new structure was an improvement in public transport operation.

Another key aspect that took place in the early steps was the creation of a trust fund for the system modernization. The fund's resources were collected from the surpluses of the tariff rounding during five years<sup>22</sup> and they were spent on personnel training, technical studies and supported the system modernization, among others [102] [103].

León's Integrated Public Transport System has been operating for the last 13 years, and so far it has been able to reduce pollution by 13%, remove 200 old buses, reduce fatal accidents by 30%, and increase user quality perception up to 8 out of 10 [104] [105].

The following sections present a comparison of the institutional organization, regulatory framework, contract and service contracts, before and after the city's public transport organization took place. In addition, a section is included to explain key elements of the transition process.

### G.1. Public Transport Overview

#### G.1.1 Before Public Transport Transformation

By 1995, the public transport worked under route concessions granted to private companies for a 10-year period. At the time, concessions were assigned to 12 companies: 6 limited corporations, 2 unions, 1 cooperative and 3 civil associations. Although the city had organized companies, each permit-holder was responsible for the operation and maintenance of its own fleet. [106].

León had 61 urban routes operated with 1,830 vehicles and 29 suburban routes operated with 60 vehicles. Although the State Law of Transit and Transport defined a 10-year useful life for a bus, the average age of the fleet was 11 years and only 10% of the vehicles had ecological engines [106].

The system did not have a common fare collection or revenue management system. Each permit-holder received daily revenue from the operation of their buses in a given route. Concessions did not have any type of direct or indirect subsidy from the government, so fare collection was the only income for bus operators. Under this model, there was no control over the number of buses per route

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<sup>22</sup> As of 2003, the fund was worth MXN \$120 million [103] (USD \$12 million [138])

since the unions and cooperatives received higher incomes as the number of affiliated bus owners increased.

The urban and suburban transport had low service quality and oversupply, since there were excessively long routes and high concentration of routes downtown. In addition, the State General Direction of Transit and Transport had not defined service level standards or requirements for the public transport service providers and had transferred route planning to the twelve companies. The operators were mainly cooperatives and unions, whose creation had been promoted back in 1980s [107].

Some additional aspects worsened the service quality. For example, drivers had long working shifts, in some cases almost 16 hours; the remuneration was based on the number of boarded passengers, which encouraged overcrowding in vehicles, on-street competition, higher incident rates and legal offenses. To mitigate this phenomenon, the municipal government implemented road inspectors to verify fleet headways and to avoid the unfair competition. This generated several fines and penalties to drivers, which clearly unsatisfied them [108].

The lack of organized assignment of routes caused an ill alignment between the routes' demand and supply, which heightened the competition for passengers. The lack of drivers' training caused user dissatisfaction due to lack of politeness. As of 1995, there was no specialized and structured entity monitoring public transport quality of service. Neither was there strong enforcement of the operation nor was there a formal tendering process that promoted the suitability of the transport operators or an organized assignment of routes. All of these difficulties encouraged the government to reframe the public transport model in the municipality with the creation of The Integrated Transport System (ITS).

### G.1.2 After Public Transport Transformation

The transformation of public transport in León involved three key processes: i) the creation of a new institutional structure; ii) the formalization of private operating companies, and iii) the organization of fare collection, revenue management and the operator's remuneration models. The new integrated transport system of León has been achieved in several stages, where the following changes have been implemented:

#### **Creation of a new institutional structure**

Since 1994, León's institutional organization has undergone significant changes. New institutions have been created in order to distribute the responsibilities that the government of the state of Guanajuato previously bore. Two of the main new institutions are the Municipal Department of Mobility and the Coordinated Transport Operators of León (CTOL). The latter is considered one of the main organizational changes that have contributed to the successful implementation of the integrated transport system.

CTOL was created in 1994 in order to strengthen the relationship between transport authorities and transport operators, thus achieving an improvement of bus service operation [109]. CTOL is responsible for structuring plans, programs and projects that enabled greater efficiency, safety, regularity, better economy and service coordination. Furthermore, it facilitated the relationship between bus operators and with the authorities.

### Formalization of private operating companies

The new Integrated Transport System model required that only organized enterprises could be granted a transport concession. Those enterprises would be responsible for the technical, operational, and administrative areas of bus service contracts.

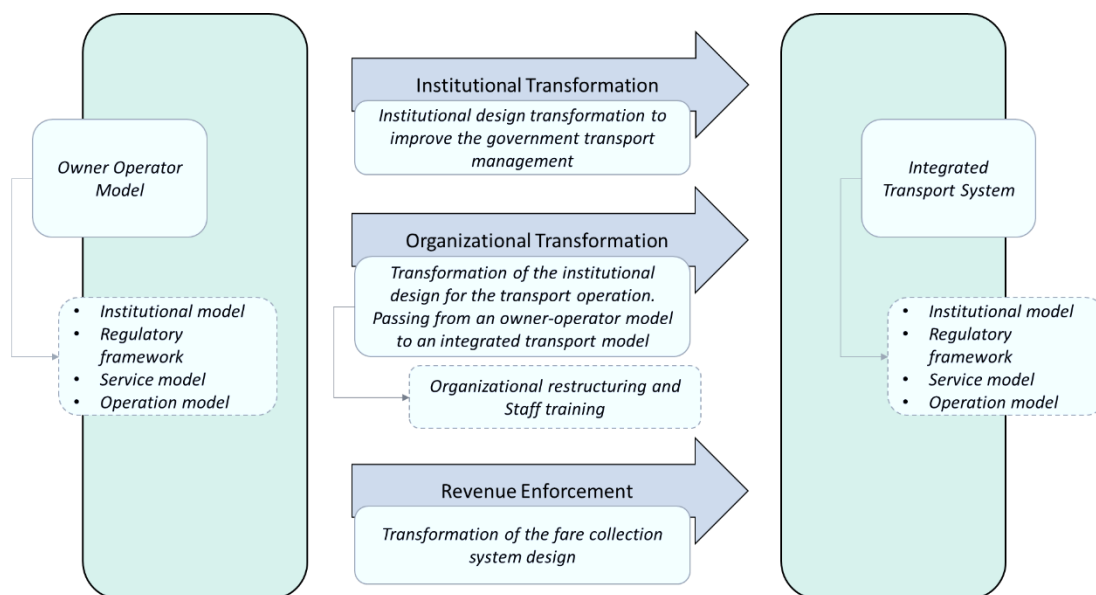
In that way, bus operators are now responsible for: i) hiring the operational and administrative staff; ii) performing fleet maintenance (a task that was previously done by vehicle owners), and iii) fulfilling a set of operational requirements that includes operation (frequencies, schedule, etc.), quality (fleet condition, cleanliness, etc.), and security standards (safety on-board equipment, etc.), among others.

In addition, the formal establishment of operating companies was promoted by the creation of a modernization trust fund in 1998. Resources collected in the trust fund were used to improve transport operators organization, train staff, provide drivers with proper uniforms and implement the Integrated Fare Collection System and access control systems [103].

### Revenue enforcement

One of the key factors of León's public transport transformation was the creation of the Automated Fare Collection System (AFC) in the early stages of the system transformation. The AFC provided the government with additional tools to monitor system performance and revenue management, and encouraged operators to better understand the bus operation business model.

The following figure depicts key elements of the public transport system transformation.



**FIGURE 32 PUBLIC TRANSPORT TRANSFORMATION MODEL**  
SOURCE: PREPARED BY THE AUTHORS BASED ON A PUBLICATION OF EMBARQ [110]

#### ■ **Bus Service**

Bus services are run by 19 bus companies that are shareholders of the Coordinated Transport Operators of León. These bus operators are responsible for running the routes of the integrated transport system as well as those that have not been fully integrated. The following are the main characteristics of each type of route:

- The Integrated Transport System includes the BRT system and the traditional bus system. Under the ITS, users are allowed to transfer between routes by paying a single fare.

The BRT is the heart of the ITS and part of the new transport model. The BRT has 5 trunk routes, with 61 Euro 4 articulated buses, and a feeder service made up of 67 routes. The BRT has a fleet management system that has enabled the enforcement of service plans and a proper authority monitoring. In addition, the BRT has implemented a user information system that includes information panels at stations.

The traditional bus system is composed of auxiliary routes that connect neighborhoods where BRT or feeder routes are not present.

- On the other hand, the non-integrated traditional bus system provides service for the ITS auxiliary routes (inter-neighborhood routes). However, there is no fare integration and users cannot make transfers between routes at no cost. In fact, they must pay a full fare for every journey made on different bus routes.

Users can pay fares either in cash or with the contactless card Pagobús. As of 2015, cash payments are high: 45% of users pay with this method. Bus drivers are responsible for collecting payments in cash and delivering them to the operator at the end of the day. Regarding electronic payments, the system has an integrated fare collection system that has been running since 2001. The AFC system includes an external top-up network with 250 points of sale [111]. The objective of the municipality is to achieve 100% payments with Pagobús card. The use of smart cards has been promoted by charging a higher fare for cash payments (US\$ 0.68 in cash vs. US\$ 0.53 with smart cards). The BRT and the traditional bus system are responsible for nearly 850,000 daily trips in the city. The following is the trip breakdown by transport mode:

**TABLE 16. LEÓN DAILY TRIPS ON PUBLIC TRANSPORT**

Transport Systems	Daily average trips (thousands)	Percentage
<b>Total</b>	<b>2,632</b>	<b>100%</b>
<b>Private</b>	<b>1,742</b>	<b>66.2%</b>
<b>Walking</b>	<b>881</b>	<b>33.5%</b>
<b>Car</b>	<b>694</b>	<b>26.4%</b>
<b>Bicycle</b>	<b>150</b>	<b>5.7%</b>
<b>Motorcycle</b>	<b>17</b>	<b>0.6%</b>

Transport Systems	Daily average trips (thousands)	Percentage
<b>Public</b>	<b>890</b>	<b>33.8%</b>
BRT	430	16.3%
Traditional bus systems	412	15.7%
Taxi	48	1.8%

## G.2. Institutional Organization

### G.2.1 Before Public Transport Organization

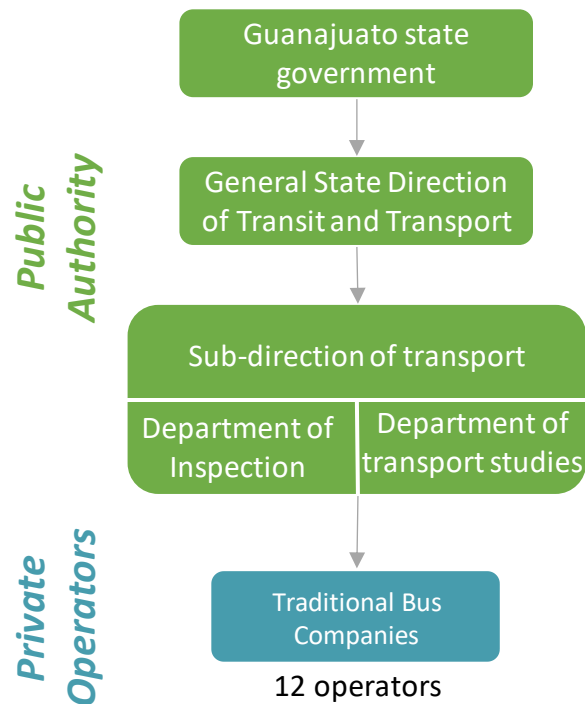


FIGURE 33. PUBLIC TRANSPORT INSTITUTIONAL ORGANIZATION IN LEÓN BEFORE TRANSFORMATION

- **Guanajuato State Government**

Guanajuato State Government issued the first state law of Transit and Transportation in 1993. According to this law, the main responsibilities regarding public transport and transit were responsibility of the state of Guanajuato.

- **State General Direction of Transit and Transport**

Before 1994, the State General Direction of Transit and Transport was responsible for signing concessions, defining tariffs, and issuing driving licenses and plates. It was also responsible for planning, managing and controlling the public urban and sub-urban transport in the municipality. In 1996, under the Administrative Cooperation Agreement on transit and transportation those responsibilities were transferred to the municipality.

- **Municipal Sub-direction of Transit and Transport**

It was created after the Administrative Cooperation Agreement on Transit and Transport. It is composed of two departments: the Inspections Department and the Transport Studies Department.

The Transport Studies Department was responsible for: i) identifying and studying new transport needs; ii) identifying and analyzing changes in the route network, and iii) creating and managing the database of routes, vehicles and transport operators. The Inspections Department was responsible for i) enforcing and monitoring transport concessions in accordance to the transit and transport law, and ii) the collection of the user complaints.

- **Traditional bus companies**

By 1995, there were 12 companies in charge of the public transport service contracts. There were 4 companies operating under an owner-operator model. They included limited corporations, unions, cooperatives and civil associations. 55% of the public transport vehicles were operated by 6 limited corporations, 29% by 2 unions and 1 cooperative, and 16% by 3 civil associations.

## G.2.2 After Public Transport Transformation

The current institutional organization of León is presented below.

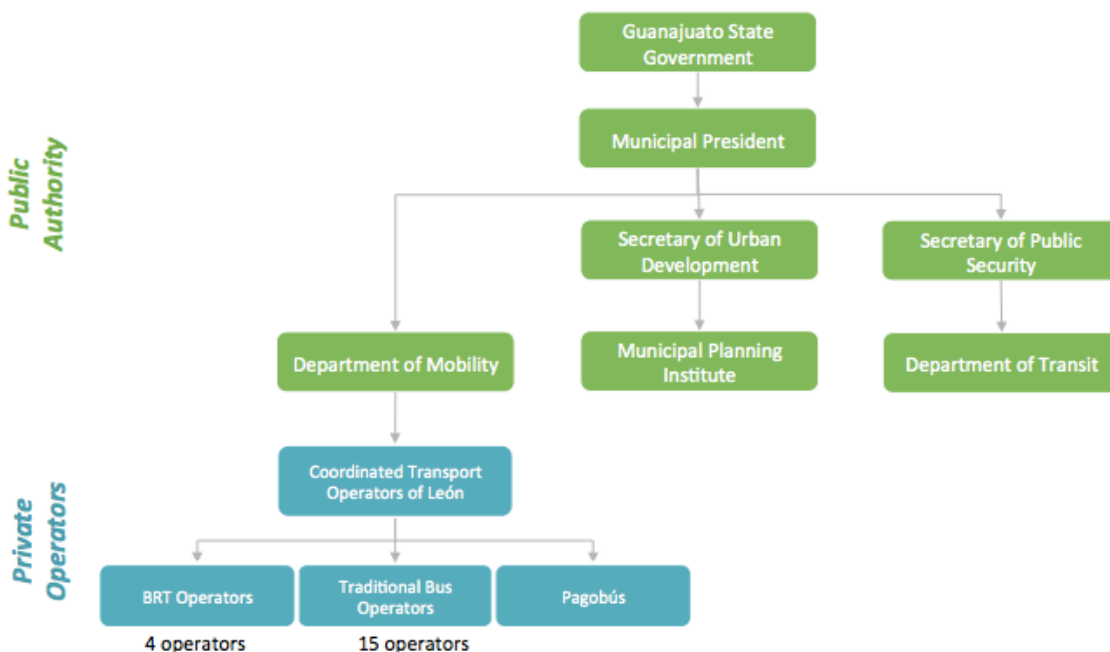


FIGURE 34. PUBLIC TRANSPORT INSTITUTIONAL ORGANIZATION IN LEÓN AFTER TRANSFORMATION

- ***Guanajuato State Government***

It is in charge of issuing the Guanajuato State Transit and Transportation Law. All the municipalities in the state must comply with this law, since it specifies the regulatory framework under which public transport concessions are granted. Additionally, it defines the kinds of tariffs to be applied for public transport in the state [112].

- ***Municipal President***

His/her main transport related functions are: i) to propose, conduct and disseminate policies related to municipal public transport; ii) to publish the declaration of need for public transport services (this declaration is previously agreed upon with the city council), and iii) to subscribe concessions for the public transport service contracts. Additionally, the president, together with the city council, is in charge of defining user fares [113].

- ***Mobility Department***

Its main responsibilities are:

1. Establish, monitor and evaluate operational plans, which are designed to pay special attention to the population needs. For each route, the Mobility Department identifies the path, defines timetable and a frequency per timeslot that is defined considering the system's demand.
2. Set quality parameters under which the concessionaire provides the service on each route type. These parameters consider the characteristics of the fleet, cleanliness of the bus and driver image, among others.
3. Determine the remuneration model for concessionaires, considering the mileage, operating costs and investment.
4. Issue rules of operation and functioning of the transport system stations. [113]

- ***Secretariat of Urban Development (SUD)***

The SUD's main functions are: i) to evaluate urban development programs arising from the Municipal Land Use Plan; ii) to verify that infrastructure and urban development comply with Municipal Land Use Plan and urban development programs, and iii) to promote research by educational institutions and research groups that contribute to urban development in the municipality [114].

- ***Municipal Planning Institute (MPI)***

It is a decentralized entity created in 1989 and its main function is to establish the Municipal Development Plan. In addition, it advises the City Council on integrated planning with long-term vision and promotes participatory planning. Furthermore, it coordinates the development, updates and modifications of the Municipal Planning System [105] with the Citizens Planning Council.

- ***Secretariat of Public Security***

Its main functions are: i) to preserve public order, ii) to prevent antisocial behaviors, offenses and infractions, and iii) to protect the legal assets of the community members that may be affected by any kind of antisocial behavior, crime, accidents or disasters. These functions incorporate the scope of the municipal transport [115].

- ***Transit Department***

Its main functions are: i) to regulate and control the vehicular and pedestrian traffic through signs and traffic control devices, ii) to implement permanent road safety education programs, iii) to seek citizen participation in the implementation of actions or programs to control traffic, and iv) to gather statistics on traffic accidents, including causes, economic losses, injuries and other factors [116].

- **Coordinated Transport Operators of León (CTOL)**

CTOL is a private entity that brings together the 19 public transport operators of León. CTOL's responsibilities are:

1. Operating the Fare Collection System Pagobús.
2. Setting fare revenue collection and bus operators' remuneration.
3. Calculating each bus operator's remuneration for a given period.
4. Managing the different trust funds, although any movement to the trust fund accounts requires an authorization from the Mobility Department.
5. Training and certificating bus drivers. CTOL owns a simulator where drivers' aptitudes are assessed.

- **Bus operators**

The bus operators are responsible for running the system. There are 4 exclusive operators for the BRT system while other 15 operators are responsible for both integrated and conventional bus routes operation.

### G.3. Regulatory Framework

In **1989**, the municipality of León structured the Integral Plan of Road and Urban Transport. Under the plan the MPI was created, the centralized system of traffic lights was implemented as well as boulevards and streets, among others, were built. [105].

In **1994**, the State Government of Guanajuato and the municipality of León signed a preliminary administrative cooperation agreement on transit services and transportation. This cooperation agreement conferred the municipality jurisdiction to supervise and inspect public transport service. It also allowed the municipality to get involved in transport tasks. [117].

In **1996**, the Agreement on Administrative Cooperation was signed. This regulation gave the municipality of León the monitoring, control, and inspection of the public transport service for urban and suburban routes [117].

In **2002**, the municipal transport regulation was issued because the municipality of León wanted to organize public transport. It introduced two types of transport systems, the non-integrated transport system and the integrated transport system.

The first one operates individually on radial and diametrical routes and circuits in urban areas<sup>23</sup>. In this system the remuneration to concessionaires is based on the number of passengers boarded. The regulation states that the non-integrated system can become part of the integrated one once it meets the operating characteristics of the integrated transport system.

Regulation also states that two non-integrated routes cannot overlap more than 60% in order to maintain the balance between demand and supply among the routes. Additionally, the regulation states that the non-integrated concessionaires should not only have a proper business organization supported by administrative, operational and technical personnel, but also facilities that enable efficient transport services. [113]

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<sup>23</sup> Radials routes: those operating from outlying settlements of the urban area to the downtown area of the city, returning to the same point of origin.

Diametrical routes: those in which origin and destination is a settlement on the periphery of the urban area, passing through the downtown area of the city or near it.

Circuit routes: those in which the starting and end point is the same, forming an irregular polygon on its path, where provided services circulate in both directions, passing exceptionally through the downtown area of the city.

