
ADDRESSING LIMA'S BUS TRANSPORTATION FIASCO



AUTHORS: YUNJUNG YANG, ROSEMARY ULFE
SECTION LEADER: MICHAEL WALTON
FACULTY ADVISOR: HENRY LEE

MASTER IN PUBLIC ADMINISTRATION IN INTERNATIONAL DEVELOPMENT
HARVARD UNIVERSITY, HARVARD KENNEDY SCHOOL OF GOVERNMENT
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ABBREVIATIONS AND ACRONYMS

AATE	Autonomous Authority for the Electrical Train
ATU	Authority for Urban Transportation (Autoridad de Transporte Urbano para Lima y Callao)
AFC	Automatic Fare Collection
BIS	Bus Information System
BMS	Bus Management System
BRT	Bus Rapid Transit
CC	Complementary Corridors
EMAPE	Lima Municipal Enterprise for Fare Management (Empresa Municipal Administradora de Peaje de Lima)
ENATRU	National Urban Transport Company (Empresa Nacional de Transporte Urbano)
GTU Lima	Urban Transport Bureau (Gerencia de Transporte Urbano)
LED	Light-emitting Diode
MML	Metropolitan Municipality of Lima
OBU	On-Board Unit
PROTRANSPORTE	Project for the Preparation of the Lima Transport Investment Plan (Proyecto de Preparación del Plan de Inversiones para el Transporte Metropolitano de lima)

Executive Summary

Chaotic traffic, heavy congestion, high rates of fatalities, confusing public transportation network. These all highlights Lima's infamous transportation issues. Over the last years, the Public Transportation System has been consistently rated the second most important problem that hurts quality life in Lima¹. As a city of 10 million people in size, Lima faces complex mobility issues with a strong reliance on informal transport modes due to the deterioration of its transit system quality². A deficient public transportation translates into increased use of private cars, traffic jams and time wasted on the road, which hinders the economic potential of a city, in this case, where it creates a major part (49.8%³) of the national GDP.

To fundamentally improve the situation, a law establishing the Authority for Urban Transportation (ATU) was passed in 2018. ATU integrates responsibilities previously dispersed over Lima and Callao Municipalities and the Ministry of Transportation and is fully supported by the current administration. In support of ATU's initiatives to fundamentally solve the transportation problem in the long term, we focused on alleviating its pernicious effects through the reform in the public bus transportation system. More than 80 percent of the city's residents use bus transportation, and with this rate of ride-share, successful reform has huge potential.

In this paper, we lay down the specificities of the public bus transportation system in Metropolitan Lima, diagnose the problems and recommend a policy proposal with implementation strategy to most effectively tackle them. The problems we identified were limited information, difficult transit, and lack of regulations. After careful evaluation on technical correctness, administrative feasibility and political support, we propose to roll-out an ITS reform, a set of measures around these three pillars: Information, Transit, and Standardization.

¹ Lima Como Vamos (2016, 2017, 2018)

² Jauregui-Fung et al. (2019)

³ Instituto Nacional de Estadística e Informática (2018)

I. Introduction: Lima's Bus Transportation Fiasco

An increasing pressure on the transportation infrastructure. Peru has experienced a sustained population increase in urban centers due to economic and social factors. Lima, the capital and largest city of Peru, has absorbed most of these people who have migrated from the rural areas. Currently, Lima is home to approx. 9.8 million inhabitants⁴, which represents a third of the total population of the country. Though the population growth rate has declined, the city is estimated to still grow at a 1.2% annual rate⁵. This population increase has translated into a sustained expansion of its vehicle fleet, which represents two thirds of the vehicles in the country⁶. This has posed major challenges in the city's transportation sector, whose heavy road congestion⁷ calls for a more efficient system, with cost-effective public transportation for the urban poor.

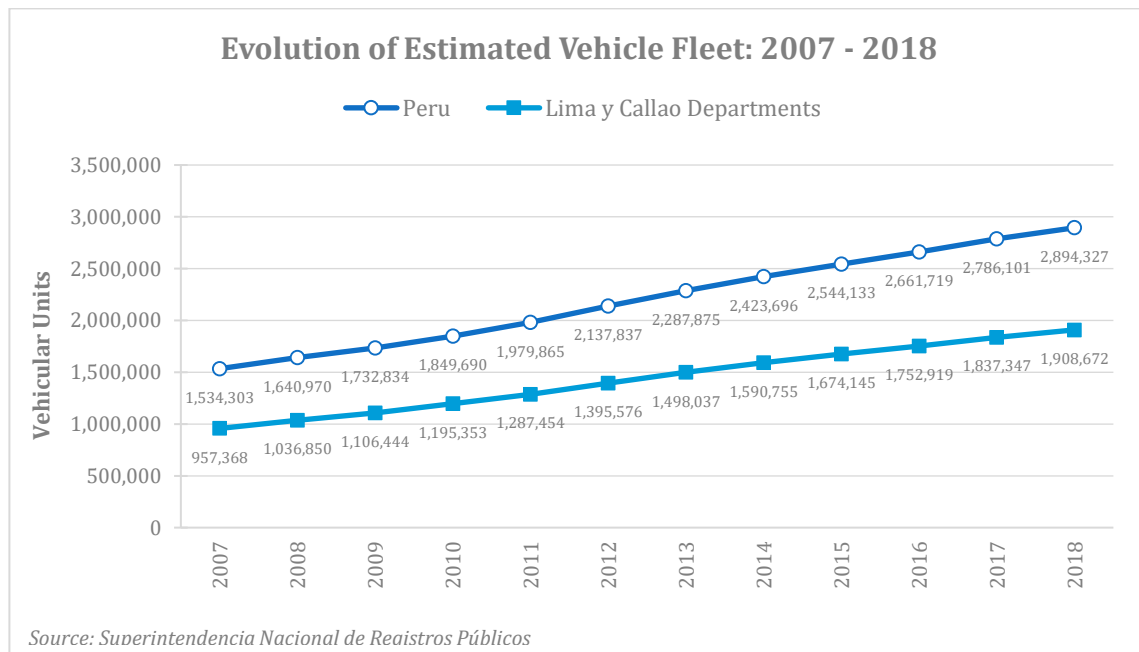


Figure 1. Evolution of Estimated Vehicle Fleet: 2007 - 2018

⁴ Compañía Peruana de Estudios de Mercado y Opinión Pública (2019)

⁵ Instituto Nacional de Estadística e Informática (2017)

⁶ SUNARP (2018)

⁷ In 2018, 35% of Limeños reported that their commute took longer than in the previous year. Source: Compañía Peruana de Estudios de Mercado y Opinión Pública (2019)

The characteristics and failures of the current public transportation system. Lima generates 11 million transport journeys daily, from which 82% are made on public transport⁸. Currently, public transport in Lima is operating with one Bus Rapid Transit (the *Metropolitano*) line, one metro line, and several bus lines. Although the number of passengers is still increasing, the processing capacity of public transport is insufficient compared to traffic demand. Although bus is the most common means of public transportation used in the city with 63% of commuting citizens relying on it, at the same time it is showing highest user dissatisfaction⁹.

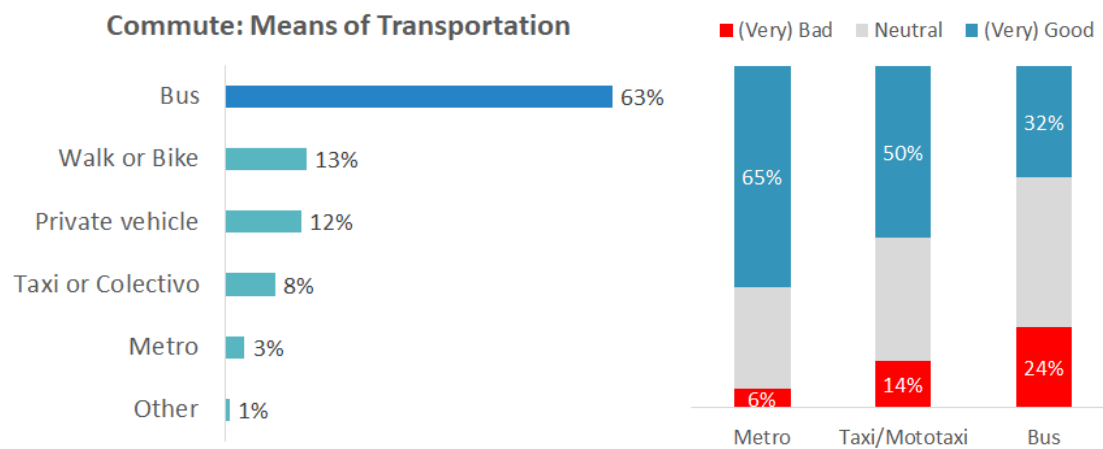


Figure 2. Means of Transportation and service ratings

Weak planning, enforcement and control strategies have resulted in the perception of disorganized bus system and deteriorating user satisfaction. A low-quality transport service is provided by several formal and informal private bus operators. Small-sized private operators use aging, defective low capacity vehicles and compete in routes where they can pick up the most passengers. Coupled with increase in car ownership, this resulted in severe traffic congestion throughout the day, even outside of peak travelling times. Transit time has dramatically increased in certain corridors, as well as negative externalities such as air pollution, noise, and traffic accidents. It became a critical issue in the agenda of the current mayor of Lima whose political campaign pivoted around safety and improvement in transport system which has so far failed to meet the citizens expectations¹⁰.

⁸ Guevara, R. (2017)

⁹ Lima Como Vamos (2018). Pg. 18.

¹⁰ The lack of a solution for Lima's traffic jam ranked as the second most important critique to mayor Jorge Munoz's mandate. Compañía Peruana de Estudios de Mercado y Opinión Pública (2019).

Recent changes in administrative capability. There has been a huge renovation regarding the administrative authority managing Lima's public transportation. Before the change, three semi-public agencies established by the Metropolitan Municipality of Lima (MML) each managed parts of public transportation. PROTRANSPORTE managed Metropolitano, GTU Lima managed Complementary Corridors, and AATE (Autonomous Authority for Electrical Train) managed Metro. Fragmentation posed obstacles such as lack of coordination between transportation means, local transport consultants' lack of experience and skills, time-consuming bureaucratic processes, and nearly non-existing management on linkage transportation between Lima and Callao which together constitute Metropolitan Lima.

In Dec 2018, Autoridad de Transporte Urbano para Lima y Callao (ATU) was created to oversee all public transportation in the provinces of Lima and Callao¹¹. The specialized public organization is under the Ministry of Transport, and has undivided authority as well as functional and financial resources. Although ATU has undivided authority to coordinate public transportation in Metropolitan Lima, it is still in the process of absorbing the function from municipality of Lima and Callao as well as three semi-public agencies. It is expected to operate in full force from June 2020.