The municipal transport regulation stipulates that any form of compensation to drivers that encourages the risk of accidents or ill treatment of users due to conflicts on public roads to uptake more users is prohibited. To avoid this, it is the concessionaires' responsibility to collect the income of all of the routes periodically. Once the income is collected, it should be distributed among the partners of the concessionaire. The distribution is based on the percentages established between them. The percentage definition depends on the number of kilometers traveled per vehicle.

On the other hand, the ITS service contracts are done among trunk, auxiliary (inter-neighborhoods) and feeder (station-neighborhood) routes. The characteristics of the integrated transport system are its physical, operational and tariff integration. Physical integration refers to the connection of routes through transfer stations and intermediate stations. Operational integration refers to the harmonized planning of routes that make up the system, where the planning is done through an operational central programming to determine operational aspects which include the frequency and number of units in operation in each route. Additionally, planning is done looking for balance between the routes supply and demand. Finally, tariff integration refers to the payment of a fee that allows the user to transfer between routes without additional payment, through a fare collection system that is suitable for this purpose [113].

In the ITS, concessionaires' remuneration is based on kilometers traveled, operating costs, investment and a reasonable profit.

On the other hand, the municipal transport regulation sets a minimum set of requirements in regards to infrastructure, drivers, administrative organization and a contractual scheme.

In **2013**, the last version of the Transit and Transport Law of the State of Guanajuato (TTLSG) was published. It stipulated that concessions for the public transport service could only be granted by routes. It also stated the regulatory framework under which concessions had to be granted. In particular, this law highlighted that:

- i) Municipal authorities were responsible for conducting technical studies to timely detect the transportation needs of the municipalities. Those studies should include statistical studies supporting current and potential demand of the transport service, as well as, the type of transport service that should be implemented, defining fleet size and fleet technical requirements, and a cost benefit assessment.
- ii) Based on the technical studies, the city council should approve the declaration of service needs, and the municipality president should publish it.
- iii) Once the declaration of service needs was issued, the president had to publish the invitation to tender specifying the type of transport service needed, as well as, the legal and administrative requirements for applying.
- iv) Finally, the city council had to evaluate the proposals taking into account the proponents. The law also set the time of the concession to 15 years, which can be extended, based on their performance [112].

In regards to public transport tariffs the TTLSG stated that the tariff scheme includes tariff reductions for specific segments as students, people with disabilities, senior citizens and citizens under twelve years old.

## **G.4. Bus System Transformation**

### **G.4.1 Definition of the authority's objectives under the new model**

The objectives sought by the city with the ITS implementation are:

- i.To structure and order the city.
- ii.To give priority to mass transit, pedestrians and cyclists.
- iii.To reduce accident rates.
- iv.To reduce levels of traffic congestion, especially in the downtown area.

- v. To reduce noise pollution levels and emissions.
- vi. To promote the modernization of transport companies [105].

The objectives sought for the users with the ITS implementation are:

- i. To have a more efficient and reliable transport service.
- ii. To have a user-friendly approach and provide a safer service.
- iii. To reduce travel times.
- iv. To create a unique payment option for multiple destinations.
- v. To facilitate the use of transport to users with reduced capabilities [105].

## G.4.2 Definition of the operator's interests and main concerns under the new model

**Operator's investments for the fleet adjustment:** the operators need to fulfill a set of requirements in order to operate under the new model. These requirements include physical and mechanical fleet conditions, among others. Therefore, they were concerned about additional investment to comply with these requirements.

**Operator's remuneration changes:** In regards to ITS operators (which include BRT), the remuneration under the new model was modified. Before, the remuneration to operators was based on the passengers carried. Under the new model, the remuneration to operators is based on the mileage. The operators feared a profit margin reduction.

## G.4.3 Steps followed for the system transformation

To achieve the ITS objectives, the following steps were undertaken:

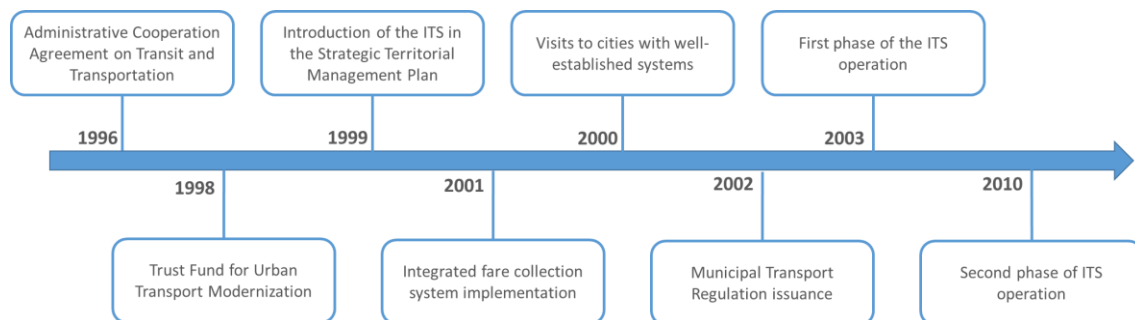


FIGURE 35. STEPS FOLLOWED FOR THE SYSTEM TRANSFORMATION

In 1996, the Administrative Cooperation Agreement on Transit and Transportation (ACATT) was signed. This agreement was made between the state of Guanajuato and the municipality of León. Under this agreement, the municipality of León was responsible for the public transport system monitoring, control, and inspection. Nevertheless, the concessions signing and the tariff scheme definition remained controlled by the municipality. In addition, the municipality and concessionaire companies agreed to a set of objectives that were established to improve the service quality. Among those objectives were: i) to reduce the fleet age, which by that time was 11 years old; ii) to train drivers; iii) to create a trust fund for the transport system renovation, and iv) to acquire on board technology for fare collection and fleet management, among others. Additionally, it was established that the municipality had to execute technical studies, in order to adjust the public transport supply to the system's demand.

In 1998, the trust fund for urban transport modernization was created. Since the creation of the fund, the operator concessionaires have made daily contributions that consider each of the operator's fleet size. It is the responsibility of the city council and the municipal president to determine the contributions from the operating companies. The trust fund resources have been used for fleet modernization, technology renovation, and personnel training, among others [118].

In 1999, the Strategic Territorial Management Plan introduced the Integrated Transport System (ITS). The ITS objective was to create and organize a route network that would improve public transport service efficiency and enforcement. It was also expected to improve congestion and pollution, among others.

In 2000, the transport operators and municipal government staff visited cities like Bogota, Sao Paulo, Porto Alegre, and some cities in Spain and France, with well-established transport systems. Those visits allowed the transport operators and the municipal government to get in touch with fare Collection, and fleet management technology as well as to visualize how the operation and monitoring of the fleet was done. Also technology and operational processes that could be implemented locally were identified. At the end, this was valuable input to decide whether or not to implement the ITS.

In 2001, the integrated fare collection system was implemented by using contactless cards. Since the municipal government's first approach to the operators was to organize the fare collection system, the organization of the transport operation was done subsequently.

In 2002, the Municipal Transport Regulation was issued. It introduced the non-integrated and the integrated transport system. This regulation also defined the system's remuneration model; tendering process; operational requirements; fleet and premises characteristics; the operation evaluation, and the enforcement procedures, among others.

In 2003, the first phase of the ITS started operation. It was composed of 3 trunk routes, 31 feeder routes (station-neighborhood), and 6 auxiliary routes (inter-neighborhoods). The system started operation with 55 stations, 25 km of trunk routes, of which 60% were implemented in an exclusive lane. The first phase of implementation allowed for the removal of 200 old buses [111].

In 2010, the second phase of the ITS started operation with 2 new trunk routes, 12 new auxiliary routes, 18 new feeder routes, and 5 additional km of trunk routes. The second phase started operation with 11 additional stations. Up to now, the second phase implementation has permitted the extraction of 100 old buses [111].

The Strategic Territorial Management Plan of León includes a third and fourth implementation phases of the ITS in León, which are still under construction. These phases will add 2 trunk routes, 3 feeder routes, and 4 stations [119]. Their implementation intends to reduce the participation of the system that is under the traditional transport system [120] from 10% to 4%. In addition, around 25 million pesos are going to be invested for automatic self-vending machines, contactless cards, improved network, and software development. It is also expected that by the end of the fourth phase, the use of electronic fare collection payment reaches 100%.

## G.4.4 Resistance to change management

The municipal government of León provided benefits to the operator concessionaires in order to handle resistance to change. A list of the main aspects that stimulated the transport system transformation is presented below.

**Competition elimination:** One of the difficulties of the owner operator model was the over-supply of routes. Under the ITS, route supply is controlled following the municipality's operational requirements for operator concessionaires, which specify the enabled number of operators, fleet size, frequencies and schedules for each route. Thus, the regulation ensures that the competition among operators in the routes is eliminated thanks to the demand and supply alignment.

**Concessions extensions:** In the ITS, the transport operators that adopt the new model can have contract extensions of up to 15 years, which is the initial duration of the concessions. They guarantee the concessionaires income for a longer period. Therefore, this constitutes an incentive that stimulates the transport operators' entailment to the ITS system.

**Transport companies' transformation support:** The municipal government closely supported the operator companies through the system transformation. This was achieved through training and organizational restructuring programs that were well accepted by the operator concessionaries.

## G.4.5 Comparison of key aspects of the public transport model

This section presents key aspects of the routes concession, planning, revenue and supporting services. Table 17<sub>A</sub> shows the public transport business and operational model characteristics before the SIT was implemented. Table 17<sub>B</sub> summarizes the way the system works after Phases 1 and 2 of SIT were implemented.

TABLE 17<sub>A</sub>. MATRIX OF THE BUS SYSTEM IN LEÓN BEFORE THE TRANSFORMATION PROCESS

CONCESSIONS	
▪ Type of allocation	By route.
▪ Type of concession / permits	Transit permits per route and per vehicle.
▪ Concessions duration	10 years.
▪ Concessions extension	There were no extensions.
▪ Tendering process	There was no formal tendering process in place.
SYSTEM PLANNING AND OPERATION	
▪ Transport Service Planning	The government did the routes definition. The operating frequencies definition was the responsibility of the operators, who hardly ensured alignment between the routes supply and demand.
▪ Transport Service Supervision	Under the owner operator model there was no strong enforcement of the operation. There were no mechanisms to control the routes overlapping, which generated inefficiencies in the operation.

▪ <b>Transport Service Evaluation</b>	There was a lack of formalization in the performance indicators scheme. Thus, there was not a multi criteria evaluation of the operation regarding, quality, security, adequate administrative organization, and infrastructure conditions.
<b>TARIFFS AND REMUNERATION</b>	
▪ <b>User Payment Method</b>	Users accessed the public transport services using cash as means of payment.
▪ <b>Revenue and Remuneration Model</b>	Revenue for transport operators came from fares paid by boarded passengers. Under this model, operators competed in the market, while trying to maximize the number of boarded passengers.
▪ <b>Tariff model</b>	User fare was set by the authority.  Regarding fares for concessionary passengers, there were problems with operators complying to charge only the reduced fares.
<b>SUPPORTING SERVICES</b>	
▪ <b>Automated Fare Collection System (AFC)</b>	Bus operators collected revenue; there was no integrated fare collection system in place.  In 2001, the municipality implemented a fare collection system that accepted cash and smart cards as payment methods. The AFC started running before the integrated transport system was created in 2003.
▪ <b>Fleet Management System</b>	The system did not have a technological platform for fleet management, therefore, information and instructions could not be provided to drivers to ensure uniform spacing and headways between buses.  The transport operation could not quickly react to unexpected events, like accidents, protests and over demand.

After the public transport reforms that started in 2003, the operational model for the integrated and non-integrated public transport systems changed.

The following table summarizes the main characteristics of the route concession contracts.

**TABLE 17b. MATRIX OF THE BUS SYSTEM IN LEÓN AFTER THE TRANSFORMATION PROCESS**

<b>CONCESSIONS</b>	
▪ <b>Type of allocation</b>	By routes.
▪ <b>Type of concession / permits</b>	Concessions and permits are granted by route to bus operators.
▪ <b>Concessions duration</b>	15 years.
▪ <b>Concessions extension</b>	Concessions can be extended for an additional 15 years, as long as the operators have complied with service contracts during the first period of the concession.

<p>▪ <b>Tendering process</b></p>	<p>Formal tendering process with the following steps:</p> <ul style="list-style-type: none"> <li>i) Preparation of technical studies justifying the service need. This is done by the DM and approved by the city council.</li> <li>ii) Approval and publication of the declaration of service needed. The approval is done by the city council, and the publication is done by the municipality president.</li> <li>iv) Publication of the invitation to tender.</li> <li>v) Receipt and evaluation of invitations to tender. This is done by a technical expert panel.</li> <li>vi) Verdict issuance and expedition of the concession title.</li> <li>v) Beginning of service delivery.</li> </ul> <p>Furthermore, concessionaires that are providing the service efficiently have additional points in the evaluation process. Service quality is assessed through periodical evaluations carried out by the Department of Mobility.</p>
<p><b>SYSTEM PLANNING AND OPERATION</b></p>	
<p>▪ <b>Transport Service Planning</b></p>	<p>The Department of Mobility is in charge of the definition of routes, schedules and frequencies.</p>
<p>▪ <b>Transport Service Supervision</b></p>	<p>The Department of Mobility is in charge of the supervision of routes, schedules and frequencies.</p>
<p>▪ <b>Transport Service Evaluation</b></p>	<p>The Department of Mobility performs periodical evaluations of the system's operation, quality of service, security, administrative organization and infrastructure.</p> <p>Operation indicators include an evaluation of compliance with frequencies, schedules, operation speed and lead times.</p> <p>Quality service indicators include an assessment of the physical (including cleanliness) and mechanical conditions of the vehicle, and compliance with tariff and revenue collection procedures. In addition, complaints and suggestions received from users or other stakeholders are taken into account.</p> <p>Security indicators include a review of incidents such as accidents, and an evaluation of fleet compliance with on-board safety equipment. In case of infringements of security provisions, penalties are applied to operators based on the severity of the event and how often it has occurred.</p> <p>Administrative organization indicators assess the recruitment and training processes and monitor drivers' performance.</p> <p>Infrastructure indicators include an evaluation of bus operators' premises like offices and workshops, as well as, the availability of vehicle fleet and on-board equipment.</p>

TARIFFS AND REMUNERATION	
▪ <b>User payment Method</b>	<p>Cash and smart cards.</p> <p>Although the automatic fare collection system was implemented in 2001, nearly half of the users still pay their fare in cash. The target is that all users access the system with smart cards after the integrated transport system is fully implemented.</p>
▪ <b>Revenue Management</b>	<p>The system's fare revenue comes from top-ups of Pagobús smart cards and cash paid by users. The money collected from top-ups is deposited in a trust fund, while operators keep revenue collected in cash from fares at each station or bus.</p> <p>The company Pagobús S.A. is responsible for consolidating and settling all system revenue, as well as conciliating information from transactions made in the AFC. The company calculates the total system revenue in a given period based on the number of trips paid with smart cards and the number of trips paid with cash. The latter is provided by figures from passenger counters installed on each bus.</p> <p>The following figures depicts the interaction of bus operators, the Authority and the trust fund with the company Pagobús S.A.</p>
▪ <b>Remuneration Model</b>	<p>Operator's remuneration in a given period is determined by the operator's share over total revenue minus any discounts that should be given due to non-compliance with quality of service standards and their contribution to the fleet renewal fund. Remuneration for an operator in any period <math>i</math> is calculated with the following formula:</p> $  \begin{aligned}  \text{Remuneration Operator}_i &= \text{Revenue Operator}_i - \text{Penalties}_i \\  &\quad - \text{Contribution to the fleet renewal fund}_i  \end{aligned}  $ <p>Each operator's revenue is determined by the total available revenue and the number of kilometers the operator logged in a given period. This means that each operator's share over revenue in period <math>i</math> is calculated as:</p> $  \text{Revenue Operator}_i = \text{Available Revenue} * \frac{\text{kms logged by Operator}_i}{\text{Total kms logged}}  $ <p>Remuneration to bus operators should cover operational expenditures, capital expenditures and the operator's profit margin. The operational expenditures include: administrative expenses (staff salaries, taxes, insurance expenses, etc.), as well as, variable expenses (fuel, tires, lubricants, preventive and corrective maintenance, cleaning and oiling, etc.). Capital expenditures include depreciation investments, vehicle fleet, etc.</p>
▪ <b>Tariff model</b>	<p>There are four types of tariffs:</p> <p>Ordinary tariff, which is paid by ordinary users.</p>

	<p>Preferential tariff, which is paid by concessionary passengers (e.g. elders, people with disabilities).</p> <p>Special tariff, which may be authorized for particular evening hours and Sundays, or holidays, as well as, low demand periods.</p> <p>Integrated tariffs, which are paid in the route, integrated system, allowing users to make transfers in the system at no additional cost.</p>
<b>SUPPORTING SERVICES</b>	
▪ <b>Automated Fare Collection System</b>	The ITS is a full contactless accessible system. With an external top-up network, with 250 points.
▪ <b>Fleet Management System</b>	The ITS has a centralized fleet management system that enables the fleet operation enforcement. This system monitors the fulfillment of routes, schedules, frequencies and mileage per day per concessionaire. Additionally, it monitors congestion and bus headways.

## G.5. Risk Allocation

The purpose of this section is to contrast the risk allocation before and after the restructuring of the transport system. To this end, four categories of risk are studied: evasion risk, demand risk, implementation risk and operational risk.

Before – Owner Operator Model	After – Integrated Transport System and Route Independent System
<b>EVASION RISK</b>	
Evasion risk was borne by the bus operators since their income comes from collected fares from passengers.	<p>For integrated route and independent route systems, evasion risk is allocated to transport operators.</p> <p>In daily operation, drivers and personal at stations are responsible for controlling evasion by monitoring user's fare payment as they access the bus or station. In addition, remuneration of transport operators is determined by the distribution of total fare revenue. Thus, if the evasion increases, the system's revenue decreases, and the remuneration to transport operators decreases.</p>
<b>DEMAND RISK</b>	
Under the owner operator model, the demand risk was allocated to the transport operators. Their remuneration directly depended on the number of passengers boarded.	<p>For integrated route and independent route systems, demand risk is allocated to the transport operators.</p> <p>The remuneration to transport operators depends on the collected fares, and the participation of each operator in the total logged kilometers. Thus, if the system's</p>

	demand decreases, the system's revenue decreases, and the remuneration to transport operators decreases as well.
<b>OPERATION RISK</b>	
Operational risk was transferred to operators. Bus operators were responsible for daily fleet operation and maintenance.	<p>For integrated and independent route systems:</p> <p>Operational risk is allocated to transport operators. Transport operators are responsible for daily fleet operation, maintenance and staff management and training.</p> <p>The Authority is in charge of route design. This task includes determining the number and type of vehicles, the frequencies and operation hours. It is also responsible for the systems settlements, the monitoring of the kilometers logged by each operator, and the evasion supervision.</p>
<b>IMPLEMENTATION RISK</b>	
There was no significant implementation risk, since infrastructure and auxiliary services were rather limited.	<p>For integrated and independent route systems:</p> <p>The transport operators supply the fleet, workshops and courtyards, fulfilling a set of technical specifications. The non-compliance of these requirements represents a breach in the contractual agreement.</p> <p>The municipal government is in charge of building bus stations, bus stops and the infrastructure for trunk services. In addition, the government provided the Fare Collection Technological platform (external top-up network, self-vending machines, etc.).</p>

## G.6. Lessons Learned and Conclusions

The ITS implementation brought the following benefits:

- **Modernization of the transportation companies:** The training of the operator concessionaire personnel, as well as the redefinition of its organizational scheme had an improvement in the service contracts. Additionally, this has improved the personnel-user relationship, which is evidenced in the perception of quality service. Only 10% of the users consider that the service quality is bad [121].
- **Accidents reduction:** The accident rate has been reduced by 20%. Fatal accidents in particular have decreased by 30% [104].

- **Congestion reduction:** 200 traditional old buses have been removed. The ITS transports a higher number of users using less buses due to the articulated fleet [104]. The congestion reduction has been evident for the users of the system since 92% of them consider that travel time in public transport is either good or excellent.
- **Higher user satisfaction:** Users give security and accessibility of the service an average score of 8 out of 10. Moreover, the user complaints decreased in 40%. Additionally, the ITS could implement a tariff scheme that took into account discounts for vulnerable segments. Furthermore, the ITS implemented infrastructure to provide access to people with disabilities [105].
- **Pollution reduction:** There is a lessening of 13% in the emission of polluting gases, because of the fleet renovation and the Euro 4 articulated fleet insertion. Diesel consumption was reduced by 2 million liters, which reduced annual operation costs in MXN \$15 million [104].
- **Lower costs for the users:** Now users spend less money in public transport thanks to transfer stations implementation. Currently, only 10% of the routes are not integrated, but once Phases 3 and 4 are implemented, 4% of the routes will be non-integrated.

The key elements in the successful implementation of the integrated transport system of León were:

- The continuity and coherence of its implementation phases.
- The creation of a regulatory framework that set the rules for the new institutional organization and defined the requirements that bus operators had to fulfill.
- The strengthening of the municipal authority that was able to improve significantly the system enforcement.
- The support of the municipal government to transform the operator companies.
- The change in the remuneration model, in which the operators do not compete for passengers because the revenue of the system that comes from collected fares is distributed within the transport operators based on the number of kilometers logged.
- The creation of a modernization trust fund, which promoted the transport operator's transformation through the training staff programs, fleet modernization, and technology acquisition.

Thanks to its successful transformation of its public transportation system, León was given the Sustainable Transport Award granted by ITDP (Institute for Transportation and Development Policy) in 2011.

## 03 Benchmark Matrices

This section presents a set of benchmark matrixes that help summarize the public transport characteristics, the contracts' main clauses and the roles and responsibilities of the authorities and operators.

### 3.1. Transport Overview

Regarding the transport overview, each case has been analyzed taking into account the city's population, density and the transport systems in operation. Each case study includes daily trips made in the bus system(s) and bus market share over total daily trips. Finally, certain characteristics of bus operation are included such as service hours and support services. A broader explanation of each category is provided below:

- **Population and density:** The city's population and density provides a general understanding of the required capacity and the complexity of the transport system.
- **Transport systems:** In this section, all the transport systems in operation are listed. It is important to note that an organized bus system refers to a system where there are contracts or explicit conditions of operation for each bus company, while unregulated bus systems refer to the existence of traditional owner-operator models. The field *Other formal services* refers to less important transport systems that cover a smaller share of daily trips.
- **Daily trips:** Number of average daily trips, based on annual demand and equivalent days in a year. This category shows how important the bus systems trips are for the city if compared to public transport trips and total trips.
- **Service availability:** Refers to the days per week and the hours per day the systems operate.
- **Support services:** This category indicates if support services (AFC and Fleet Management systems) are implemented in the bus systems.

Table 18 shows the public transport overview of the five cities.

**TABLE 18. PUBLIC TRANSPORT OVERVIEW**

Indicator	Units	London	Bogota	Mexico City	Stockholm	Uberlandia
Country		United Kingdom	Colombia	Mexico	Sweden	Brazil
Population	M people	8.5	7.8	20.0	2.2	0.7
Density	People/km2	5,432	13,500	2,561	340	2,681
Transport systems						
BRT system		-	?	?	-	?
Organized Bus system		?	?	?	?	?
Unregulated Bus system		-	?	?		-
Heavy Rail		?	-	?	?	-
Light Rail		?	-	?	?	-

Indicator	Units	London	Bogota	Mexico City	Stockholm	Uberlandia
Public bicycles		?	?	?	?	-
Other formal		River bus service and Cable car	-	-	Vessel, Special transport for disabled people	Special transport for disabled people
Daily trips in public transport	Million	9.5	5.6	14.5	2.78	0.2
Daily trips in BRT and bus systems	Million	4.1	3.5	9.7	1.1	
Share of BRT and bus trips over total trips	%	43%	62%	67%	40%	33%
Service availability						
BRT system	Days x Hours	-	7 x 17	7 x 18.5	-	7 x 17

Indicator	Units	London	Bogota	Mexico City	Stockholm	Uberlandia
<b>Organized Bus system</b>	Days x Hours	7 x 24	7 x 17 Certain routes 7 x 24	7 x 18 Night routes 7 x 5	7 x 20	7 x 17
<b>Integrated Fare Collection</b>		?	?	?	?	?
<b>Systems with SmartCard</b>		All	All	BRT, light and heavy train	All	All (Only for certain types of user)
<b>Fleet Management System</b>		?	?	?	?	?

## 3.2. Contract Characteristics

The second matrix refers to the main contract characteristics of the concession contracts, which include contract type, scheme for allocation (routes or areas), length, remuneration model and incentive clauses. In addition, an assessment is performed to determine whether the contract clauses are strong or not regarding service level standards. This comparison highlights the best practices in each city regarding the effectiveness of the contractual conditions. Finally, an evaluation of the authority's monitoring is included. The categories taken into account are the following:

- **How are contracts allocated?** This question will help to determine whether competitive tendering, a negotiation or an authorization to operate takes place.
- **Allocation:** Defines whether concession contracts are assigned by route or by areas.
- **Type of contract:** Defines whether gross-cost, net-cost, mixed, or gross-cost contracts with quality incentives are used.
- **Duration:** The duration of each concession contract.
- **Quality clauses:** A set of quality clauses categories is listed. The categories include reliability, vehicle quality, driver quality, engineering quality, customer satisfaction and environmental requirements. For each category, an assessment is performed to determine whether the contract has a high, medium or low strength in the definition of these clauses. This is a qualitative analysis based on the quality indicators that are defined in the concession contracts of the five case studies.
- **Remuneration:** Defines the remuneration for each city, stating whether payments to private companies are calculated based on km logged, boarded passengers or a mix of both. The remuneration model is documented separately for the BRT corridors and the organized bus system.
- **Incentives and penalties:** It defines the upper bound of incentives and the lower bound of penalties over operator's base remuneration.
- **Assessment of Authority monitoring:** Due to the importance of contract clause enforcement, a set of issues is addressed to determine the authority's strength. Questions to be addressed in this section include whether the authority has a strong technical team, has the IT tools available for monitoring? and if information is available for contract enforcement?

Table 19 shows the concessions contract characteristics in each city.

**TABLE 19. CONTRACTS CHARACTERISTICS AND CONTRACTS / PERMITS ALLOCATION PROCESS**

Indicator	London	Bogota	Mexico City	Stockholm	Uberlandia
<b>How are contracts allocated?</b>	Competitive tendering	Competitive tendering	Government assignation	Competitive tendering	Competitive tendering
<b>Type of allocation</b>	By route	By area	By corridor	By area	By area
<b>Type of contracts</b>	Gross cost with quality incentives	Mixed gross cost and net cost	Gross contract per bus kilometer	Gross cost with high quality incentives	Net cost
<b>Duration of concessions</b>					
<b>BRT system</b>	-	15 yrs or 850,000 kms (whichever occurs first)	10 yrs	-	10 yrs
<b>Organized bus system</b>	5 yrs	24 yrs	10 yrs	8 - 10 yrs	10 yrs

Indicator	London	Bogota	Mexico City	Stockholm	Uberlandia
Assessment of strength of Quality Clauses					
Reliability	High	Medium	High	Medium	Medium
Vehicle quality	High	Medium	Medium	High	Medium
Driver quality	High	Low	Medium	High	Medium
Engineering quality	High	Medium	Medium	High	Medium
Customer satisfaction	High	Low	Medium	High	Low
Safety	High	Medium	Medium	High	Medium
Environment	Medium	Medium	Medium	Medium	Medium
Base remuneration					

Indicator	London	Bogota	Mexico City	Stockholm	Uberlandia
<b>BRT system</b>	-	Phases I and II: kms logged, passenger boarded (indirect) Phase III: kms logged	kms logged and demand (for some contracts)	-	kms logged and costs per km
<b>Organized bus system</b>	Fixed with discounts for kms not operated	kms logged, passenger boarded	kms logged and demand (for some contracts)	kms logged, boarded passengers	kms logged
<b>Is it impacted by QA incentives or penalties?</b>	Yes	Yes	Yes	Yes	Yes
<b>Incentives and penalties</b>					
<b>Incentives</b>	Up to +15% of base remuneration	Up to the funds available from penalties in a given month	As high as the remainder of the system revenue	25% - 100% remuneration	-

Indicator	London	Bogota	Mexico City	Stockholm	Uberlandia
<b>Penalties</b>	As low as -10% of base remuneration	As low as -3% of base remuneration	Fixed penalty depending on the gravity and recurrence	Information not available	Daily fine until fixed, without limit
<b>Assessment of Authority monitoring</b>					
<b>Is there a strong technical team?</b>	Yes	Yes	Yes	Yes	Information not available
<b>Are there IT tools available for monitoring?</b>	Yes	Yes	Yes	Yes	Yes
<b>Is the information available for contract enforcement?</b>	Yes	Partial - there is still room for improvement	Yes	Yes	Information not available

### 3.3. RACI Matrix

- A RACI matrix is built to summarize the main duties regarding system operation and implementation. For each task it is determined whether the authority or the operator is: R- Responsible, A- Accountable, C- Consulted or I- Informed. The following fourteen duties were analyzed:
- **Transport Strategy Definition:** It is the task of defining the Transport Strategy, which is a global plan on public transport with medium and long-term goals. It may be a master plan, a mobility plan, or a transport guidebook.
- **Regulation & Policies:** It is the task of building the regulatory framework for public transport and concession contracts.
- **Infrastructure Construction & Maintenance:** It is the task of building and maintaining the infrastructure required for BRT and bus operation. The infrastructure elements include bus stations, bus stops, roads, depots and traffic signaling.
- **Route Planning Definition:** The route planning category lists tasks regarding the definition of path and schedule (frequency and hours), as well as, the allocation of drivers and vehicles.
- **Tendering Process:** It covers all the tasks and stages of the process for operator's evaluation and concession contracts allocation.
- **Contracts:** Once a tender has been granted, several activities are needed for contract management. These tasks include the contract drafting, its daily monitoring and audit, and the calculation of incentives, penalties and base remuneration.
- **Fleet provision:** Includes tasks related to fleet provision. In some cities, the bus operators offer most of the fleet. Nevertheless, the city may purchase or finance part of the fleet in order to promote the use of buses with cleaner technologies or with specific technical requirements.
- **Operation:** Includes maintenance and operation of the buses.
- **Tariff Policy Definition:** Activities regarding user and technical fare definition.

Table 20 shows the RACI Matrix where **R** is Responsible, **A** is Accountable, **C** is Consulted and **I** is Informed.

TABLE 20. RACI MATRIX

Indicator	London		Bogota		Mexico City		Stockholm		Uberlandia	
	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator
Transport strategy definition	R	-	R	-	R	-	R	-	R	-
Regulation & policies definition	R	I	R	I	R	I	R	I	R	I
Infrastructure construction										
Bus stations, stops	R	I	R	I	R	I	R	I	R	I
Streets	R	I	R	I	R	I	R	I	R	I
Depots (Patios)	R	I		R	R/A	I/R	R	I	A	R
Signaling (including bus priority)	R	I	R	I	R	I	R	I	R	I

Indicator	London		Bogota		Mexico City		Stockholm		Uberlandia	
	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator
Infrastructure Maintenance										
Bus stations, stops	R	I	R	I	R	I	A	R	R	I
Streets	R	I	R	I	R	I	R	I	R	I
Depots	R	I		R	R/A	I/R	A	R	A	R
Signaling (including bus priority)	R	I	R	I	R	I	R	I	R	I
Route planning definition										
Route design	R	I	R	I	R	I	A	R	R	I
Schedule - Frequency	R	I	R	I	R	I	A	R	R	I

Indicator	London		Bogota		Mexico City		Stockholm		Uberlandia	
	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator
Schedule - Operation hours	R	I	R	I	R	I	A	R	R	I
Allocation of drivers and fleet	A	R	A	R	A	R	A	R	A	R
Tendering process										
Full process management	R	I	R	I	R	I	R	I	R	I
Proposal presentation	A	R	A	R	A	R	A	R	A	R
Contracts										
Drafting	R	I	R	I	R	I	R	I	R	I

Indicator	London		Bogota		Mexico City		Stockholm		Uberlandia	
	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator
Monitoring and Audit	R	C	R	C	R	I	R	I	R	I
Calculation of incentives and penalties	R	I	R	I	R	I	R	I	R	I
Calculation of operators remuneration	R	I	R	I	R	I	R	I	R	I
Fleet provision										
Main services	I	R	I	R	A	R	A	R	A	R
Other services (less than 10% of fleet)	R	I	I	R	A	R	A	R	A	R
Operation										

Indicator	London		Bogota		Mexico City		Stockholm		Uberlandia	
	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator
BRT and Feeders	-	-	A	R	A	R	A	R	A	R
Organized bus system	A	R	A	R	A	R	A	R	A	R
Unregulated bus system	-	-	-	R	A	R	-	-	-	-
Tariff policy definition	R	I	R	I	R	I	R	I	R	I
User fare definition	R	I	R	I	R	I	R	-	R	C
Revenue control	R	I	R	I	R	-	R	-	I	R
Creation of Trust Fund (or account)	R	-	R	-	R	-	R	-	A	R
Support Services provision										

Indicator	London		Bogota		Mexico City		Stockholm		Uberlandia	
	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator	Authority	Operator
Fare Collection	R	I	A	R*	A	R*	A	R*	A	R
Control System	R	C	A	R*	A	R*	A	R*	A	R
User Information	R	I	A	R*	A	R*	A	R*	-	R
Marketing	R	I	R	C	A	R	A	R	A	R

\*Separate Concession

## 04 Needs of Stakeholders

To improve the quality of the service, it seems important to review the model of engagement with the private operators. The following figure presents the quality cycle described in the UNE-EN 13816 Certification of Public Transport Service, which provides certain directives to public transport operators in order to establish quality of service policies. UNE-EN 13816 identifies the three main service-providing actors.

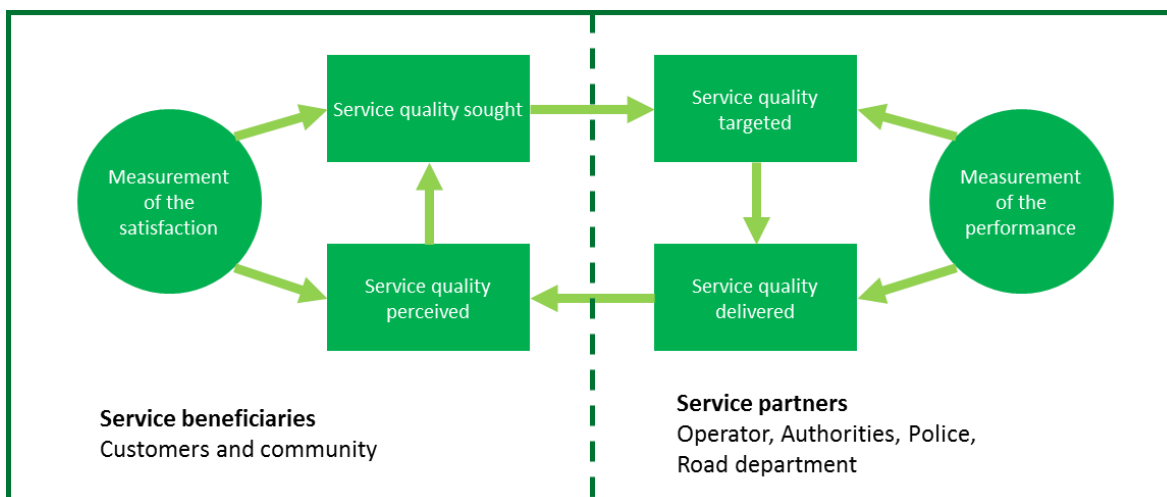


FIGURE 36. SERVICE QUALITY CYCLE  
SOURCE: UNE-EN 13816

The quality cycle examines - from different points of view - the service quality; it is a powerful methodology to improve it continuously. It takes into account the consumer's expectations and perceptions as important inputs for the service design, as well as the service provider's perspectives to procure the service expected by the customer. The cycle considers that the service provider can always improve task to achieve the proper service quality. It is composed of measurements for the following aspects:

**Service quality sought** is the level of quality that is, explicitly or implicitly, required by the customer.

**Service quality targeted** is the level of quality that is aimed to be provided to the customers. It is based on the service quality sought, external variables, budgetary and technical constraints and the competitors' own performance. The service provider has to define specific goals in order to strive for the service sought by the customers.

**Service quality delivered** is the level of quality achieved on a day-to-day basis. It is measured with the use of statistical tools to evaluate compliance with certain performance standards. Its comparison

with the targeted quality allows to estimate the efficiency of the service providers in achieving their targets.

**Service quality perceived** is the personal experience that the customer has with the service. It includes the associated services, the information received about the service and their personal environment. The difference between quality delivered and quality perceived lies in the customer's perception of the service delivered and his/her own experience. Moreover, its comparison with the quality sought measures the customer's satisfaction with the service.

According to the service cycle, it is possible to divide the service quality sought between the user's and authorities' needs. The service quality targeted and delivered should be determined by the operators' and authorities' needs and capabilities. Finally, the identification of the users' responsibilities should determine the service quality sought. With this in mind, the needs and responsibilities of each actor make it possible to dimension the entire picture and to define the service specifications for all the stakeholders.

Defining appropriate indicators and measuring them periodically can be a powerful way to identify service quality gaps, assign responsibilities, set clear and achievable expectations and define an improvement path.

## 4.1 User Needs

The users' needs are the main drivers of the policies of a city. In the case of public transport, there are needs that all the users have[1]. There may be core needs that define the main aspects of the service, or additional ones that may be specific to some users or may not be as relevant as the core needs. The following needs are typical of public transport users:

- **Reduced journey time:** as a city develops, citizens usually have tight schedules that must be strictly met. Additionally, the growth of a city may increase congestion, tend to worsen traffic and increase the journey times of users. This situation makes them worry more about travel times and the need to keep their schedules on track.
- **Shorter waiting times:** the time spent by users waiting for access to a transport mode is usually perceived as wasted time. As they are less willing to spend time waiting, it can cause discomfort to them.
- **Low vehicle occupancy:** a high occupancy of the vehicles in rush hours may cause discomfort to the users. Although the peak levels of occupancy may have been defined differently between cities or between public transport systems, it has been widely determined that every public transport system should not exceed an occupancy of 6 standing passengers per square meter during peak hours.
- **Cleanliness:** the vehicles and installations of the public transport system must be clean and well maintained. If the users perceive that the system has been abandoned or deteriorated, they are less likely to be attracted to use it and take care of its facilities.
- **Comfort:** the comfort of the journey is related to the cleanliness and vehicle occupancy, but it is also related to the smoothness of the journey, which depends on the driver's driving skills, training and kindness; it is also affected by the condition of the roads, the mechanical conditions of the vehicle, their temperature, seats, bars and floor conditions.

- **Better interaction with personnel and drivers:** depending on the type of service and level of interaction between users and personnel, users might consider the behavior of the personnel to be important. For example, if the user has to interact with a driver or a ticket office person, their behavior is considered important for the overall experience of the user.
- **High reliability:** as users are not willing to waste time, they need a reliable service that always complies with its schedules and guarantees that the service offered is equal to the service expected.
- **Safety:** users should be guaranteed that the service is safe, and that the risk of accidents or injuries caused by irregularities in the service is reduced to a minimum. Also, the service should evidence that any external danger is being avoided.
- **Access to an integrated information service:** users need information about the services constantly. Information before the trip may be needed to select a proper transport mode, such as information on arrival times, available stops, estimated time of arrival, optimal route, etc. Also, during the trip, users may need to be informed about the next stops of the service, connections with other services, abnormal events, etc. The access to audible information is specially needed for users with visual impairments.
- **Easily accessible bus stops:** the stops or stations of the service should be close to the origin and destination of the users' journeys. Users should be able to reach the service easily without walking long distances or requiring a significant effort. Accessibility is a priority need for users with physical disabilities and the elderly.
- **Easily accessible ticket points of sale:** when required, points of sale should be easily available to users, as they may become an important barrier for the service in case these are not accessible for all kinds of users.
- **Higher seat availability:** some users need access to a seat. Several aspects of the service like the type of vehicles, usage rules, or crowdedness determine the overall probability of getting a seat for each kind of user.
- **Low on-board noise:** this aspect could play a role in the overall comfort of the service. Excessive noise during travel may be uncomfortable for some users.
- **Low travel costs:** users are only willing to spend a certain amount of their income in public transport. This is of special importance to the most vulnerable segments of users, which may need additional support to access public transport.