Our focus. In order to fundamentally solve the urban transportation problem in Lima, it is necessary to increase public transport utilization rate by improving service. This can be done by expanding the road capacity and installing new transportation infrastructure but also by streamlining the current infrastructure. For the former, central ministry and Lima municipal government are planning to invest in transportation infrastructure projects such as the outer ring road and new metro line¹², but due to the delay in implementation, it is hardly alleviating the current situation. Thus, we are focusing on the latter, improving transportation services within the current infrastructure at hand.

Given (1) the aforementioned wide scope of the usage in the bus, (2) the demand of citizens for immediate improvements, and (3) recent creation of unified authority to tackle the problems in public transportation; we will focus on designing a policy to generate user convenience in bus system by addressing inefficiencies that also contribute to the perception of "chaos" in the current system.

¹¹ El Peruano (2018)

¹² Municipality of Lima (2013). Regional Plan for Concerted Development of Lima 2012-2025.

II. Problem Identification

The traditional bus system is chaotic enough to be known as the so-called “anti-system”. This phenomenon of Lima’s bus fiasco results in two main problems. The first is direct user dissatisfaction on public bus transportation system, and the second is social externality exacerbated by oversupply of competing buses.

1. Unsatisfying Public Bus Transportation Service

According to the 2018 survey, less than 20% of citizens were satisfied with Bus transportation service.¹³ Lima’s buses are categorized into three types - Microbuses, Complementary Corridors, and Metropolitano. Microbuses are privately owned and are composed of traditional buses, combis and coasters. Complementary Corridors are large modern buses that cover five main vial axis of the city. Metropolitano operates in Bus Rapid Transit lines with utmost punctuality. Although serving 93% of the bus passengers, microbuses are ranked the worst, with at least 30% of the population finding these services, bad or very bad¹⁴.

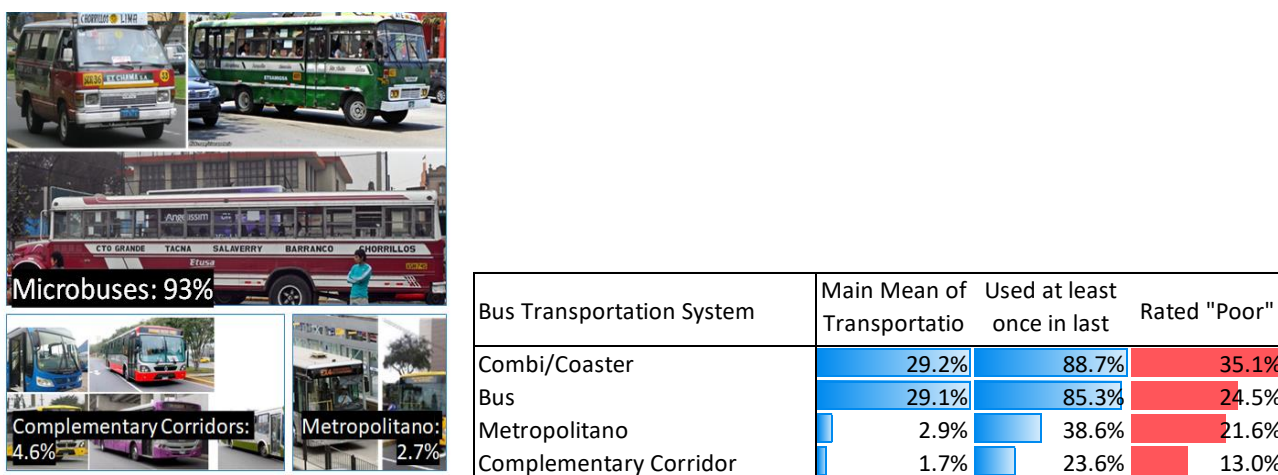


Figure 3. Category of Buses and Satisfaction Rate

¹³ Lima Como Vamos (2018). Pg. 20.

¹⁴ Lima Como Vamos (2018). Pg. 18.

Each type of bus has different advantages and disadvantages. Microbuses are mostly appreciated by their wide reach and low fares. However, these are reportedly lacking in aspects such as punctuality, cleanliness, order and security. One of the contributing reasons is because coaster and bus are handled by small-size bus operators. The Metropolitano and Complementary Corridors (CC) do much better regarding service aspect but have higher fares and a limited coverage¹⁵.

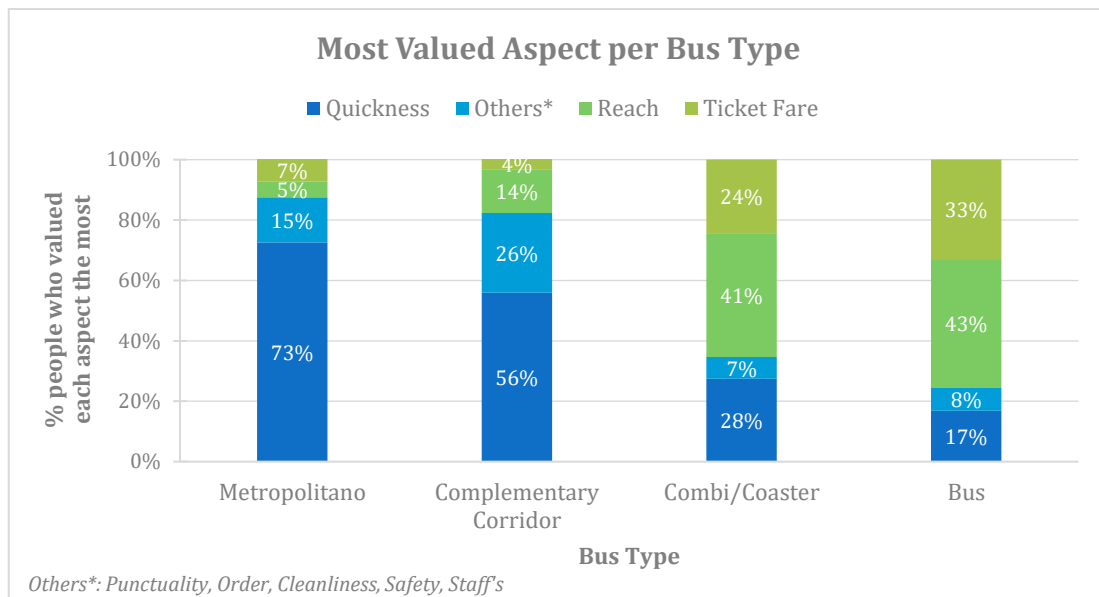


Figure 4. Most Values Aspects of each Bus Type

a. Unpredictable and unreliable bus system

The survey also identified that the main source of users' dissatisfaction is their 'perceived' waste of time¹⁶. People confessed that they do not know when the microbuses are going to arrive. For example, one source quotes that microbuses "appear out of nowhere" and "nobody knows exactly where the bus goes"¹⁷. Unpredictable arrival time of the buses leads to citizens' perception of unreliableness of public bus transportation system. Particularly in suburban areas, due to the unreliable vehicle arrival time, there's low expectation on the existing transportation system. As a result, citizens with cars avoid public transportation thus further exacerbating traffic congestion. As of 2018, 24% of the population spent an hour on average solely in a one-way daily commute from their homes to work or study centers¹⁸.

¹⁵ Compañía Peruana de Estudios de Mercado y Opinión Pública (2019)

¹⁶ Piedra, A. (2018). Pg. 1.

¹⁷ Abal, E. (2019)

¹⁸ Lima Como Vamos (2018). Pg. 22.

b. Difficult Transit

Obstacles to transit is another major cause of user dissatisfaction. Fragmented payment methods for each public transportation is causing inconvenience and impeding the transit process. There is no transit discount system, which increases the cost burden of public transportation users¹⁹. In addition, the lack of information on the available routes as well as lack of transit infrastructure which connects different means of transportation make it difficult for users to navigate efficiently. They cannot assess what route is the fastest or the most efficient considering transit, and even if they do, it is complex to hop off and find the right stop to take the next desired bus.



Figure 5 Different Payment methods for Public Transportation Means

2. Oversupply of Competing Buses

In the aspect of social externality, competing buses create unsafe driving environment by frequently violating traffic rules, and add to air pollution and noises. Excessive public transport vehicle registration in the past accounts for unnecessary competition today. There is a point that bus is oversupplied as more than 25,000 vehicles are registered for public bus transport in Lima. About 51% of public bus transport vehicles are microbus, which can accommodate small number of passengers due to its small size, thus inefficient for use on main public transport routes. Therefore, intense competition among bus operators results in longer passage times due to congestion on the city's main roads. Moreover, violation of traffic laws are not properly sanctioned by the relevant authorities, which leaves no incentive to abide the rules.

¹⁹ Compañía Peruana de Estudios de Mercado y Opinión Pública (2018)