User satisfaction with regards to public transport is determined by meeting the user's needs and expectations with the service quality perceived. This is because their satisfaction is considered an overall measurement of the fulfillment of their needs. However, user satisfaction is a very relative measurement of their needs, as there are various internal and external variables that may influence user satisfaction and needs [2]. These variables allow for the definition of segments of users with different priorities. The following are examples of segments that could be taken into account when considering user needs.

- **Age segment:** for instance, older people may prioritize their needs differently due to physical deterioration or differences in activities and behavior of younger people.

- **Access to private transport:** some users might also have access to private transport like their own car and it may influence their decision to choose private transport rather than public transport. Hence, the segment of users with access to private transport would use public transport only when it meets the needs that private transport doesn't.
- **Location within a city:** users that typically have longer distance journeys may prioritize the aspects that mitigate their overall transport time or that increase their level of comfort.
- **Previous negative experiences:** users that have previously experienced specific negative situations with the public transport service would pay more attention to the component where the negative experience originated. For instance, if a user has previously experienced overcrowdings of the vehicles, the impact in comfort will lead him to prioritize this aspect over others.
- **Social vulnerability:** segments that are affected by social vulnerabilities need service aspects that reduce them. For instance, if a user suffers from safety issues, he will prioritize the need for a public service that guarantees his safety. If a user has an income lower than acceptable levels, he may need access to special fares or subsidies.
- **People with disabilities:** easy access to public transport allows them to have easier access to the services of the city.
- **Inherent service expectations:** if the service quality targeted for a service is better than that of other services the user has experienced, the expectations of the service will increase and their needs will become more demanding. For instance, if a city formalizes its public transport service, users will demand better service quality compared to the previous services.

The variety of user segments is an important variable to take into account when designing a public transport service. The authority has to determine the importance of each user's needs and how user satisfaction is maximized. The policies that rule the transport service may become a balance between the sustainability of the system and a maximization of overall user satisfaction.

## 4.2 Operator Needs

As private companies, operators usually seek the same general objectives as any private company under the control of a public authority. It is useful to keep this in mind, as it may be necessary to align those objectives with the needs of the other actors. The needs below are applicable to any operating company:

- **Business stability:** operators usually need to face the lowest business risk at the expected return. For instance, in Bogota the operation contracts are valid for the entire lifespan of the bus fleet. This makes the operators less susceptible to face the risk of an incomplete amortization of the investments.
- **Clear regulatory framework:** operators seek a clear set of rules that allows them to mitigate potential operational risks.
- **Implementation with reduced external risk:** operators should be guaranteed that external implementation risks are mitigated so that the impact for the execution of the operation contract is minimized. Such external implementation risks include unexpected infrastructure implementation delays, or the impossibility from external parties to meet prerequisites for the contract.

- **Meeting operation requirements:** as long as compliance with the requirements is aligned with the operator's remuneration, the operator will be motivated to fulfill the requirements the authority defines.
- **Expected business return:** operators always expect a minimum return from their business. It is highly desirable that during the contract period the remuneration scheme is guaranteed as long as the operation requirements are met.
- **Resources optimization:** in order to attain higher profits, operators may seek the optimal usage of their resources given the operation requirements from the authority.
- **Reduce operation costs:** in order to improve their return and improve the performance of the business, operators may want to reduce their operational costs as much as possible, make budget cuts, or limit unnecessary expenses.
- **Extend the duration of their successful operation contracts:** as long as the operation contracts have been successful for the operators, they may want to extend their duration to take advantage of the investments already made to reduce new ones, and hence increase their profit.
- **Earn regional or international reputation for future business opportunities:** some operators seek to establish a regional reputation in order to compete for future businesses. The experience and reputation they gain with operation contracts could be used as a "cover letter" to expand their operation business.

### 4.3 Authority's Needs

The needs of a region are usually reflected by the authority needs, which represent the common interests of the region and its inhabitants. In the case of the transport authorities, the interest is solving users' transport needs and promoting the development of the city. The following needs are the response of the authority to fulfill the user needs [3]:

- **Provide a democratic and inclusive transport service:** the authority is a public entity that must favor the most democratic and inclusive policies. Hence, the authority needs to design a transport service that meets the needs of the majority of the population, including the user segments with disabilities and/or vulnerabilities.
- **Meet the needs of the users:** the public authority is interested in satisfying user needs, as it is the most influential actor in the transport service and represents the public needs of a region.
- **Define better transport services:** the authorities are interested in providing the most efficient, useful and accessible transport services. The operators may be interested in the usage of tools to obtain and analyze data to improve the services they are responsible to define.
- **Reduce traffic congestion:** the efficient use of the public space is an important goal of the authority. It is in charge of executing policies that promote the use of public transport and reduce the use of private modes. Since public transport modes carry a higher number of passengers per unit space than private modes, it is more efficient and environmentally friendly in terms of use of roads and public space.

- **Protect the environment against damaging practices:** the policies and solutions designed by the authority should be environmentally friendly. The current global effort to reduce greenhouse gas emissions and improve air quality in cities is a major concern for the public authorities of most cities, and much effort goes into investing on more efficient and cleaner vehicles or the use of cleaner energy sources.
- **Promote urban development to ensure a sustainable future:** the authority is also interested in the development of the region, hence the policies it implements tend towards the future development of the region in short-term and long-term perspectives.
- **Improve energy efficiency on public transport:** the authority seeks for an efficient usage of energy resources in order to reduce air pollution, avoid squandering of resources and/or help mitigate climate change.
- **Systematic business return control:** the authority may be interested in controlling the gross income of the system in order to guarantee a transparent distribution of the revenue among the actors.
- **Control and supervision of the operation:** as operation responsibilities are transferred to the operator, the authorities must be in constant control of the compliance with the operational requirements. These requirements are aligned with user and authority needs, but they usually are not with the operator's. For example, the compliance with maintenance routines may increase the operator's costs but it may also benefit user satisfaction. Thus, the control and supervision of the operators works as the most adequate balance to guarantee that the needs of the three main actors are fulfilled.

## 05 Concession Models

This section presents a walkthrough guide to design the conceptual outline of a concession model for an integrated transport system (ITS). The outline section addresses the main components required in contracts to guarantee that the objectives and expected outcomes set by the authority and the stakeholders' needs identified previously, are properly met.

The technical components addressed include allocation of the service contracts; duration of the concession contracts; remuneration of bus operators; design of quality indicators; definition of incentives and penalties; technical/technological requirements of the system; risk allocation between the authority and bus operators, and key elements of bus operation procurement processes.

### 5.1. Allocation of Service Contracts

Allocating the service contracts of an ITS should take into account the different type of services that could be offered in the system and the models that would work best for each of these services.

An ITS may be composed of trunk and feeder services, each with its own characteristics, operational features and infrastructure, as in the case of BRT systems. In some cases, such as Bogota or Medellin in Colombia, mixed services have been implemented using two-side-access buses. That means the same route can work both as a trunk and a feeder service in different route sections (See Figure 37).

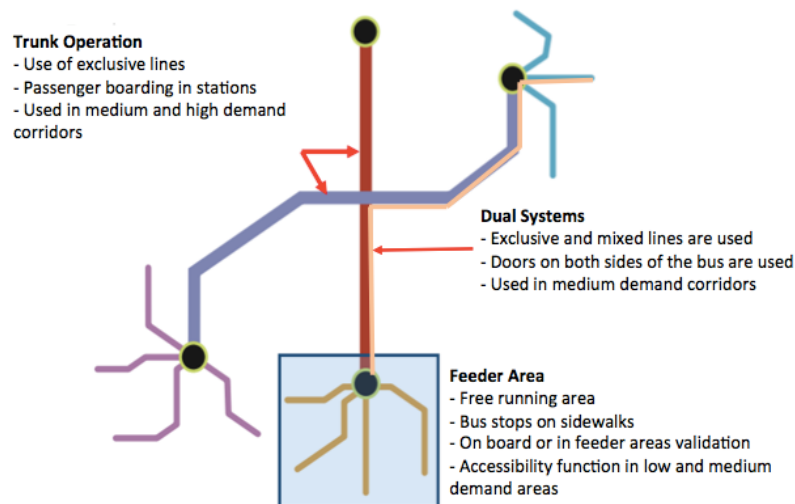


FIGURE 37. OPERATIONAL SCHEME FOR BRT MIXED SERVICES.

SOURCE: GSDPLUS BASED ON AN ILLUSTRATION [125] BY THE INSTITUTE FOR TRANSPORTATION AND DEVELOPMENT POLICY (ITDP).

Below are pictures of the BRT system in trunk, feeder and mixed services for Bogota and Medellin.

Feeder service	Trunk service
	

Source: Transmilenio - SITP, Bogota

Feeder service	
Trunk service	

**FIGURE 38. MIXED SERVICES: FEEDER + TRUNK SERVICES**  
SOURCE: METROPLUS, MEDELLIN

Four of the most common allocation models for service contracts are: allocation per route, by group of routes, by fleet batches, and by areas. The characteristics presented for each model are based on case studies and lessons learned from different cities with medium and high demand transit corridors with an ITS implementation. Under the models presented, operation is allocated to private companies; however, the authority keeps responsibility over the design, approval and monitoring of the service.

The operational model for the ITS should be selected taking into account characteristics of travel demand, the city's size and physical structure, service schedule and route design. Moreover, an initial assessment must be performed on the level of organization of the current private bus operators and the authority's institutional capacity. The choice of allocation model with an impact on the types of services that can be offered in the system and on the elements chosen for the concession contracts (e.g. contract duration, remuneration model, etc.)

Based on the initial diagnosis and the definition of the city's mobility objectives, the selected operation model for the ITS should have reasonable flexibility to allow changes in operation due to the dynamic nature of the economic activity and travel patterns. In addition, it should create an alignment of the expectations and objectives between the operator and the authority, and define the technical staff and tools required from the authority to fulfill its responsibilities regarding contract monitoring.

Each allocation model is further explained in the following sections.

### 5.1.1. By route

This kind of concession is based on an allocation per route, with the service being provided between a specific origin and destination. The operator must offer a fixed supply for every route that includes provision of vehicles and compliance with the path and schedule. Although concessionaires are awarded a single route, one operating company may operate various routes at the same time.

This type of model requires a transit authority with well-structured processes and staff that is able to carry the operational load of an individual route allocation. This model is also recommended for cities with consolidated urban spaces, to guarantee that minimum changes to the route design are required throughout the life of the concession. An example is the concession model in London's traditional bus system, where operation is allocated per route and with nearly 24% of the routes being tendered each year[5]. The number of routes tendered is adjusted so that the evaluation and allocation processes do not surpass the institutional and technical capabilities of the transit authority. This scheme is also used in inter-municipal or regional services, assigning route by route according to the population growth in each municipality or region.

#### Advantages:

- It provides flexibility to modify the service conditions (path, schedule, among others), when the operators' remuneration does not only depend on the number of paid passengers.
- It allows the user to associate the operator responsible for the service in every route. This direct relation allows the operator to identify and handle suggestions and complaints more easily.
- The transition from the unorganized operation scheme to a concession by route is easier than other concession models. The authorities can follow up a gradual implementation process, and properly control the impact of changes in a given area.
- This scheme allows a high participation of traditional operators in the new service, thus facilitating the contract negotiation process.

### Disadvantages:

- In cases where demand risk is assigned to the operator (i.e. the operator's payment depends on the total number of paid passengers), it is difficult to adjust the supply, since such adjustments may modify the demand of other routes in the area of influence. Therefore, a negotiation process and an agreement must be reached with the concessionaires that run routes in that influence area.
- The creation of new routes requires independent tenders that have to be preceded by evaluations and negotiations with the operators due to potential modifications of demand of other routes in the influence area that may belong to several different operators. These requirements imply a high administrative effort from the authority.
- Among the operational schemes, this is the least likely to generate economies of scale. The routes' origins and destinations are geographically widespread because operators tend to behave individually and there are difficulties to establish common garages and workshops, thus cost overruns may be generated.
- This model may result in on-street competition between operators on corridors where different routes overlap. This applies especially if remuneration to operators is based on the number of paid passengers.
- It makes it difficult to reduce or eliminate the empty mileage because it is often not possible for the operators to establish common garages and workshops at the routes' origins and destinations.

### 5.1.2. Group of routes

Under this model, a concessionaire is granted a group of routes with common or close origins and destinations. The motivation under such allocation is to promote operational efficiency due to conveniently locating garages, workshops and offices close to such origins and destinations. Mexico City is an example of this model, since allocation is performed by a group of routes that make up a whole feeder or trunk services.

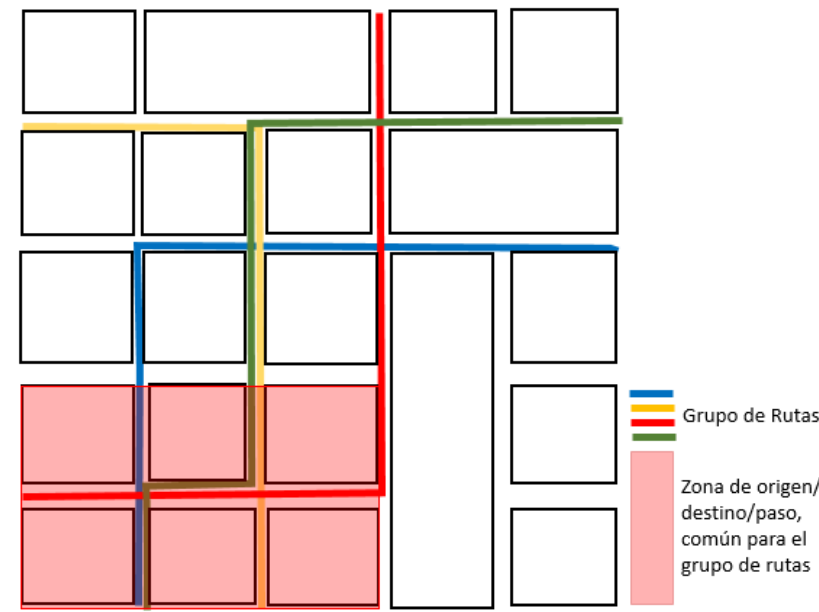


FIGURE 39. SCHEME FOR GROUP OF ROUTES.  
SOURCE: GSDPLUS

**Advantages:**

- This model diminishes the rivalries among routes because there are fewer operators. The bigger the number of routes in a given group, the fewer operators in the system. Thus, drivers won't try dangerous road behavior in order to maximize the number of transported passengers.
- It reduces the administrative, negotiation and auditing tasks that need to be performed by the authority, since there is a smaller number of concessionaires.
- The authority is able to interact more easily with concessionaires and keep a closer relation with them to monitor their performance.
- It makes changes easier in terms of paths and schedules, since the authority will need to maintain demand and operational costs for a whole group of routes and not on an individual route basis.

**Disadvantages:**

- It does not ensure that routes will not overlap, especially in corridors with high demand where several routes come together. The requirements in route design and optimization are still important.
- When the allocated routes are scattered throughout the city, economies of scale may not be achieved. The main reason is that the origins and destinations of the routes may be far from depots and dispatch points.
- If all the routes in a group cover one zone or area it may be difficult to change the service characteristics outside that zone. Such will be the case of feeder services, where changes may be required in route designs that imply longer journeys and where a new negotiation with operators may need to take place.
- The creation of new routes requires independent tenders that have to be preceded by evaluations and negotiations with the operators. These requirements imply a high administrative effort from the authority.

### 5.1.3. Service based on number of buses or distance covered

Under this model the transit authority defines the routes and their schedules, while the operator provides the fleet, the personnel, and complies with a set of performance and quality indicators set by the transit authority. Therefore, the routes served by operators may change in time as defined by the transit authority during the contract life, but the fleet or commercial kilometers will be the ones defined in the concession contracts. The BRT systems in Bogota (Colombia) and Uberlandia (Brazil) work with this allocation model.

Some of the cities that have adopted the fleet model are currently changing it to an area allocation model, due to the difficulties in monitoring and controlling groups of vehicles. Under this model, the operators have an incentive to increase the number of buses and the mileage per fleet in order to receive a higher income, thus generating an excess of supply. To address this issue, the authority has to perform a greater oversight of service programming and identify possible mismatches between demand and supply. Such control and monitoring can be done in a more efficient way in smaller cities or in specific components of the transport system (e.g. trunk system).

In this model, fleet allocation can be done either by vehicle type (full-size bus, minibus, etc.) or by the fleet required to provide the service in a given area of the city. This second alternative promotes a more efficient location of workshops and depots.

**Advantages:**

- It enables the integration and changes in the system since there is no competition between operators for passengers.
- In this model, the city administration is responsible for planning, programming, regulating and controlling the operation, therefore, there is greater oversight of the way the city's mobility objectives are met.
- There is a straightforward compensation method that is usually based on production and availability. Remuneration is generally based on the number of vehicles and logged kilometers.

**Disadvantages or requirements:**

- When there is more than one operator, it is more difficult to identify what operator is held accountable and who should be responsible to answer for queries and complaints made by users. Most users do not identify a specific vehicle (plate number) or driver when reporting a claim, so corrective actions cannot be properly targeted to the operator that offered a poor service.
- It requires a stronger public administration that can be responsible for the complete management of the system.
- The public transport authority requires a good capacity to do the operational programming, control and monitoring.
- The public transport authority bears demand risk so it will be responsible for any deficit or surplus on fare collection required to cover operational costs.

#### 5.1.4. Operation by areas

In this model an operator is responsible for service contracts in a predefined geographical area. Within the given zone a set of routes are designed, which can be later optimized by the operator or the Transit Authority to address changes in demand or to gain higher operational efficiency. Bogota's zonal service works under this model.

**Advantages:**

- As the city is dynamic, routes need to be adjusted periodically in terms of schedule, path and the creation of new services. This operational model gives higher flexibility to answer to the city's needs and to make new arrangements with the concessionaire.
- Under this model, the city manager is accountable for planning, regulating and controlling all the services.
- The model recognizes the area's needs (demand behavior, infrastructure conditions, etc.) and allows for the generation of conditions that guarantee the business balance to the system and to each area operator.
- This model makes the transport system integration easier since the operator will make an integral management of the area, taking into account features like capacity, path and infrastructure availability.
- This model of organization reduces competitiveness in the areas since it usually selects only one operator. Thus, competition between routes in a given area is reduced.
- It allows users to interact with the operators directly in a one on one basis, or through the public transport authority.
- In some cases, the route operational programming is done by the concessionaire and before being implemented it is revised by the public transport authority in case adjustments are needed. The rules for programming are specified in the contract and they must include quality standards.

- The concessionaire can identify changes needed and suggest adjustments over programming, which must be approved by the authority. Shared management over demand of the area is created.
- There are less management and control tasks for the public transport authority because the efforts related to planning, programming and monitoring of the demand, are reduced. The authority focuses on control tasks and follow-up of quality levels.
- The quality criteria control is done by the public transport authority.

#### **Disadvantages:**

- It requires a transformation towards a consolidated transport company business structure, which can be traumatic for traditional operators and can result in a delay in the implementation process.
- There are incentives to reduce services in routes with captive users.

### **5.1.5. Criteria to compare the offer of allocation models**

All the operational models presented will allow for adequate service contracts although each has differences regarding the type of incentives created, the institutional capacity required from the authority and how risk is allocated between the parties.

In a trunk-feeder BRT system there can be different types of services and each of them can have a specific allocation model. Regarding trunk services, the allocation model should provide enough flexibility in the short, medium and long term in order to adapt it to demand fluctuations. On the other hand, for feeder and dual services a higher involvement of the operators is recommended since they are the first contact point between the user and the public transport system. In addition, the operator has a better knowledge of the area and can help to reduce demand risk.