III. Problem Analysis: Deep dive to the Current Collective Bus Transportation System

1. Supply-side Analysis: Bus Operators, Routes and Fares

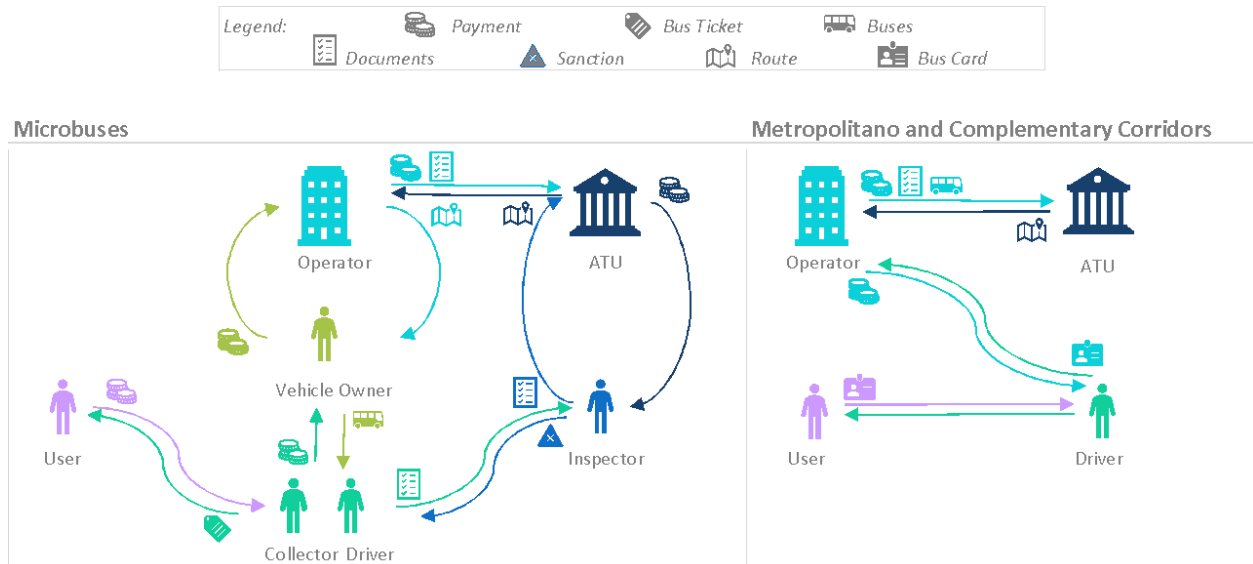


Figure 6. Stakeholders Map²⁰

a. Bus Operators

Lima Metropolitan's bus transportation system can be largely divided into three types: El Metropolitano, Corredores Complementarios (CC), and microbuses. According to bus types, current operating routes are composed of one El Metropolitano route, 18 CC routes²¹, and 109 Microbus routes. Besides El Metropolitano route, other bus routes are not properly equipped with facilities such as designated bus stops. Passengers hop on and hop off freely, buses stopping recklessly, which are factors that threaten safety and congest traffic. Microbuses account for the largest number of buses, but as 75% of these buses are aged more than 15 years, it is contributing to high rate of traffic accidents.

Table 1. Lima's Bus Transportation System at a Glance

²⁰ Microbuses: Consorcio de Investigacion Economica y Social (2010)
 Metropolitano: PROTRANSPORTE (2008)
 Complementary Corridors: PROTRANSPORTE (2014)

²¹ Guardia, K. (2019)

Classification of Buses

Metropolitano
and its
Metropolitano
Feeders



**Complementary
Corridors**
Blue, Red, Yellow,
Purple and Green
Line



Microbuses
Traditional Combis,
Coasters and Buses



El Metropolitano is the first and only Bus Rapid Transit (BRT) system, established in 2010. BRT circulates buses in dedicated lanes which exclude regular traffic. It is running a total length of 27km with 35 stops, linking 18 districts²² of Lima from Chorrillos in the south to Independencia in the north. Each end station serves as a terminal for other buses linking isolated districts, and these are called Metropolitano feeder buses. There are four routes to the south (Matellini Station), and eighteen routes to the north (Naranjal Station). In total, 300 bus fleets with the capacity of 160 passengers operate in the system²³. Users pay the fare for the Metropolitano before entering elevated platforms with automatically opening doors which open when users swipe a pre-bought electronic card.

²² Jauregui-Fung et al. (2019)

²³ Guevara, R. (2017)



Figure 7. Metropolitano's Main Route

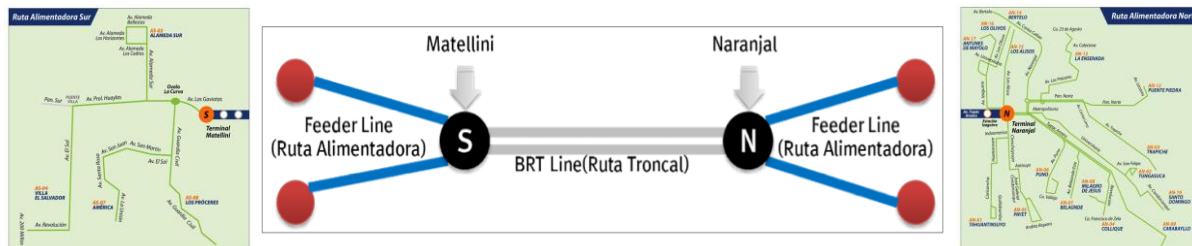
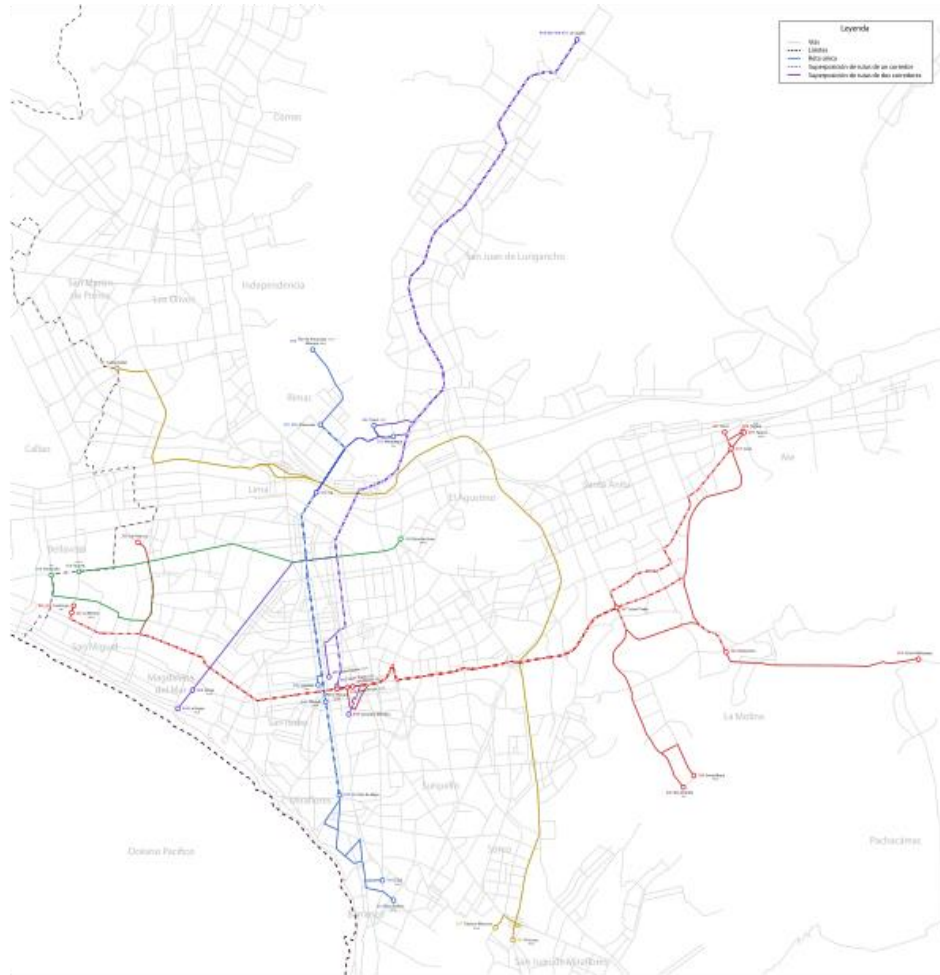