When selecting the allocation model of an ITS, it is necessary to assess:

#### **Transport authority intervention level**

Each allocation model implies a certain level of intervention or commitments from the responsible entity, regarding planning, programming and operation management. In addition, each model has different requirements of resources such as staffing, technologies and budget in order to comply with the assigned responsibilities.

Therefore, the ease of management each model implies is proportional to three elements: the roles and responsibilities assigned to the transport authority, the demand and the number of operators.

#### **Flexibility in change of routes (supply adjustment)**

The concession model should be flexible so that the authority is able to modify the services (route, programming, typology and fleet dimensioning) and answer to changes in the time and spatial distribution of demand. This feature is especially relevant in Latin America, where there are constant urban expansion and consolidation processes taking place in the metropolitan areas.

In this context, if fewer concessionaires are involved in the ITS operation (without reaching a monopoly scenario), a negotiation process to modify contract terms will be easier and less legal changes will be required.

## **Economies of scale**

This is related to the economic efficiency of the allocation of operation contracts regarding the use of the resources directly associated with the operation (equipment maintenance, depots and workshops, regulation systems and fleet control, etc.).

It is important to give operators the possibility to reach economies of scale in service delivery, which will allow them to achieve lower costs and user fares. An operator that only runs one route has fewer possibilities to get cost reductions when buying supplies or trying to keep inventories to minimize costs. On the other hand, operators that have more routes -meaning more buses-, have better buses and maintenance strategies.

Nevertheless, a detailed analysis should be performed to identify elements that may generate diseconomies of scale when operators have a very large fleet. For example, depots with over 400 vehicles will most likely generate longer traveling and unnecessary empty mileage. Since there are fewer depots that concentrate more vehicles, it is mostly likely that buses from different routes will have to travel longer distances in order to start or end the actual journey.

It is necessary to keep in mind that operators that are too big may have inefficiencies in their processes or might outsource part of their services to balance their responsibilities. Therefore, it is not necessarily true that an operator with a large number of services assigned has the ability to take advantage of the economies of scale they have access to. This will depend on the specific responsibilities assigned to the operator regarding elements such as planning, programming and control.

## **Engagement of the authority in the operation of the system**

It specifically refers to the responsibilities of the public transport authority in the transport system operation. For this matter, each stakeholder interacting with the transport system should meet the responsibilities that better fit their knowledge and experience. Therefore, the authority's efforts should focus on regulation, quality control and audit of services, while the operator should be accountable for programming the operation according to the parameters and indicators established by the public transport authority.

The distribution of responsibilities differs between countries. For example, trunk operation schemes in Latin American systems hold the authority responsible for service programming, while in feeder services (e.g. SITP in Bogota), programming is done by the operator and approved by the authority.

## **Integration with other transport systems**

It should promote the integration between different transport systems in the city.

## **Change from the current to the suggested transport system**

The model should allow a smooth migration from the current transport system to the new system. An assessment should be performed on how easy it would be to modify the operation, infrastructure, fare collection and fare integration features of the system.

## 5.2. Contract Duration

The best practices on public transport concessions recommend a contract period between 7 and 12 years, based on the following:

- i. It is a reasonable period that allows the authority to improve the contract clauses between successive tendering processes. Longer contract durations will hinder the possibility to include new content to better align the authority and operator's objectives.
- ii. **It encourages competition.** Since the concessionaire will face competition on a more frequent basis in tendering processes, incentives will be created for it to improve performance and target better quality standards. Long duration contracts can lead to market foreclosure, thus diminishing the benefits of competitive pressure [6].

London Public Transport System is an example of the implementation of short contract durations, since the initial concession is granted for 5 years and after that, operators can be offered 2 year extensions if they had shown a good performance.

- iii. This period is aligned with the **useful life of the assets (vehicles)** that provide the service. To determine the useful life of the fleet, two elements have been considered. The first is the annual investment and operational cost of a bus. As a vehicle reaches 10 years of age, operational efficiency diminishes and failure rates and maintenance costs increase. Therefore, it is not desirable to have old units with higher operational costs and that do not offer improvements in technology (e.g. higher efficiency in fuel usage). The second element is the quality of the service offered to users. New vehicles offer better features, like an easy and faster access especially for the disabled, lower energy consumption, higher capacity, reduced air and noise pollution, more comfortable facilities, higher aesthetic appeal, etc.

General stages in the lifetime of a vehicle have been defined and depict how failure rate changes within these stages [7] [8].

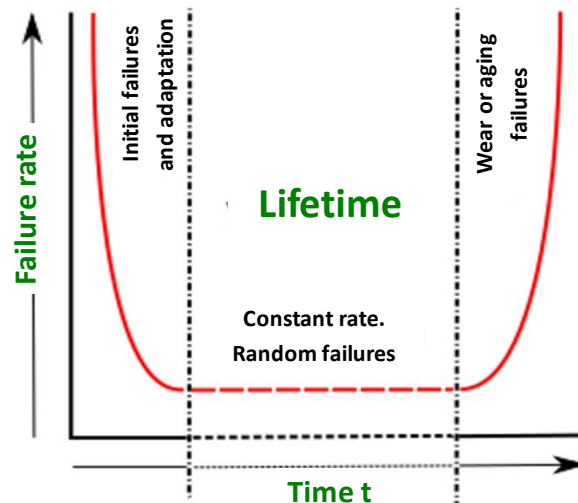


FIGURE 40. BATHTUB OR DAVIES CURVE: FAILURE RATE VS. TIME OF USE  
SOURCE: GSDPLUS BASED ON [7] [8]

The failure rate is proportional to the resources allocated by the operator for purposes of periodic, preventive and corrective maintenance; as the fleet becomes older, failure rates increase and so do maintenance costs. The typical lifetime of a vehicle in the operation of a public transport system is generally related to the following timeframes [9]:

First 1 to 5 years: in this period the fleet must be adapted to the specific conditions of the operation. Once a unit starts operation, it is a common step to perform adjustments, repairs and improvements in order to take the vehicle to the ideal level of operation and efficiency. This stage includes the initial investment required to purchase the vehicle and the investment required for the Adaptation Plan.<sup>24</sup> At the same time, in this period the vehicle's debt is partially paid, hence the operator's liquidity is constrained.

Between 6 to 10 years: in this period the bus owner has a higher profit margin, since the failure rate is reduced and there are lower maintenance costs. The operational costs just include standard maintenance, consumables (fuels, tires, among others) and, in some cases, special events (accidents, etc.).

10 to 12 years onwards: the maintenance costs increase and the reliability decreases, which results in lower operation efficiency. This stage is characterized by a rapidly increasing error rate due to the natural wear out of the equipment (bodywork, chassis, engine and other components). Additional investments, such as unit overhauls, will be required to achieve the proper operation of the fleet.

In certain BRT systems, the contract duration is determined by the maximum number of kilometers per bus or the average kilometers of the total fleet. In this regard, typical operated kilometers in Latin America are: 800,000 km (Megabús of Pereira and Transmilenio of Bogota); 1,000,000 km (Transantiago (diesel vehicles) of Santiago), and 1,800,000 km (Transantiago (hybrid vehicles) of Santiago).<sup>25</sup> In the case of Transmilenio,<sup>26</sup> the useful life of an articulated bus is set at one million kilometers per unit, which divided by the average value of kilometers/year per bus (between 80,000 and 100,000 km), results in an estimated useful life of 10 to 12 years.

If the contract duration is determined by the kilometers operated by the fleet, a clear and accessible methodology for kilometer measurement (odometer or high-precision GPS) should be defined before starting the operation. It must also be clear, how kilometers will be measured on the operational and reserve fleet, and how both quantities will be added or averaged.

Notwithstanding the above, the useful life of a vehicle can be extended by performing internal and external overhauls.<sup>27</sup> Nevertheless, this practice is not recommended since it requires the authority to perform more frequent and detailed audits to ensure the minimum maintenance, safety and quality of service conditions are achieved. In addition, it increases the risk of mechanical failures and the

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<sup>24</sup> Fleet adaptation: generally, the failures are caused by different reasons, such as defective vehicles, incorrect installations, design errors, ignorance of operations by the technicians or ignorance of appropriate procedures [16].

<sup>25</sup> <http://www.latercera.com/noticia/nacional/2016/02/680-669868-9-transantiago-el-28-de-la-flota-cumple-10-anos-y-amplian-fiscalizacion-por.shtml>

<sup>26</sup> Stages I and II initially considered 850,000 km as first limit of use for the fleet. However, the initial contracts were extended and the current maximum number of kilometers stands at 1,000,000 per vehicle.

<sup>27</sup> Overhaul: when applied to used vehicles it can be understood as a complete revamp or restoration of said vehicle, including external (engine, transmission, paint, accessories, lighting, among others) and internal (upholstery, dashboard, interior lighting, among others) operations. Adapted from [17].

frequency of corrective maintenance. Finally, from a cost-benefit perspective it is also not desirable to extend the useful life since older fleet contributes to higher level of emissions and has a negative impact over environmental conditions.

In several countries, the vehicle useful life has been extended in order to increase the duration of the concession contracts. Some examples include the Transmilenio (Bogota), which in Stage I extended the lifetime up to 1,240,000 km, Megabús (Pereira), which extended the distance up to the limit certified by the manufacturer (1,500,000 km), and Transantiago, which has extended its initial limit of one million kilometers per bus.

Table 21 shows a comparison of concession contracts duration in different cities, with most of the contracts having a 5 or 10-year term. London and Stockholm are the cities with the shortest contract periods. Coincidentally, these cities have well-established, long-standing public transport systems, and their experience has led them to prefer short-term contracts due to their benefits.

Bogota's concession contracts have the longest duration: 15 years for the BRT and 24 years for the organized bus system. Therefore, if the authority wants to change quality of service or technical requirements during the contract term, a negotiation process must take place with the operator. Changes in contract clauses are likely to imply a different set of responsibilities for the operator and an adjustment to operational costs.

**TABLE 21. CONTRACT DURATION IN DIFFERENT BRT AND TRADITIONAL TRANSPORT SYSTEMS**

City	Operation contracts period	
	Organized bus system	BRT system
León (Mexico)	15 years	---
Mexico City (Mexico)	10 years	10 years
Uberlandia (Brazil)	10 years	10 years
Stockholm (Sweden)	8-10 years	---
London (UK)	5 years	---
Bogota (Colombia)	24 years	15 years

The contract duration is also determined by the responsibilities, services and investments the operator must provide. As an example, in countries with limited resources, operators are requested to bear the costs of investments that should be made by the authority. Some of these key aspects that may modify contract duration are explained below.

#### **Operator investments/Investment amortization**

In the general framework of a bus operation concession contract, the private party takes part of the investment for the fleet and offers the transport service in return for a fee for an agreed period of time. During this period, the private operator will target to recover investments, operational costs and receive a profit margin.

The operator may be assigned additional responsibilities, in order to facilitate the transition from the previous owner-operator model to an organized system. The additional services and investments may include the construction of infrastructure (e.g. depots); the costs of scrapping the old fleet; the costs of vehicle overhauls; compensation payment to previous operators, among others.

The new responsibilities may require an extension of contract durations, in order to guarantee the return of investments. Therefore, the authority should be very careful in allocating responsibilities and in defining the type and amount of investments the operator must bear. Bogota's SITP is an example of long contract duration (24 years), where operators had to provide depots and cover the costs of the overhaul of the old units.

#### **Technological modifications (Euro rating, gas, electric, hybrid)**

The authority must assess whether the use of clean technologies will be promoted. A separate financial model should be developed to properly remunerate the fleet that contributes to the city's environmental goals.<sup>28</sup> Clean energy vehicles are more likely to have higher investments and operational costs, and a different useful life in several components.

#### **Asset use versatility**

In some cases, the concession contract duration is shorter than the useful life of the vehicle. This is likely to occur when the unit is allocated in a new tender within the same transport system, or where there is an alternate use for the bus. In any case, it is necessary to clearly understand the asset depreciation method from the beginning.

As a reference, the Bolivian transport system operates with a fleet that had already been used in Asia.

### **5.3. Remuneration**

The concession contracts of a public transport system should define the remuneration scheme, and incentives and penalties designed to guarantee the operator's performance and compliance with quality of service indicators. The operator's total revenue will be made up of:

- a. **The payment mechanism** for the operator, which may be a combination of remuneration per vehicle, number of passengers, kilometers logged, among others. The importance of each variable within remuneration will influence the strategies the operator will develop to maximize income and reduce costs.
- b. **The incentives** (reward, bonus) and **penalties** (economic penalties, fines), will be calculated according to their compliance with the service standards. This mechanism will be detailed in section 5.5.

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<sup>28</sup> Such is the case for the Bogota's Integrated Public Transit System Transformation Program which, as stated by the Climate Investment Funds (CIF): "In 2010, CIF partnered with the government of Colombia and the Inter-American Development Bank and offered \$40 million in CTF funding for this project, which will take place over seven years. The project's goal is to improve the quality of public transport in Bogota through the introduction and promotion of clean technology buses. Additionally, the project will support a number of system-wide improvements to the quality of service provided by the TPC(...)" [19] [18].

Three types of individual remuneration schemes are described below. Nevertheless, in practice, hybrid remuneration schemes based on these individual schemes are usually adopted.

### 5.3.1. Types of remuneration

#### 5.3.1.1. Remuneration by buses

A periodic (weekly, biweekly or monthly) remuneration is granted to the operator for each vehicle that is registered and operational in the transport system. The compensation per unit may vary according to vehicle type, size, technology and age. Hence, the contract must define a clear baseline for payment based on the aforementioned characteristics.

**Advantages:**

- It defines clear rules for the incorporation of a new fleet, if required.
- Remuneration by operating units allows the authority to offer incentives to promote the purchase of new vehicles with technology upgrades.
- The managing body is free to assign the vehicles to any route or line.
- The operator does not bear demand risk, so there is no incentive to compete for passengers in the market (on-street competition).

**Disadvantages:** (if considered as the sole remuneration scheme)

- The concession holder may try to create an excess supply, since the higher the number of vehicles the more revenue he/she will receive.
- The transit authority needs additional control, given that the operator will try to incorporate more fleet without considering any operational optimizations or mechanisms to increase demand.
- The operator would resist scheduling additional kilometers to those established in the contract.
- There is no incentive to control user fare evasion.
- Since the operator does not share demand risk, the authority must control compliance with mandatory stops or stops as requested by the users.

#### 5.3.1.2. Remuneration by kilometers

A periodic (weekly, biweekly or monthly) remuneration is granted to the operator based on the number of commercial kilometers logged on each type of vehicle. Each vehicle typology and propulsion technology has a different cost per kilometer covered, so the contract should define a clear methodology to determine both the number of kilometers and their unit price.

If the contract period is significantly long, a methodology should be defined to periodically update the cost of the most important supplies (fuel, oil, tires and labor costs, among others)<sup>29</sup>.

**Advantages:**

- It defines clear rules for the amount of kilometers and their unit price, which allows for a flexible negotiation if a change on supply is needed (kilometers covered).
- A model of payment by kilometers allows the authority to assign the vehicle to any route. This means that in a given day one unit can serve as many routes as necessary.

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<sup>29</sup> The contracts of Stages I and II of the trunk line component of Transmilenio include an adjustment to the cost basket every 3 to 5 years.

The operator does not bear demand risk, so there is no incentive to compete for passengers in the market (on-street competition).

**Disadvantages:** (if considered as the only remuneration scheme)

- The concession holder exerts pressure to create an excess supply, because a higher number of kilometers logged will increase the operator's income. This is undesirable since it increases the public transport system operational costs and creates a negative impact over congestion, as the size of the operational fleet will be above the one required to cover demand.
- The managing body must be careful when scheduling the kilometers of the entire fleet, in order to balance the use of the fleet provided by the different operators.
- The negotiation for the replacement of the fleet is more difficult as there are no incentives to the concession holder for the incorporation of a new fleet/technology with lower emissions.
- The transit authority needs additional control, given that the operator will try to increase the total number of kilometers logged without considering any operational optimizations or mechanisms to increase demand.
- The operator would show resistance to include additional vehicles to those defined in the contract (if so required).
- There is no incentive to control user's evasion of payment into the system.
- Since the operator does not share demand risk, the authority must control compliance with mandatory stops or stops as requested by the users.

### 5.3.1.3. Remuneration by passengers

A periodic (weekly, biweekly or monthly) remuneration is granted to the operator based on the number of paid passengers. Under this model, demand risk is totally or partially transferred to the operator. Therefore, it should be assessed whether the operator is capable of designing mechanisms to promote demand and controlling user's evasion of payment.

**Advantages:**

- Demand risk is either totally or partially transferred to the operator. Therefore, the company will try to improve service quality and user satisfaction. In addition, the operator will have incentives to help the authority identify needs in different areas as a way to increase demand.
- Possible increase in the operational efficiency by reducing the number of kilometers traveled, given that, the operator tries to maximize its income by adjusting supply to the demand. As the number of kilometers operated decrease, so do externalities like pollution, accident rate, and traffic, among others.

**Disadvantages** (if considered as the sole remuneration scheme)

- Possible rise of phenomena such as on-street competition, if routes from different concession holders overlap.
- Possible excess supply in profitable routes (with higher number of passengers) and deterioration of the service in areas where the demand is not attractive for the concession holder.
- Lack of incentives for the operator to increase fleet/kilometers covered, which can impact the service levels with higher occupation and lower frequencies.
- The negotiation for the replacement of the fleet is more difficult as there are no incentives to the concession holder for the incorporation of a new fleet/technology with lower emissions.

Based upon the description of the individual remuneration types, a set of recommendations for the remuneration models of trunk and feeder services are presented in the following sections.

#### 5.3.1.4. Payment mechanism for the trunk services

When users access the system through stations and no validation takes place on the vehicles, there are operational difficulties in appraising and identifying the demand of each route/vehicle, since payments are usually made at the stations' entrances and several routes can be taken at each station. In this case, it is recommended to assign remuneration schemes by vehicle and/or kilometer but not by the number of paid passengers. The income of the concession holders will depend solely on operational variables, as is the case of the different trunk stages of Transmilenio (Bogota, Colombia) and Integrated Bus System (Uberlandia, Brazil). These models provide flexibility to adapt supply to demand, and to adopt new technologies and vehicles type.

This scheme requires a complete strategic planning exercise before operation starts, to determine the required fleet, the schedules and the average kilometers for every route. The additional costs derived from an oversized fleet and kilometers operated in excess, will have to be covered by the municipality.

Since the operator's revenue is calculated by a set of operational variables, the authority must have the staff and tools to perform planning and control operation. Such tools imply the required technology to audit each stage of operation and easily process data

#### 5.3.1.5. Payment mechanism for the feeder services

The feeder services remuneration, unlike trunk operation, should depend on the number of paid passengers. In this type of service, the operator usually has a direct impact on demand, since the company can define strategies or perform daily control of the routes to improve quality of service and promote boarding. However, it is recommended to develop a payment scheme that combines passengers, vehicle and kilometers to avoid the undesirable consequences of on-street competition.

The weight of each component of revenue shall be based on the financial model. The weight of the demand variable should not be as high as to create financial risk for the concession holders if the number of paid passengers is significantly below the initial estimations.

The following is a summary of lessons learned from feeder services in Stage 1 of Transmilenio:

- Validation of smart cards can be performed in the bus; however, each of these alternatives has implications over evasion control and operational efficiency. Validation inside the bus implies the bus driver should control payment at every bus stop. In this scenario, boarding times are longer since users must "tap on" the smart card on the validating machine as they access the vehicle.
- Validation can also be done at integration paid zones (as it is for Transantiago, the transit system of Santiago). This mechanism concentrates users and security staff in the same area, enhancing payment evasion control while transferring passengers from feeder to trunk services.
- The operator has no incentive to increase fleet or kilometers logged.

### 5.4. Quality Clauses

The contracts should define the quality clauses the operator must comply with and define a set of rules to ensure that the user's perception of the service is as close as possible to the expected quality. In this regard, the clauses shall consider the following recommendations:

- Every quality-related aspect must respond to the service quality principles and shall be based upon predefined policies established by the authority. For example, in Quito the main transport principles are accessibility, comfort and safety, whereas in Bogota, the principles are consistency, safety, comfort and environmental sustainability.
- Each parameter must be associated to clear indicators, with respect to a baseline and an expected outcome. Every indicator must be specific, measurable, timely and feasible.
- The responsible party, tools and frequency of measurement should be clearly defined from the beginning.
- The authority should define the staff and tools required to perform quality control.

Generally, the indicators are classified in the following categories: Quality, Productivity and Externalities. The first category of indicators measures the users' perception of service quality and is essential data for service improvement and future planning; the second category measures the efficiency and efficacy of the resources with respect to the service, and the last category includes the collateral effects of the operation.

#### 5.4.1. Quality indicators

**User satisfaction index:** it can be measured through surveys in order to capture perception of every component of the operation (service, infrastructure, bus conditions and driver's attitude, among others).

In Transantiago, user satisfaction measurements are performed for every operator on a quarterly basis. The results of surveys are always published, so users are able to identify the most and least qualified operators. This assessment is also used to calculate bonuses for the most qualified operators; the funds for these incentives come from the fines applied to other indicators. This has encouraged operators to invest in service improvement and target the areas where poorest performance was identified through the surveys.

**Questions, complaints, claims and suggestions management index:** this is related to how the operator handles questions, complaints, claims or suggestions raised by community. Most contracts include monitoring of these indicators to ensure that operators handle nonconformities.

#### 5.4.2. Productivity / Performance Indicators

The productivity or performance indicators measure the efficacy and efficiency of the services. The selected indicators must allow an objective and reliable measurement of the operation. In London, for example, the city has high-quality traffic control and management system, so some indicators can be measured with a higher accuracy and frequency than in other cities.

The following productivity/performance indicators are generally used in transport systems:

##### **Coverage indicator**

It measures compliance with the route path and schedule in a given zone or area. This indicator is usually implemented in contracts if the operation is allocated by areas or zones.

##### **Regularity indicator**

The regularity indicators measure the operator's ability to schedule, control and adjust services. It is mainly targeted to measure compliance with the scheduled service frequency.

In short-length trunk systems with usually no interferences in vehicle circulation, this measurement is performed at the route's start and endpoints, e.g. Megabús in Pereira. On the other hand, in systems that operate in highly congested areas with, inspections are performed in middle points in order to ensure the regularity of the service in every part of the route, e.g. Transmilenio in Bogota. In zonal services<sup>30</sup> of the Integrated Public Transport System (SITP, Bogota's Public Transport System, previously described in this study), the indicator excludes events of force majeure or those that are not attributable to the operators. Such events may be failures in traffic signals, vandalism, defects in the road infrastructure, among others.

#### **Punctuality/reliability indicator**

It measures compliance with the scheduled departure and stop times. This indicator is especially useful in systems where the infrastructure and traffic conditions are designed to achieve a higher reliability, such as the trunk components of a BRT system or systems with robust fleet management platforms. In services offered on preferential bus lanes next to mixed traffic or on the mixed traffic lanes, operation is more likely to be affected by external events like accidents, mechanical failures, among others.

The target values of this indicator should be revised frequently, since changes in the system design or in traffic conditions may affect what achievable outcomes can be. An example of this is the restriction to use private vehicles based on plate number (in Mexico "*Hoy No Circula*" or "*Pico y placa*" in other Latin American countries), which had a direct impact on operational speeds and on service reliability.

#### **Maintenance indicator**

It includes a review of the mechanical conditions and maintenance procedures of the fleet in operation.

### **5.4.3. Externalities indicators**

This group of indicators is used to measure how effective the mitigation of externalities (accident rate, pollution, noise, among others) generated by the operation of the transport system is.

#### **Safety/accident rate indicator**

It assesses the types and frequency of events risking the physical integrity of users, crew and third parties. It is recommended that the indicator weighs each type of event according to its severity (accidents, incidents or setbacks).

#### **Environmental management indicator (emissions and noise)**

It measures the level of emissions and/or noise generated by the vehicle. The institution responsible for this type of measurement should be properly identified.

Annex 2 includes a summary of the quality indicators used in the public transport systems in London, Santiago, Sao Paulo, Bogota and Medellin. For each indicator, the methodology used to calculate it is explained.

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<sup>30</sup> Zonal component: bus services of the SITP that cover areas where Transmilenio does not operate. It includes urban services that connect different zones of the city, complementary services that cover routes inside a specific zone, special services that transport users to and from peripheral areas where there is less demand or limited accessibility.

## 5.5. Incentives and Penalties

In transit operation agreements, incentives are strategic mechanisms for encouraging operating companies to reach certain levels of service that have been previously established by the authority. These are included in order to generate a high quality service contracts, operational cost reduction and operational efficiency maximization. In addition, the concession contract must contain penalties for the failure to fulfill service standards within previously defined parameters.

In different cities worldwide, the strategic use of incentives and penalties has persuaded operating companies to focus on the provision of the service and the mitigation of activity externalities. This is feasible if such tools are designed upon system needs and its specific requirements. These components drive operating companies to provide an efficient and good quality service, which, in turn, increases their revenue.

It is mandatory to take into account some features when considering incentives and penalties within operating agreements. These aspects are listed below:

- All the terms and conditions must be clearly specified from the beginning. Nevertheless, these can be modified in the course of the contract term if needed, depending on mobility conditions and requirements.
- It is very important to define the consequences of not achieving every proposed indicator since each one of these can have different encouraging or punishing methods.
- The transport authority must be in charge of the administrative management of measurement, auditing, payment and other contractual processes related to the application of penalties.
- Encouragement and discouragement fees must be clearly defined and established according to the level of importance given to the compliance or breach of contract conditions.

The design of these mechanisms for motivating the achievement of goals must be developed by the transport authority upon the operational cost structure in order to accurately define the pricing scheme for incentives and penalties. As an example, London's transit scheme sets the operating companies' payment depending on their performance and their level of compliance.

It is essential to guarantee that the incentive and penalty scheme does not cause economic instability to operating companies, since this could deteriorate the service and generate unnecessary administrative procedures to the transit authority.

Additionally, it is highly recommended to include safety and operational requirements in the contracts. These requirements must be mandatory and therefore, failure to comply with safety levels cannot be accepted. Incentives and penalties should not be used to evaluate compliance with safety standards. Instead, a breach in the safety clauses should imply the automatic cancellation of the contract and the banning of new transit operation agreements.

### 5.5.1. Incentives to promote a high quality service or operational efficiency

It may be convenient to incorporate an economic compensation for operating companies that achieve certain indicators, especially those related to user service quality perception. These satisfaction indexes are usually measured through surveys and by using the 'mystery consumer' method.

Two examples are the Transantiago system and the Transmilenio trunk component, where there are discouragement mechanisms for operating companies reaching certain levels of dissatisfaction. Bonuses are granted as an incentive to operating companies with the best scores in the customer satisfaction survey.

Additionally, another incentive for accomplishing quality indicators is a contract extension. This allows operators to generate more revenue by optimizing the assets they already own. Additionally, rigorous requirements for the provision of the service shall be imposed for any contract extension. For example, London and Stockholm concession schemes offer contract extensions between two and four years if high quality clauses are fully accomplished.

### **5.5.2. Penalties for low quality service or breach of agreement**

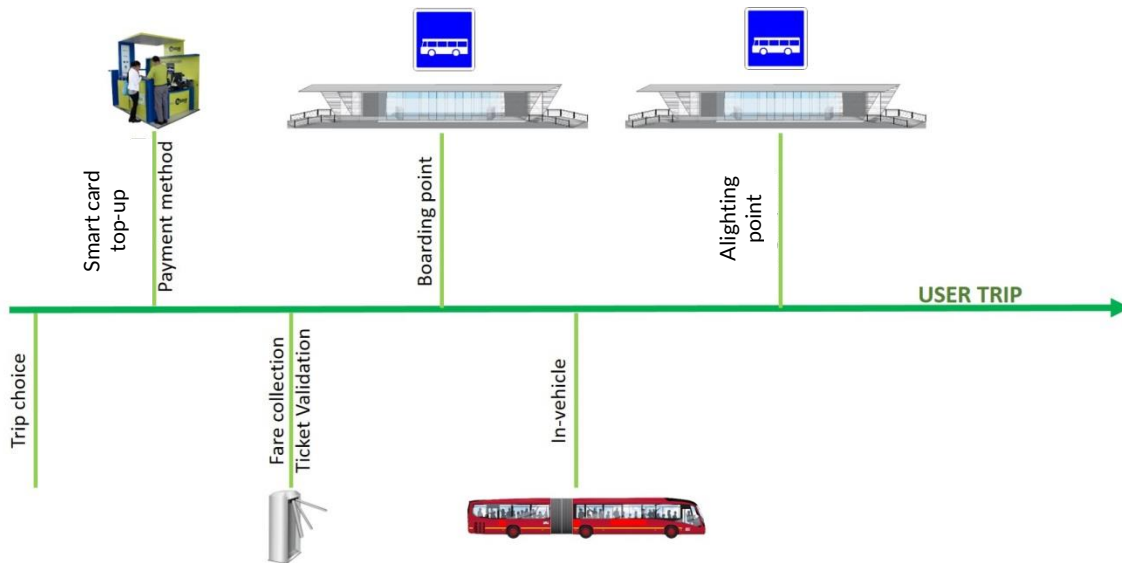
There are different penalties that can be applied to a poor performance of each indicator or clause breach, depending on the seriousness of the failure and its persistence through time. Therefore, there are different options such as disincentives or fines (including the cancellation of the contract) that may be used, depending on whether it is a sporadic or isolated situation or a recurring failure, the severity of the failure and/or how relevant the non-accomplished requirement is to the contract and transit performance.

Technological developments can be used to measure different quality, productivity and externality indicators, as well as to calculate the amount of incentives and penalties. These allow the system to achieve a better performance in customer service perception.

For a better control over compliance with indicators (e.g. coverage, headway reliability or punctuality), the transit authority can use specialized software and hardware for the programming and planning areas (e.g. GoalBus® [10], HASTUS [11]) and control (real-time fleet operation management) area (e.g. GoalDriver® [12], IVU.fleet [13]). In this way, it will be possible to compare the scheduled supply with the achieved supply in a more accurate manner.

### **5.5.3. Technical Requirements**

In this section, basic technical and technological requirements will be explained for an adequate implementation of an ITS within the different stages of a trip, which are described below.



**FIGURE 41 – BRT TRIP STAGES**  
SOURCE: GSDPLUS

#### 5.5.4. Trip choice

In this first stage, the user decides which among the available modes to use and which route will he/she take to reach his/her destination. For better decisions, it is appropriate to provide the user with as much information as possible through different media channels (e.g. internet, advertisements, social media, among others). An example of the use of advertisements includes distributing flyers every time a new route is implemented or is moved from the traditional bus system to the integrated systems.

In case of using static communication interfaces, these must be updated with each change made in the operation. On the other hand, if affordable, a dynamic interface can provide real-time information of the operation. However, it must be simultaneously structured and synchronized with the fleet information management system in order to allow a constant interaction and flow of information.

In this stage, user information must contain at least the following: schedules, route descriptions, paths stop points and payment information.

#### 5.5.5. Ticket purchase/smart card recharge

It is very important for the payment not to become a barrier to access the system. Hence, the top-up network should be reasonably and strategically distributed, which means it should be located within walking distances from stops and stations.

In the case of the Transmilenio Phases I and II, contactless card purchase and reloading could only be done at the ticket windows located at the entrance of the stations. Therefore, congestion and long queues constantly occurred and pedestrian circulation was usually reduced. In Phase III, a recharge network was implemented through small businesses. However, this network has been presenting problems, as the planned number of reloading points has not been completed and the established ones are insufficient for an adequate coverage. In addition, the business hours of these stores are not always the ones required, since many of them remain closed during peak hours. The insufficient size of top-up network is due to fact that it has higher costs for the concessionaire compared to other

channels. Therefore, the Intelligent Transport System concessionaire will target to comply with the minimum number of top-up points defined in the contract and offer alternative channels for top-up.

Based on this experience, it is highly recommended to provide ticket offices and a machine network with adequate locations and schedules that match the system's operation. An online reloading option should be considered as well.

#### 5.5.6. Payment point

The payment point varies depending on the operational component of the ITS accessed by the user. The trunk component needs to be a set of high-capacity corridors. Therefore, it is expected that dwell time at the system's stops or stations is as short as possible, thus requiring the validation process to be performed out of the vehicle. This is why installing validators at the entrances of stations (and not inside the bus) is suggested. This equipment sizing, number of units and specifications shall respond to the forecasted demand and particular conditions of payment evasion.

Regarding the feeder component, the recommendation is that the validator is installed inside the bus, therefore requiring that both the interior design and the space required for this element are considered within the vehicle's capacity.

In this case, the device should be linked to the fleet information management system for the provision of data (boarding records) and future adjustment to the planning process. In turn, it is important to establish clear interaction protocols among operating companies and the fare collector in order to define responsibilities regarding storage, maintenance, installing and uninstalling equipment, as well as the associated cost and operation times.

#### 5.5.7. Stop areas

Passenger boarding and alighting areas depend on the ITS component analyzed. In the case of the feeder component of a BRT system, the infrastructure consists of fully signposted bus stops next to the sidewalk, where the user should find basic information on schedules, routes at the stop point, and transit interchange. Moreover, it should provide a shelter against unfavorable weather conditions, as well as guaranteeing full accessibility.

On the other hand, the trunk component of a BRT system should pursue the reduction of dwell time in order to reduce overall travel times, thereby allowing user entrance and exit to be as fast as possible.<sup>31</sup> Additionally, the size and width of user circulation and waiting zones should be designed based on the forecasted demand, considering universal access and comfort criteria for the user (lights, shelter, cleanliness, maintenance, among others).

For terminals and hub stations, an additional area for operation regulation (stops made by the transport system vehicles in order to comply with programmed dispatch schedules), bus-waiting zones, service zones for staff, among others, should be included in order to make a better use of the available fleet and therefore, offer a more reliable service.

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<sup>31</sup> In this regard, it is essential to define the number and type of doors of the station and vehicle, as well as the access type (with steps or low-floor bus), and the communication interface between the vehicle and the station.

### 5.5.8. Vehicles

Vehicle characteristics must meet the needs of the system's technical specifications according to the expected demand and the part of the system it will serve (e.g. feeder, trunk or other). When establishing bus features, the following details must be taken into account:

- Door location.
- Required passenger capacity according to operational design.
- Mechanical conditions that may vary depending on the topography and geometry of the road network where the vehicle will operate.
- Equipment for universal access (elevators, ramps, kneeling buses).
- Engine technology. The worldwide market offers diverse technologies with different costs and environmental impacts. The chosen technology may vary depending on the environmental policies and the cost of the different materials and commodities within the region or country. In addition, technology must be able to function correctly in critical road conditions. As an example, the hybrid buses of Transmilenio cannot be used in some routes due to the topographic conditions.
- The chassis and vehicle body have to meet user comfort and safety needs.
- The responsibility of each stakeholder for the installation, maintenance, movement, replacement and storage of on-board equipment.
- The technical specification of on-board equipment like ticket validators; fleet information hardware; on-board consoles to provide information to drivers; GPS; user advertisements; speakers; vehicle doors' remote opening system; communication devices; emergency communication elements and other devices, must be clearly defined by the authority.

## 5.6. Risk Matrix

The main risks associated to a transit system are:

**Demand risk:** The economic effect produced by the variation in the total number of passengers in relation to the expected demand. The main causes of this risk are:

- Lower demand due to variations in economic and demographic variables used to calculate the demand evolution forecasts. This generates a smaller economic activity and thus a decrease in transit demand.
- Policies discouraging the usage of sustainable and eco-friendly transport modes. These policies, usually car-friendly, include new road construction, car taxes reduction, uncontrolled parking development, etc. Even wrongly designed traffic policies, such as an all-day "*Pico y Placa*" (a driving restriction policy based on the last digit of the license plate), can result in an increase in car purchase as a side effect.
- Competition with informal modes (bike taxis, shared taxis, etc.), which are not considered within the transit system planning, or have failed to be included.
- Competition with other (formal) transport modes that are not physically or fare integrated. As an example, the BRT demand in Quito, Ecuador, is expected to decrease by 20% due to the opening of a new metro line.

**Fare evasion risk:** Risk related to a decrease in fare income due to fraud in the payment system (due to technological failure or inappropriate subsidy management and control) or because users jump into the transit system without paying. Some causes related to this risk are:

- Establishing fare prices without considering the user's purchasing power.
- Lack of awareness of new operational payment methods by the user.
- Insufficient or difficult-to-reach payment locations, especially for smart cards.

- Lack of continuity in city programs oriented to improve social-behavior. Programs should be promoted between different administrations.
- Implementation of the transit system with no continuous promotion programs for developing a sense of belonging among users.
- Wrongly oriented subsidies that are not directly related to recipients.
- IT vulnerability of the smart card system.
- Some complicity of drivers as they allow passengers to access the system without paying.

**Operational risk:** The economic effect produced by the erroneous estimation of operation, maintenance, staff, and contingency costs, which can generate additional expenses for the provision of the service or cause financial instability. The main causes for this risk are:

- Unreliable financial model assumptions or inaccurate cost estimation.
- Changes made in technical, technological and financial model evaluation scenarios.
- Political decision-making going against transit system use.
- Damaged infrastructure, which can increase maintenance costs and accident rate.
- Wrongly located bus lots that generate unnecessary empty mileage.
- Unexpected acclimatization processes.
- Additional maintenance procedures due to mechanical failures found at overhauling.
- Damages caused by third parties (e.g. by protests or vandalism).

**Implementation risk:** The economic effect caused by the lack of readiness of the projected infrastructure, vehicles or other equipment and assets that are necessary for system functioning. The main causes of this risk are:

- Delayed start of operations due to political factors, financial capacity insufficiency of the operating company (especially when restructuring the service scheme), among others.
- Delay in equipment and fleet availability scheduling.
- Misalignment or lack of coordination among local entities and other stakeholders.

**Regulation risk:** The economic effect due to the modifications to law and regulatory policies. It can arise from a tax code reform (changes in fees and taxes) at local, regional or national levels. It can also take place as a result of a fare regulation issued by the local government. These modifications might fail to consider the system or the economic situation of the people. Some causes are the following:

- Misalignment among authorities and the reality of the system.
- Tax reforms not considering transit system needs.
- Changes in labor regulations.

**Foreign exchange (FX) risk:** The economic effect of the exchange rate difference between the forward price (e.g. the expected price) and the actual price at the time of payment. This risk can occur in the following situations:

- Imported assets, such as vehicles, replacement parts, etc., priced in foreign currency.
- Consultancy or specific technical assistance (e.g. for imported software).

The risk matrix shown below defines the pros and cons of the different stakeholders managing the different risks. The existence of a transit authority is assumed in this matrix. Please note that if the city's transport authority manages the risks defined in the risk matrix (and not a separate entity), there should be a technical group within it specializing in urban transit and with full-time commitment to managing the transit system. It is also assumed that there is at least one operating company.