Figure 8. Metropolitano's Feeder Lines

The Complementary Corridors consist of five lines represented with colors blue, red, yellow, purple and green, which transit through major avenues of Lima.²⁴ Each color line has different “services” which go through the same main avenues but differ in terms of number of stops, final stops and frequency. The introduction of the Complementary Corridors was an attempt of the Lima Municipality to formalize routes, organize bus stops, decrease use of combis, standardize fares and improve the labor conditions of drivers. The first complementary corridor, the Blue line, was implemented in 2014 facing opposition from minibuses operators and complaints from users due to over demand, evidenced by long lines in the bus stops. Currently, the complementary corridors are mostly appreciated due to their reach, quickness, organization and neatness, and overall are the best-ranked bus type available in the city.

²⁴ Lima Como Vamos (2018)



b. Bus Routes

There are a total of 415 routes operated by Lima and Callao, with 265 downtown routes, 77 suburban, 58 inter-city, and 15 others. For the users, the departure-stop-endpoint is described on the exterior of the bus, but the route map is not accurately followed, so it is necessary to check with the bus driver before boarding.

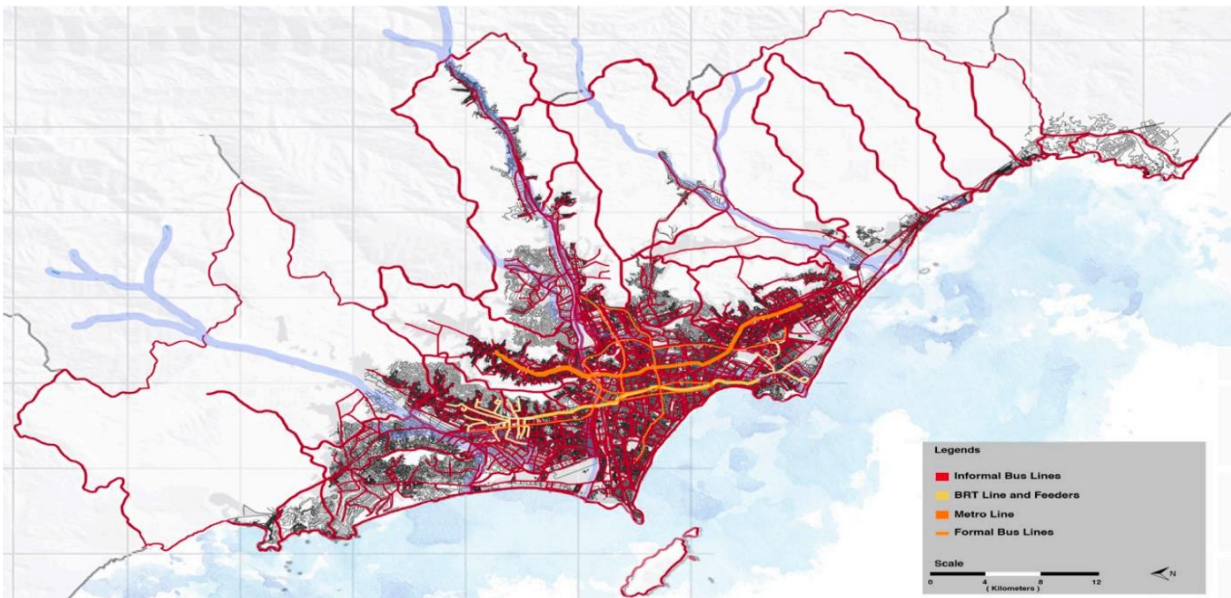


Figure 10. Lima's Bus Routes²⁶

The concentration of bus routes adds to the problem. There are approximately 460 bus operators in Peru, and most bus companies operate in the form of small businesses that own few buses. These small-scale businesses tend to operate only in the routes where they can make revenue, which is noticeable in route redundancy and contention. Bus operators are concentrated on the main avenues so called “the surplus line”, and suburban areas with fewer users are covered inadequately²⁷. Due to this excessive competition, each route shows large difference in operating bus numbers and fleet intervals, acting as the factor that reduces the efficiency of the bus operating system and the profitability of bus companies as well. From an institutional standpoint, there is a need to consolidate bus operators. The overall bus operating system deciding the appropriate number of buses in each route and the fleet interval, and as importantly, the regulation to uphold the system is required.

²⁶ Jauregui-Fung et al. (2019)

²⁷ Leon Almenara, J.P. (2019)

c. Bus Fare System

Lima's public transportation has different fare systems for BRT, Metro and regular buses. BRT and Metro use an electronic transportation card as a means of payment while others use cash payment. The problem of incompatibility between BRT and Metro card, as the operator is different for each, requires the user to own both cards and adds to their discomfort.

In addition, BRT and Metro are operating by uniform fare rate, which poses a matter of equity between short-distance users and long-distance users. Microbuses and CCs are equipped with a distance-proportional fare rate, but in the Microbuses the fare structure is obscure as the bus conductor has the authority to tweak the fare. Recently some CCs have adopted electronic card called "Lima Pass", but it is limited to certain lines.²⁸

Table 2. Fare System per Bus Type

Public Transportation	Means of Payment	Fare Rates
Metropolitano <i>BRT</i>	Transportation Card <i>Operator: XEROX</i>	Card purchase fee is S./5 (need to charge at least S./5 when purchasing a card)
		Three type of fares:
		1. General: S/. 2.50 for main route. 2. Preferential: S/. 1.25 for main route (or + feeder). Feeder alone: S/. 1.00. 3. Integrated (Feeder+Main+Main+Feeder, within 122 mins) : S/2.50.
Metro	Transportation Card <i>Operator: INDRA</i>	The card purchase fee S./4.5 (need to charge at least S./0.5 when purchasing a card)
		Uniform fare is S./1.5
		Student discount fare of S./0.75
Regular Buses <i>Complementary Corridors and Microbuses</i>	Cash Payment	Base rate is S./0.50, and this increases to S./3.00 depending on distance traveled.
		Normally close distance pays S./1.0 and longer distances pay S./1.2 or S./1.5
		The fare is S/0.50 for children and school students, half regular rates for university students
		Some fare rates are posted inside the vehicle but they are not always respected. Thus, discussions with the fare collector on the rate charges are not uncommon.
		Holidays are more expensive than weekdays Combis generally charge more than larger vehicles for similar distances.

Furthermore, there is no transit discount system, which increases the cost burden of users. The urbanization of Lima and Callao is spreading to the outskirts, leading to longer commute distances for users and diversification of the means of public transportation. Accordingly, in the current system, the fare is set for each means, so for users that take two or more in their commute must pay relatively high fares²⁹. This may act as a factor that lowers the competitiveness of public transportation, hindering its use. Increased usage of private cars worsen traffic congestion and environmental problems.

²⁸ PROTRANSPORTE (2019)

²⁹ Lara, J.G. (2018)

2. Deep-dive to Microbus: Assessment of the level of Informality

a. Overview of the Microbus system

More than 32,500 buses operate in Lima while 5,600 runs in New York, a comparably sized city with similar population. Microbuses amount to 31,118, 96% of the total buses that operate in Lima. Although it is the main reason for public transportation chaos, it also provides cheap and accessible transportation to the city's working class.

Microbuses' flexibility, coverage, affordable service it provides to low-income communities on the periphery of the city should be valued, but Lima should not ignore the problems that existing Microbus system causes. According to the 2012 World Bank report, the city's expanding bus fleet made Lima one of Latin America's most polluted cities. In addition, it leads to a loss of \$500 million per year in terms of man-hours and operating costs due to congestion and inefficiencies of the urban transportation system³⁰.

Restructuring Microbus sector is necessary to establish and support sustainable urban transportation system. Understanding why it came into place, what ecosystem it works under, and which aspects of citizens' needs it satisfies will help design the plan to formalize the system with minimum disruption.

b. History of Microbus establishment - liberalization of the public bus system

Surprisingly, the current chaotic state of the transit in Lima was preceded by an organized bus system. During the 1980s, the bus public transportation system was heavily controlled by the state. The state-owned National Urban Transport Company (ENATRU) buses were highly organized and comfortable, but severely insufficient, especially given the city's marked population expansion of the 1960s to 70s.

Microbus system relies on a complex model that developed in 1990s to open the public bus routes to private bus operators. It allowed for-profit transportation firms to license public bus routes.³¹ In 1991, President Alberto Fujimori began deregulating Lima's bus transportation network as a solution to unemployment and insufficiency of the supply. The Legislative Decree 651 transformed the public bus transportation system into a free market. The bill stipulated competition in prices and free access to routes. It also gave permission to any judicial or natural person to provide this service with almost any

³⁰ World Bank (2012)

³¹ Vigo, M. (2013)

vehicle, with approval from municipalities. In 1992, the state-owned ENATRU was dissolved, its buses sold to private transport enterprises.³² The situation turned quickly into an oversupply of buses, facilitated by the Decree 080-91-EF, which removed constraints to the import of used vehicles. By 1993, more than 323 new bus routes were created and private firms were allowed to work the routes, import buses, and set their own prices. By the early 2000s, the city had 570 bus routes operated by 257 different transportation companies.

The legislation allowed for private transit companies to rent their routes to vehicle owners, who would rent the vehicles to drivers and collectors. This labor system led to the “Penny War”, a state of extreme competition between drivers to get more passengers. Drivers would decide whether to pick up passengers or just pass at the bus stop according to the information *dateros*³³ shout. They would sometimes ignore red lights and accelerate on yellow lights to pick up more customers prior to competitors, in order to survive with the existing low fares (typically ~USD 0.3).

Hence, the liberalization of the public bus system translated into traffic congestion, caused by the overlap of routes, excessive vehicle fleets, and reckless driving. Increased working-hours for drivers and fare collectors were added to the current malpractices. Although *combis* were attractive to transporters due to their low cost and high flexibility, citizens rated it the worst in comfortability and law-abiding behavior.

c. Challenges to Reform - Economic ecosystem behind Microbuses

Important consideration before the reform that intends to dramatically formalize the transportation system is the political backlash: multitude of drivers and fare collectors, vehicle owners and transportation companies would be affected. The impact on drivers and fare collectors is especially important, as they typically come from low-level income segments and may struggle to reinsert into the labor market. Informal ecosystem that revolves around Microbus business, such as *dateros*, fare collectors, roadside vendors to window washers rely on the current system for employment, so change is not easy. But they all agree that some kind of change is necessary, and Lima’s future depends on it finding a way out of the transportation mess.