**TABLE 22. RISK MATRIX FOR A TRANSIT SYSTEM**

Risk	Responsible Entity	Pros	Cons	Applicable Context
<b>Demand Risk</b>	Transit Authority	Reduces legal claims or operator protests due to economic instability.	Implies more funds to comply with the income target in case of a low demand situation. It can even result in a fare rise to cover the deficit.	<p>Previous experiences have shown that the local transport authority should manage the demand risk, especially regarding the BRT trunk component. The other option is that this should be a shared responsibility (between authority and operating companies) in the case of a mixed or feeder operation.</p> <p>Operating companies cannot control informal transport and car overuse, (which may affect this risk) since these are beyond their reach.</p>
	Operating Company	It may lead to a greater commitment to demand management since their income depends on passenger volume.	<p>It may reduce the number of offerors for the tender for operating in the transit system, especially if previous forecasts were based on optimistic scenarios.</p> <p>In case of being unable to reach the break-even point, the operating company can suffer financial problems that may be reflected in operation quality or economic instability. In the worst-case scenario, the company might go bankrupt and end transit operation.</p>	

Risk	Responsible Entity	Pros	Cons	Applicable Context
<b>Fare Evasion Risk</b>	Transit Authority	<p>It may be possible to work together among local public entities through central policies in order to fight this phenomenon in a more effective way.</p> <p>The transit authority may develop and process the necessary policies for reducing the non-payment behavior among passengers (e.g. through awareness campaigns and legal actions).</p>	<p>Implies more funds to comply with the income target and to develop policies and control mechanisms. It may also require the presence of staff in order to prevent evasion.</p>	<p>The control of fare evasion may be assumed by a transit authority in the cases where user access concentrates on specific points (e.g. station entrances) where massive control is feasible and fewer staff is required.</p> <p>This risk is normally assigned to the operating companies when using on-board fare payment/ticket validation (e.g. in feeder zones).</p> <p>In systems with outsourced technological elements such as the fare collection process, the risk may be partly managed by the outsourcing</p>

Risk	Responsible Entity	Pros	Cons	Applicable Context
	Operating Company	<p>Operating companies can perform ticket validation verification through drivers and on-the-road personnel.</p> <p>Access monitoring, whether technological or manual, may become stricter.</p>	<p>Additional investment or expenses are required, which may not be considered enough within the operation agreement.</p> <p>The company cannot control public policies or authority intervention to mitigate this problem.</p>	<p>company. This may lead to improvement of payment information, ticket payment point network, the placing of surveillance, among others.</p> <p>Nevertheless, an integrated management of the problem is the best way to minimize this phenomenon.</p>
<b>Operational Risk</b>	Transit Authority	<p>Full flexibility for the whole system management.</p> <p>The transit authority's know-how can be incorporated more easily within the system structure and operation.</p>	<p>The transit authority would be in charge of the entire investment, as well as of all the operational costs and expenses.</p> <p>It is usually not an entity specializing in operations.</p> <p>Bureaucracy and political influences may affect the operations.</p>	<p>Part of the system's operation is 100% outsourced. Nevertheless, some systems have preferred the transit authority to manage operations (e.g. Quito, Ecuador).</p> <p>When using concessions for the operation and assigning this risk to a private company, the transit authority can focus on defining service quality aspects and on the conduct of monitoring and auditing.</p>

Risk	Responsible Entity	Pros	Cons	Applicable Context
	Operating Company	<p>With a specialized entity managing the operation, technical system capacity will increase as a whole.</p> <p>The operating company may carry out studies and analysis for optimizing operational features, adjust their projections and define and execute measures for operational risk mitigation.</p>	<p>In the case of cost overestimation or efficient performance, the associated profit is earned only by the operator.</p>	

Risk	Responsible Entity	Pros	Cons	Applicable Context
<b>Implementation Risk</b>	Transit authority	<p>It has a closer relation with local authorities. This may speed up the required processes.</p> <p>The transit authority has leverage in infrastructure development issues.</p>	<p>The transit authority capacity must be robust. This implies major investments.</p> <p>Its proficiency to face problems occurring during the start of operations might not be sufficient since this highly depends on the operating companies. Therefore, the start of operation might be delayed until the operator is ready or even until a breach of the contract is notified.</p>	
	Operating Company	The operating company may carry out studies and analysis to be ready for the operation start-up as scheduled.	Infrastructure construction is usually beyond the operating company's reach. Thus, in case of delay, the company cannot control or affect the progress of the work.	
<b>Regulation Risk</b>	Transit Authority	The transit authority may carry out studies and analysis in order to find an adequate fare price and justify it. In addition, it also has more interaction and credibility before the regulatory authority.		

Risk	Responsible Entity	Pros	Cons	Applicable Context
	Operating Company	N/A	Regulation risk is not an issue of the operating company.	
FX Risk	Transit Authority	Based on its coordination with the national government, it may influence FX risk mitigation through exchange policies.	It may increase public investment when covering additional costs and CAPEX and OPEX valued in a foreign currency.	The operating company usually assumes this risk since it is the one buying most of the equipment.
	Operating Company	<p>If the difference between the expected and actual rate is positive, the operating company may have savings.</p> <p>The company may use FOREX derivatives, such as forward contracts, in order to mitigate this risk.</p>	If the difference between the expected and actual rate is negative, the operating company may have severe financial consequences.	

## 5.7. Operator contracting or assignment process

The operation selection process can be carried out in two different ways: through a bargaining process of the traditional transport entities (bus drivers, bus owners, affiliating companies, among others), or by carrying out a tendering process.

Hiring through a bargaining process is normally used to minimize the social impacts arising from the implementation of a new transit plan, where traditional transport entities are the first option for operating it. This requires the fulfillment of a series of requirements and responsibilities by the interested parties within the established periods as provided by the new system conditions.

On the other hand, a tender may be considered a first-choice option to promote competition on an open market. Additionally, a tender may be included as a backup option when the bargaining process fails.

### 5.7.1. Bargaining process

This process is done in order to mitigate social and economic impacts caused by the opening of a new transit system opening in a specific territory. In several Latin American cities, bus operation is mainly based on an owner-operator model, so this service is the main source of work and income for many families. The bargaining process implies new business conditions and additional requirements for the provision of the service that will affect revenue for many families.

In cities like León (Mexico) or Pasto (Colombia), the bargaining process was undertaken through a scheme where the service was provided by numerous bus owners who were grouped in affiliating companies that owned the routes established by the city's transport authority. This caused several problems as individual interests regarding revenues prevailed. Therefore, there was a lack of management for adjusting supply vs. demand, coverage throughout the city, service quality, monitoring and control, among other important aspects.

In León and Pasto, local institutional strengthening was promoted by means of creating municipal authorities. This was necessary to adequately migrate from a disorganized scheme to a structured transit system with common objectives, quality of service features and clear public policies. It is worth mentioning that one of the objectives of the transit system transformations in these cities is to reach a territorial coverage as close as possible to 100%.

The technical, legal and financial studies to structure the systems were well received by local operators, since they were actively involved throughout the process. The strategies for system implementation were discussed with the operators.

Consistently, traditional transport entities became formal operating companies that had to fulfill several commitments within a certain period of time. The transit authority defined requirements such as:

- Consolidate and establish a formal organization (become a company).
- Conduct integrated fleet management.
- Provide specific training to drivers such as: best driving practices, road traffic safety, automotive mechanics, emergency first aid, etc.
- Implement a central fare collection system.

- Accomplish performance indicators based on service scheduling made by the transit authority (operators may help and suggest changes though).
- Manage demand together with the transit authority, among others.

Complying with the commitments has allowed operating companies to achieve well-defined activities. They will remain in the transit operation as long as they keep fulfilling the established conditions and performance indicators as defined in the service agreement.

The main advantages and disadvantages of the bargaining process are the following:

**Advantages:**

- Minimizes social and economic impacts originated from the implementation of a new transit system.
- Takes advantage of empirical knowledge of city transit conditions, for example, drivers' know-how in the area they work on.
- Turns the project from a transport issue into an inclusive project that develops technical capacities and strengthens the local economy.

**Disadvantages:**

- It may be a polemic process with long delays until its full implementation since it requires the traditional transport entities to make a whole new set of decisions.
- Traditional transport entity unions can lobby for additional benefits, which may not be good for the system.
- Traditional transport entities might fail when trying to consolidate into a company. This occurred with Bogota's transit system, SITP, where two of the operating companies, Coobus and Egobus, which consisted of numerous owners and entities, went bankrupt due to a weak financial structure and lack of good management. Consequently, they had to be taken over by the authorities and a new tender had to be opened.
- Even once they've integrated in the design of a new transport system scheme, transport operators may request additional benefits or more favorable conditions. These operators are especially powerful when there are no alternative operators or transport modes to cover demand.

### 5.7.2. Tender process

In a tender process, the right to provide a service to the public sector is normally awarded to a private company. In the case of transit, operation is awarded to companies that are able to provide the best service conditions. This hiring process is commonly used in the implementation of BRT systems.

For transit operation tenders, a call is made to companies and consortiums that fulfill the minimum requirements, based on technical, legal and financial characteristics of the business model. The chosen ones will be those with the best scores in different aspects (even additional aspects than those required), such as lower cost per kilometer, fleet supply, lower cost per passenger, among others.

Tender processes can be done either after failure in reorganizing traditional transport entities or as the primary hiring modality for the system opening. The following are the main advantages and disadvantages of using a tender process:

**Advantages:**

- It allows faster implementation.
- It should guarantee a better operator selection since all the candidates must satisfy the minimum requirements. Thus, it will be easier to choose a company with the desired financial and technical characteristics.

**Disadvantages:**

- If there's no strategy to incorporate drivers from the previous system, it may generate social and economic discomfort among them.
- It may cause protests and a lack of sense of belonging if the social impacts are not well treated and system promotion is insufficient.
- The new operating companies might not be well informed about mobility dynamics of the city. Therefore, difficulties in the operation may occur, especially at the beginning.

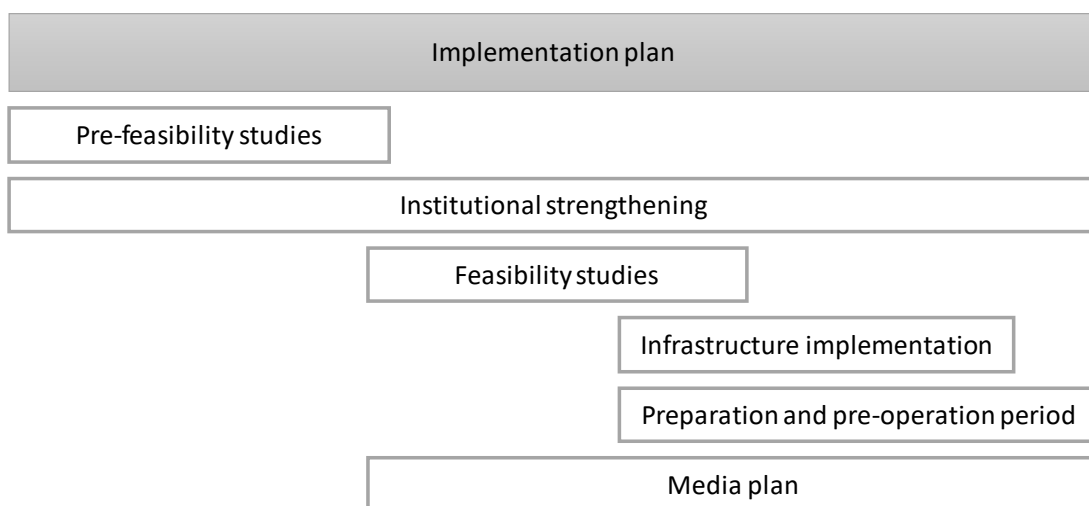
In any case, even if the option of a tender process is selected, it is mandatory to recognize social and economic externalities in order to prevent them and avoid future problems.

There are many ways of mitigating these impacts within a tender process. For example, the operating company may be forced to include a minimum number of drivers or vehicles of the traditional system. An incentive to include them is another option. As an example, different transit systems in Colombia have used these methods at implementation. Other mechanisms are fleet renting and shareholding, among others. As shareholders, operators provide funds to create company equity; in return, the operators receive dividends if the company has a positive net income.

## 06 Implementation Plan for an Integrated Transport System

Implementing an integrated transport system requires careful planning and consideration of the local contexts. Bargaining and tendering processes will require different approaches to secure social support and for the success of the various steps involved in the transformation.

A successful transformation of a city's transport system that minimizes problems and obstacles requires the careful and successful completion of a number of steps. First, pre-feasibility studies should be carried out to create a baseline; diagnose current regulatory framework, infrastructure and technical capacities of stakeholders; consider possible solutions, and ultimately, choose a general approach. Then, the authorities should carry out institutional strengthening to create an adequate legal framework, recruit qualified personnel and assign responsibilities. Authorities can then start feasibility studies to carry out detail technical, technological, legal and financial planning of the transformation or project. Infrastructure implementation, preparation and pre-operation and a media plan will also need to be undertaken to ensure equipment and infrastructure are acquired/constructed, and that users and other stakeholders are properly informed on the new system. Chapter 6 discusses these elements in more detail.



**FIGURE 42. DIAGRAM OF A SIMPLIFIED IMPLEMENTATION PLAN**  
SOURCE: GSDPLUS

## 6.1. Pre-Feasibility Studies

In the first place, it is appropriate to diagnose the current transit conditions and recognize the needs the new system must meet.

To this purpose, it is necessary to set up a team of experts to conduct the following activities and analyses:

- Construction of the baseline.
  - Review of transit service supply and demand information.
  - Analysis of the existing infrastructure.
  - Analysis of the current regulatory framework.
- Operational design at a conceptual level regarding the analyzed mobility dynamics.
- Infrastructure conceptual design, i.e. a basic infrastructure design with few detailed features, which may be modified when functional specifications are further developed.
- Technical, legal and financial structuring at a pre-feasibility level.
- Definition of roles and responsibilities.
- Dissemination plan, which should involve transport entities from the early stages of the process and establish protocols for their permanent involvement.
- Creation of knowledge transfer spaces, where most of the stakeholders will be able to share experiences, good practices in other systems, etc. With these spaces, people (especially community and traditional transport entities) are expected to understand the needs and advantages of a new system, while sharing their doubts or concerns about the project in order to improve it.
- Creation of training or professional education processes in specific areas that may be required by parties of the new system. These areas include transport engineering; finances; business plan structuring; mechanics; customer service; quality management systems; road safety; environmental resource management, among others. These processes should ensure access mechanisms for the interested parties. In addition, completion and enhancement of workers' studies must be supported (i.e. individuals should be able to finish high school, diploma courses, technical or professional careers, etc.)

Once the roadmap for the implementation is defined, the next task is to strengthen the planning team that will be responsible for the feasibility studies. The studies will require greater efforts, more detailed work, and higher technical knowledge.

## 6.2. Institutional Strengthening

Both the city transport authority and transit system authority must continuously specialize in their roles and functions. Experienced and specialized personnel must be recruited, including people who have already worked in similar projects. Furthermore, they should constantly train employees and improve processes based on experiences from other cities.

For this purpose, there must be a legal framework that establishes who the competent authority will be and what roles and responsibilities will it have. Therefore, such an entity must be created or adjusted in order to handle the technical, legal and financial structuring at a feasibility level. In addition, it must have all the capabilities to carry out all the necessary procedures for the system launch.

At this point, the structuring team should include the team members participating in the pre-feasibility stage, plus the additional specialized professionals that this stage demands.

The main activities in this stage are:

- Creation of the structure of the transit authority that will manage the system.
- Recruitment of qualified personnel and support staff for specific processes (planning, operation, infrastructure, among others), and cross-cutting processes (accounting, file management, business management, human resource management, property management, financial management, legal management, among others).
- Assignment or redistribution of responsibilities.
- Generation of additional regulations aligned with the mobility law.

### 6.3. Feasibility Studies

Once the transit authority is strengthened enough to structure the transit system, feasibility studies must be undertaken. Based on these studies, the existing infrastructure can be restructured and designed into a specialized, technical, technological, legal and financial structure of the business.

Subsequently, the city must decide if it will carry out the operator selection through a bargaining process of the traditional transport entities or through a tendering process. The entities and stakeholders involved must choose one of these options based on the goals that are to be achieved. As mentioned in Section 5.7.1, the bargaining process mitigates the social and economic impacts that implementing a new system may have on the community. On the other hand, a tendering process seeks an unobstructed implementation, although it may include mitigation strategies for such externalities. The main steps for these processes are described below.

**TABLE 23 – STEPS IN BARGAINING AND TENDERING PROCESSES**

Bargaining		or	Tender
Generate a regulatory framework for the transition period.			Prepare operation contracts (terms, clauses, requirements, etc.).
Freeze transit capacity and gradual removal of route operation permits.			
Set up conditions to operate temporarily during transition.			Open the tender for the different system components.
Establish a detailed schedule to take down old routes and open new ones.			
Issue temporary permits and agreements with specific lengths.			Choose the winner.
Assessment period to ensure compliance of agreed goals and commitments.			
<b>If the operating company complies with the commitments</b>	<b>If the operating company does not comply with the commitments</b>		
Execution of the contract for the whole period.	Revoke permit and initiate a tender process.	Award and sign operation agreement for the established period.	

The following are the main activities in this stage:

- Technical, technological, legal and financial structuring in detail.
  - Final operational design for implementation.
  - Define if the system will use a specialized or mixed infrastructure (lines, bus parking lots, stations, stops).
  - Establish which technological elements will be used by the system: control system, fleet management system, fare collection, user information system, traffic light system).
  - Financial modeling.
  - Design of the regulatory framework for the system opening.
- Inform about the project's structuring to the different stakeholders, allowing permanent involvement and feedback.
- Hiring processes for the different components.

## 6.4. Infrastructure Implementation

The infrastructure is designed in detail at this stage. For its construction, a tender process is carried out. The main activities of this stage are:

- Detailed design of each station and line (geometric, hydraulic, electric, structural, material, architectural and environmental designs, among others). This activity includes defining the detailed budget for the project, implementation timeline and permit management (e.g. construction, environmental and traffic permits, among others).
- Tendering process and awarding.
- Preconstruction and construction.

It is highly recommended to organize and set the schedule so that operating companies are ready when construction is finalized (e.g. assets are acquired, agreements signed, drivers recruited and trained, etc.). In that way there will be no extra costs due to delays.

## 6.5. Preparation and Pre-Operation Period

Once the operating companies are selected, there must be a period for the preparation of the different elements that may influence the operation. The main activities for this stage are:

- New fleet acquisition.
- Old fleet overhaul.
- Driver recruitment and training.
- Fare collection system implementation.
- Implementation of fleet information management system.
- Implementation of user information system or customer relationship management (CMR) system. It includes user information at stops, vehicles, ticket windows, among others.
- Gradual implementation of the route scheme.

## 6.6. Media Plan

The media plan must be carried out throughout the whole structuring of the transit system, especially during the preparation and pre-operation period, which is just before the start-up. Therefore, users will be aware of the system's functioning and will be more willing to accept it once it is launched.

The main activities of this stage are:

- Designing the image, logo, trademark and information tools.
- Pedagogy campaigns about the correct use of the system.
- Official launch event.
- Massive information dissemination every time a route is implemented and follow-up.

It is important to note that some of the stages may overlap in terms of time. Moreover, the sequence of the stages exposed is not strict, since a parallel development may be required in certain cases.

## 6.7. Conclusions

A transit system must be structured within the framework of the stakeholders needs (especially users, operating companies and the transit authority). Moreover, the concession model should encourage constant improvement of the service quality delivered.

In this document, four types of concession models were described: route by route, group of routes, fleet/kilometers and operation by areas or zones. Each one of these models has advantages and disadvantages that respond to different operation schemes, transit authority management capacity, business maturity of each operating company, privatization policies and local idiosyncrasy. The model chosen should include easiness to adapt supply to the demand. This is a fundamental feature not well addressed in cities undergoing constant transformation, as identified in certain Latin American cities.

During the selection of a concession or allocation model, some aspects must be taken into account:

- The agreement shall consider quality parameters for the provision of services.
- Contracts must not be too specific since they may become too rigid for the operating companies and the authority, thus becoming more difficult to fulfill and adjust in time. In return, the contract should seek a fair commercial result while keeping performance requests for both the operating companies and the transit authority.
- The definition of the contract's term should be based on assets' (especially vehicles) useful life, the financial structure of the concession and the risks assigned to the operating companies. International experience has demonstrated that contract terms lasting between ten and twelve years are desirable.
- It is important to define the agent that will be responsible to handle each type of risk, based on their capacity to control it and mitigate it. Demand, fare evasion, operation, implementation, regulation, and foreign exchange risks are the main risks related to transit system operations.
- It is mandatory to define a compensation scheme for operating companies that include a base payment plus an incentive and penalty mechanism. Three types of compensation schemes are usually used: by operating vehicles, by traveled kilometers and by passengers. Each one of these options encourages the operating company differently and makes it develop different management actions regarding demand, planning, programming and control needs.
- The incentive and penalty mechanism within the contract must be part of a strategy to motivate operating companies to reach certain levels of service. It must seek to ensure a high quality provision of the service, maximize operational efficiency and minimize negative externalities. The development of this tool must be based on the system needs and specific challenges. In addition, incentive and penalty rules must be clear and measurable, as well as aligned with the institutional capacity of the authority that must perform its monitoring and control.
- The agreement shall include clauses to handle contractual changes, actions to be taken in case of poor results and improvement mechanisms among others.
- The tendering process must guarantee transparency and has to be goal-oriented, whereas the result must be aligned with public policy goals.

## 07 Glossary

**Automated Fare Collection System (AFC):** The process used to sell, distribute, collect, and validate transit passenger fares, including media, devices, computer hardware and software, procedures, reconciliations and controls [139].

**Bus Rapid Transit (BRT):** An integrated system of facilities, equipment, services and amenities that improves the speed, reliability, and identity of bus transit. BRT is, in many respects, rubber-tired light rail transit (LRT) with greater operating flexibility and potentially lower costs.

**Bus stand:** It is a designated parking location where a bus waits out of service between scheduled public transport services. A bus stand is usually employed to allow a bus to lay over at a bus terminus, without giving the appearance of being in service, or blocking the stop from use by other buses that are in service. Bus stands also allow short-term parking for driver changes or driver breaks [122].

**Bus station:** It is a structure where city or intercity buses stop to pick up and drop off passengers. A bus station is larger than a bus stop, which is usually simply a place on the roadside, where buses can stop. It may be intended as a terminal station for a number of routes, or as a transfer station where the routes continue [123].

**Bus stop:** It is a designated place where buses stop for passengers to board or alight from a bus. These are normally positioned on the highway and are distinct from off-highway facilities such as bus stations [124].

**Central Business District (CBD):** It is the focal point of a city. It is the commercial, office, retail, and cultural center of the city and is usually the center point for transportation networks [125].

**Concessionary Fare:** Fare offered at a lower price than usual for certain people, for example students or elderly people [126].

**Concessionary Passengers:** Passengers who are granted a concessionary fare.

**Consolidated urban spaces:** Urban spaces whose buildings, their density, spatial distribution and the soil usage have been fully developed and are very unlikely to be modified.

**Dwell time:** Time spent by a transit system vehicle at a bus stop or station, required in certain operational scenarios such as passenger boarding or alighting, fare collection, ticket validation, etc.

**Fare evasion:** The act of traveling on public transport having deliberately not purchased the required ticket to travel.

**Gross-cost contract:** A gross-cost contract pays the operator a specified sum to provide a specified service for a specified period. All revenue collected is for the authority [128].

**Gross-cost contract with quality incentives:** Besides gross-cost contract remuneration, it includes a rewards scheme that grants bonuses by achieving higher service quality levels.

**Integrated Public Transport System (SITP):** The current Public Transport System of Bogota, integrating payment methods and trunk, feeder, urban complementary and special public transport systems.

**Integration Pay Zones:** Pay zone bus stops where fares are paid before boarding, allowing fast bus access. Integration Pay Zones are pay zones used for feeder services allowing fare integration of feeder and trunk services.

**Market foreclosure:** The use or result of commercial practices by one market participant or a group of market participants (possibly with governmental assistance) that limit the access of buyers and sellers to each other [129].

**Mishap:** An accident or unlucky event [130].

**Net-cost contract:** Under a net-cost contract, the operator provides a specified service for a specified period and retains all revenue. The authority pays a subsidy to the operator if the bus services in an area are unprofitable. If the services are profitable, the authority pays the operator a royalty. Under a net-cost contract, the operator has to forecast both his costs and his revenues [131].

**On-street competition:** Also known as Penny War, it is the excessive competition among bus drivers to carry as many passengers as possible, due to oversupply of the service and weak capacity of enforcement by the Authority, jeopardizing passengers and transit users' safety [30].

**Operation regulation:** Stops made by the transport system vehicles in order to comply with programmed dispatch schedules.

**Planning / Service planning:** Theoretical description of the services that a Public Transport System expects to provide. It must enable to define a detailed service plan containing at least: paths' design and length for every route; schedules, frequency and stops for every route; vehicle type for every route; validity of every route; operating days and hours for every route and operation restrictions for every route.

**Programming / Service programming (schedules, buses and/or drivers):** Allocation of human and technical resources in order to satisfy service planning requirements. Programming tasks include defining a detailed timetable containing at least: schedules for the beginning, arrivals and ending of every journey for each vehicle; vehicle allocation for every route; driver allocation for every vehicle; service and empty kilometers for every vehicle, and vehicle allocation for every workshop or depot.

**RACI Matrix:** It is a technique use to describe the participation of various roles in completing tasks or deliverables for a project or business process. It is especially useful in clarifying roles and responsibilities in cross-functional/departmental projects and processes. RACI is the acronym derived from the four key responsibilities most typically used: Responsible, Accountable, Consulted, and Informed [132].

**Real-time fleet operation management:** Georeferenced monitoring of the transport system vehicles as the transport service is provided, in order to guarantee that service programming is fulfilled. Real-time fleet operation management has to enable at least the accomplishment of the following tasks: fleet visualization on maps or any other synoptic presentation that allows to identify vehicles' programming issues; decision making tasks in order to control service programming fulfillment, and fleet communications in order to directly assign instructions to drivers or security staff.

**Secured or supported bus services:** Local bus services procured by local authorities under the 'The Service Subsidy Agreements (Tendering) Regulation 1985 (SI 1921)', 'The Service Subsidy Agreements (Tendering) (Amendments) Regulations 1989 (SI 464)' and 'The Service Subsidy Agreements (Tendering) (England) (Amendment) Regulations 2004 (SI 609)' of the 1985 Transport Act.

**VBP (*Verifierade Betalande Påstigande*):** Verified Paying Passengers, also refers to the operation contracts in Stockholm whose remuneration is highly based on the number of paid passengers.

**IPK:** Index of Passenger per Kilometer, refers to passenger boardings per day (output), per daily bus kilometers (input)[133].

**"Tap on, tap off" / "Tap in, tap out":** A fare payment mechanism where there is no physical contact between a reader and a smart card. The user just "taps" the card against the reader until an audio or visual confirmation for transaction completeness is received [15].

**To top-up:** To add money to the transport card in order to keep it at a constant or acceptable level [134].

**Top-up network:** A set of points of sale where users can purchase or top up (add credit to) their card in order to access the transport system.

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# 09 Annex 1: Formulas to calculate the Technical Fare in Bogota

## Phase I and Phase II

- **Technical Fare**

The following is the formula to calculate the technical fare for trunk line operators in Phase 1 of Transmilenio:

$$TT_{TM} = \frac{A * C_{line1} + B * C_{line2} + D * C_{line3} + E * C_{feeder} + C_{fare collector}}{(1 - C_A - C_T)}$$

The technical fare  $TT_{TM}$  has the following components:

- The tendered costs per kilometer weighted (by  $A, B, D$ ) of
- Each trunk operator ( $C_{line1}, C_{line2}, C_{line3}$ )
- The mean value of the tendered weighted costs per passenger of the feeder operators ( $C_{feeder}$ ).
- The tendered cost per ticket sold by the fare collection operator ( $C_{fare collector}$ ).
- A fixed percentage of the technical fare ( $C_A$ ) that goes to Transmilenio S.A. (about 3% of the technical fare).
- A tendered percentage of the technical fare by the trust fund operator ( $C_T$ ).

- **Adjustment to the technical fare**

In addition, a monthly adjustment to the technical fare was defined in order to cover changes in the different variables. The following is the technical fare adjustment formula:

$$\Delta TT_{TM} = \%T * \frac{\Delta C_T}{\Delta IPK} + \%F * (\Delta C_{Feeder} + \Delta \%Feeder) + \%FareCollector * \Delta C_{fare collector} - 1$$

Where:

$\Delta TT_{TM}$  = Percentage change in the technical fare

$\%T$  = Relative weight of the total trunk costs

$\Delta C_T$  = Adjustment of the cost per kilometer for the trunk operators according to the official change in cost of fuel, tires, oil, lubricant, wages, maintenance and fixed costs. The weight of each element was defined in the contract according to parameters such as current fuel efficiency, tire change and maintenance intervals, etc.

$\Delta IPK$  = Percentage change in the Passengers per Kilometer Index. However, the IPK values of the previous months are limited to a 4.75 and 5.8 passengers/km range.

$\%F$  = Relative weight of total feeder costs.

$\Delta C_{feeder}$  = Adjustment of cost per passenger using the feeder system. However, the feeder costs may not exceed 20% of the technical fare.

$\Delta \%Feeder$  = Adjustment of passengers using the feeder system.

$\%FareCollector$  = Relative weight of fare collection costs.

$\Delta C_{fare collector}$  = Adjustment to fare collection costs.

- **Formula for distribution of revenue among bus operators**

The participation of an operator K is calculated according to the following formula:

$$Participation_K = \frac{C_K * Km_K * Av_K}{\sum_{i=1}^n C_i * Km_i * Av_i} * (TrunkOperatorsIncome + C)$$

Where:

$C_i$  = Cost per kilometer offered by the operator i.

$Km_i$  = Kilometers traveled by operator i in the period.

$Av_i$  = Adjustment factor as a function of the average speed of the fleet of operator i.

$C$  = Injections from the contingency trust.

## **SITP**

- **Technical Fare**

The formula is as follows:

$$TT_{SITP} = \frac{TT_{TM} * PP_{TM} - \sum DiscTM - RTTM + \sum RT + \sum RZ + RSIRCI + RA + RR + RF_{SITP} + RP}{(1 - \%A_{SITP}) * PP_{SITP}}$$

Where:

$TT_{SITP}$  = Technical fare for the entire SITP system.

$TT_{TM}$  = Technical fare for Transmilenio Phases I and II subsystem according to the respective contracts.

$PP_{TM}$  = Paid passengers from the Transmilenio Phases I and II subsystem.

$\sum Disc_{TM}$  = Tariff discounts from Phases I and II operators for users connected by SITP services.

$RT_{TM}$  = Remuneration to the Phase III operators adjusted by penalties defined in the Phase I and II contracts for new operators.

$\sum RT$  = Remuneration to SITP trunk operators including Phase I and II trunk operators that decided to be remunerated according to the SITP methodology.

$\sum RZ$  = Remuneration of SITP zonal operators.

$RSIRCI$  = Remuneration of SIRCI concessionaire.

$RA$  = Remuneration of SITP feeder operators, including Phases I and II feeder operators who agreed remuneration according to the SITP methodology.

$RR$  = Remuneration of the Phases I and II fare collection operators who agreed remuneration according to SITP methodology.

$RF_{SITP}$  = Remuneration of the SITP trust fund operator.

$RP$  = Income used to acquire suitable properties and adequate them as depots and vehicle repair facilities.

$\%A$  = Fixed remuneration of the transport authority (Transmilenio S.A.) as a percentage of the technical fare.

$PP_{SITP}$  = Total paid passengers of the SITP, including Phases I and II subsystem, the zonal subsystem and any future subsystems.

## 10 Annex 2: Summary of the quality indicators used in the public transport systems

## 10.1 Transantiago: transit system of Santiago, Chile

Category	Indicator	Formula	Description	Mechanism / Source	Reference Values / Target Value
<b>User Satisfaction</b>	Treatment-to-user Quality Index (ICA)	$ICA_j = \frac{1}{n} \sum_{k=1}^n a_{j,k} \in \{0, 1\}$	Different aspects of the treatment provided to the user on route are measured. Index is done per bus.	Mystery customer method - This indicator is measured quarterly through a random sample of 25% of the buses of each operating company.	This indicator generates a monthly penalty on the next payment according to its value:  Higher than 0.85: No deduction. Between 0.8 and 0.85: Deduction of up to 200 UF. Lower than 0.8: Deduction of up to 200 UF*(1+(0,8 - IC))*3.
<b>Fleet Quality</b>	Vehicle Quality Index (ICV)	$ICV_j = \frac{1}{n} \sum_{k=1}^n a_{j,k} \in \{0, 1\}$	Measures different aspects of the vehicles' condition.	Each measurement is made at the concessionaire's facilities with no prior notice. This methodology assesses 21 attributes of the company's fleet by using specific formats.	This indicator generates a monthly penalty on the next payment according to its value:  Higher than 0.85: No deduction. Between 0.75 and 0.85: Deduction of up to 200 UF. Lower than 0.75: Deduction of up to 200 UF*(1+(0,75 - IC))*3.
<b>Service Delivery</b>	Frequency Compliance Index	Frequency Compliance = Monthly average ((Departures made from start points / Scheduled departures) * 100% per time zone per route)	Measures the amount of buses each company has provided for each itinerary and compares it with the expected number.	AVL - Automatic Vehicle Location Data gathered at route starting points.	Target value: 90%.
	Headway Regularity Compliance Index	Headway Regularity Compliance = Monthly average ((Headways within permitted time window / Total headways) * 100% per time zone per route).	Measures the compliance of the scheduled headway within each route.	AVL - Automatic Vehicle Location	Target value: 80%.

Category	Indicator	Formula	Description	Mechanism / Source	Reference Values / Target Value
	Fleet Operation Index - Route Capacity Index	$FO_j$ $= Truncar \left[ \frac{\sum_{i=1}^{n_j} \max(\Delta IFO_i; 0)}{n_j} \right]$ $\Delta IFO_i = (0,97 \cdot FCB_i - FOP_{max,i})$	Its purpose is to verify that the actual operating fleet is the entire fleet specified in the contract.	The fleet in operation is determined during the morning peak-hour (the most overloaded 90-minute period) through operation reports.	According to the agreement, 97% of the basic fleet must be operational during the most overloaded 90 minutes of the morning peak-hour time.

**Observations:**

Clause: 70% of the money obtained from fines for failures to comply with management indicators will be given as a bonus to operating companies with the best performance in different indicators. The decision on compliance standards for each index will be the Ministry's responsibility and will be made according to the mechanisms established for each one within the tender basis of Transantiago.

## 10.2 SITP: transit system of Bogota, Colombia

Category	Indicator	Formula	Description	Mechanism / Source	Reference Values / Target Value
Service Delivery	Departures Compliance Index (Frequency)	Departure Compliance = Monthly average ((Achieved departures / Scheduled departures) * 100% per time zone per route)	Measures compliance of departure efficacy in order to guarantee transit supply in any time zone.	Programed departures: Schedule, timetable and/or additional departures orders. Departures: SIRCI (software).	Target value: 95% Failing to fulfill will imply a penalty. If failure persists during six consecutive months, the contract will be cancelled.
	Departure Punctuality Index	Departure Punctuality = Monthly average ((On time departures / Scheduled departures) * 100% per time zone per route)	Measures departure punctuality in every route in order to take action for improving service reliability.	Programed departures: Schedule, timetable and/or additional departures orders. Departures: SIRCI (software)	Target value: 70% Failing to fulfill will imply a penalty. If punctuality index remains below 90% during six consecutive months, the contract will be cancelled.
Road Safety	Accident Rate per Vehicle	Accident rate = Road accidents / Operating Fleet	Evaluates accidents by type, as well as the frequency of events that might put user, staff and party safety at risk. It includes accidents, incidents and mishaps.	Buses in operation per zone: SIRCI (software) – Transit authority. Events: Reports made by different stakeholders.	Target value: 0.4 events per vehicle or less. Failing to fulfill will imply a penalty. If failure persists during six consecutive months, the contract will be cancelled.
Maintenance	Vehicle Engine Failure Rate	Vehicle Engine Failure Rate = Engine failures / Operating fleet	Measures the efficiency of maintenance procedures, corrective and preventive repairs of the fleet and the disposal of reliable and safe vehicles for operation.	Weekly report on failed events prepared by operators. It specifies date, vehicle, route, time, failure type and description.	Target value: 0.08 events per operating vehicle or less. Failing to fulfill will imply a penalty. If failure persists during six consecutive months, the contract will be cancelled.
Environment	Pollutant Emission Index	Pollutant Emission Index = (Vehicles not meeting emission requirements / Operating fleet) * 100%	Measures the compromise made by operating companies with the environment. Measurement is done with an opacimeter.	Form containing emission control results for each vehicle. This form is issued by the transit authority.	Target value: 5% or less. Failing to fulfill will imply a penalty. If failure persists during six consecutive months, the contract will be cancelled.
User Satisfaction	Satisfaction Survey	Technical datasheet for data gathering by survey by zone; methodology for defining satisfaction index based on the variables measured.	Estimates the degree of user satisfaction regarding service delivery. It is based on surveys per operating company.	User satisfaction survey. Outsourced.	Target value: 60% Failing to fulfill will imply a penalty. If failure persists during three consecutive trimesters, the contract will be cancelled.

### 10.3 Omnibus: transit system of Sao Paulo, Brazil

Category	Indicator	Formula	Description	Mechanism / Source	Reference Values / Target Value
<b>Maintenance</b>	Fleet Quality Index (IQF)	$IQF = \left\{ 10 - \left[ \frac{4 \cdot FSE + 2 \cdot FMA + 2 \cdot FEQ + FCF + FCS + FVE}{VI} \right] \cdot \left( 2 - \frac{FS}{FD} \right) \right\} \cdot \frac{VI}{VP}$	FSE: Safety FMA: Maintenance FEQ: Required equipment FS/FC: Fixed failures / Found failures VI/VP: Sample / Universe rate FVE: Special vehicles FCS: Equipment and fleet preservation FCF: Comfort	Visual inspection of 300 items related to vehicle and operation conditions.	
<b>Service Delivery</b>	Operation Quality Index (IQO)	$IQO = \frac{(IQOL + IQOF)}{2} - \frac{NRP}{NR}$	IQOL: Defaults on route operation IQOF: On-route vehicle failures NRP/NR: Default on operation complaints rate		
<b>Administrative Performance</b>	Operating Companies Economic and Financial Quality Index (IQE)	$IQE = 0.4 \cdot IQEC + 0.2 \cdot IQL + 0.4 \cdot IQR$	IQEC: Equity IQL: Liquidity IQR: Profitability	Technicians assess the financial performance of operating companies.	Pmin: Minimum score that satisfies the 'i' quality index. Mp: Arithmetic mean of scores of 'i' index among all operating companies. Dp: Standard deviation of scores of 'i' index among all operating companies.
<b>User Satisfaction</b>	User Satisfaction Index (IQC)	$IQC = NP - IRP$	This index uses two sources: surveys (NP) and complaints and claims management system (IRP).	20,000 user surveys. Each survey consists of 33 questions conducted only in services with more than 2,000 passengers per day.	

## 10.4 London Buses Transit System of London, United Kingdom

Category	Indicator	Description	Mechanism / Source	Reference Values / Target Value	Observations
Service Delivery	Mileage		Ibus: Operation control system that calculates the compliance of programmed kilometers.	Non-operated kilometers are deducted from the payment.	The agreement includes a list of reasons that are imputable to the operating companies (regarding drivers or vehicles).
	Performance Reliability	EWT (Excess Wait Time).	Headway regularity in high-frequency routes.	This indicator is only measured within routes with a frequency of 5 buses/hour or higher.	EWT is the extra time passengers have to wait above the average scheduled wait time. The target value is 0 (EWT=0 min).
		Punctuality.	Punctuality in low-frequency routes.	This indicator is only measured within routes with a frequency of 4 buses/hour or lower.	This measure is expressed as the percentage of punctual departures. To be considered punctual, a departure must be within a time window of 2.5 minutes earlier to 5 minutes later than the time scheduled. The goal is to achieve a 100% of timely departures.
	Driver Quality and Vehicle Monitoring	Driver and Vehicle Requirement compliance.	17,000 static audits to buses. 33,000 mystery customer forms.	This indicator generates data that can be used by operating companies for performance improvement.	Results are used by LB to generate the payment amount of incentives or penalties according to incentives and driving quality clauses.
	Customer Satisfaction	User satisfaction regarding the perceived quality of service.	Three satisfaction surveys (CSS).	Surveys on bus service, night bus service, bus stations and infrastructure.	The survey has sections about the trip the user just made, user information, safety, cleanliness, driver behavior, among others.
Road Safety	Safety	The measurement of this indicator is based on an accident rate database in order to measure the ability to provide a safe service.	Accident reports. CCTV and on-road recording equipment.	The incentive is not directly related to the payment due to the definition of this indicator (people's safety is not a compensation issue).	Failure to comply with the safety indicator standard implies the cancellation of the contract and/or disqualifying the operating company for future operation contracts.



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