³² Jauregui-Fung et al. (2019)

³³ *Dateros* are informal workers placed at strategic bus stops, who shout out three numbers to notify bus drivers of the time passed since last two competitors were on the bus stop, and the number of passengers the last one collected. Vigo, M. (2013)

d. Assets for the Reform - Unified Authority behind ATU

Currently, ATU owns the routes and give them in concession to private companies, which are legally required to own vehicles³⁴, although they often outsource this component. The multiple layers of agents involved in the service provision - the concessionary, the vehicle owner, the driver and the fare collector - results into an atomization of income for the driver and fare collector especially. Moreover, the lack of a stable labor relation between these agents conduces to reckless driving behavior and lack of accountability.

ATU was created with the support of President Martin Vizcarra and the Minister of Transportation Edmer Trujillo. Our interview with the Specialist in Logistic Management of ATU, Mr. Pablo Ramirez, revealed the interest of the Prime Minister in unifying the efforts to organize the transportation system of Lima and Callao, and the consequent full support to ATU in any measure necessary to achieve this goal. The current head of ATU is Ms. Maria Jara, former Minister of Transportation during this government, who maintains a good relationship with the President as well as the current Minister of Transportation. These favorable factors strengthen the capability of ATU to undertake hard initiatives in order to improve the current transportation system.

The main political opposition force is Fuerza Popular, a political party led by Ms. Keiko Fujimori, that represents the majority in the Parliament. However, on September 2019 the Congress was dissolved and elections were held on January 26th, 2020. The Congress was elected to complete the previous term, which will end on July 2021. With a term of eighteen months, it is unlikely that big obstacles to the transportation system reform will be raised by the new Parliament.

e. How to tackle the problem - formalizing the system

The number of private buses is now frozen at 32,500 vehicles. In January 2012, Lima pulled off a bus-scrapping program, discharging 1,000 older buses within a year. Once the buses are taken off the streets, they could not be replaced. In exchange, their owners got between \$4,000 to \$10,000 USD for each unit. Many operators commented on this positively, saying “I’m happy finally I’m out of this damn business”. A lack of financing has halted the city’s scrapping program, but the central government

³⁴ Municipality of Lima. (2013). Legislative Decree 651. Decree 080-91-EF. Ordenanza 1599.

recently introduced a law that will phase out more obsolete buses over the next decade, dropping the age of the average bus from 32 years to 15.³⁵

Besides reducing the number of buses, ATU has to work on reforming the current Microbus system. Utilizing ATU's ownership and its authority to grant concession to private companies, it should put certain measures to formalize the operation. We have laid out detailed proposals in part V of this paper, but to state it briefly, ATU has to 1) officialize the bus routes and penalize those who deviate from it, 2) standardize bus designs so that citizens would know what route it serves and where it stops, and in the long term, 3) align fare collection system and unify payment methods to provide transit discount, 4) as well as providing convenient transit infrastructure.

ATU can officialize current microbus routes as extended line of Complementary Corridors, or feeders for CCs. Transparent bidding system and adequate communication should be in place when officializing the routes and making concession over operations to the private bus operators who had previously worked on the routes. ATU can devise an incentive for operators to run undersupplied routes in the suburban periphery by packaging them with attractive "profit routes". This carrot measure would be coupled with strict regulation for other bus operators not to set foot on designated profit routes. Mexico city made smooth transition from unregulated bus system to entirely semi-public BRT system by incorporating private operators to work under the system. Private operators were given a choice to collect lump-sum pay for giving up their bus, or to collect a guaranteed steady paycheck that amounts to 80 percent of their former earnings while working on the routes with state-owned bus.³⁶

Lima already accumulated experience on formalizing the bus system with the adoption of BRT system in 2010. Metropolitano was developed under a public-private partnership with concessions for bus feeder routes. Network of private bus operators are currently covering the BRT route. Despite quality service of Metropolitano, its reach remains still quite low as it attends 5% of the demand. Five non-BRT complementary bus corridors were introduced to expand the Metropolitano's service with the expectation to reach 50% of the demand, but it only reaches 17%.

³⁵ Vigo, M. (2013)

³⁶ Ibid.

3. Infrastructure Analysis: Road Network

The spatial scope of this study is Lima Metropolitan area which includes the city of Lima and the city of Callao. Callao is administratively separated from Lima but considered as one urban area, transportation-wise. Although two cities have different municipal governments, they are integrated historically, geographically, socially, and most importantly, in terms of transportation infrastructure.



Figure 11. Lima's Map and Main Routes³⁷

Lima has 43 districts which are divided into four zones: northern, center, eastern, and southern Lima. The northern region consists of 8 districts, the center 16, the eastern 7, and the southern 12 districts. The road network is a hub and spoke structure, which is centered on Center area. The North-South axis connects Panamericana Norte and Sur(①), Paseo de la Republica(④) and Nestor Gambetta(③), while the West-East axis are composed of Javier Prado(②) and Carretera Central(⑤). Circuito de Playas is responsible for traffic circulation of the western part of the city along the coast. Callao and Lima are connected by three major roads: Argentina, Colonial, and Venezuela avenues. As the road structure suggests, vehicles moving from east to west or north to south are going through the city center, causing heavy traffic in the region. Moreover, although some main artery roads have multiple lanes for city traffic, most of the road capacity is absolutely lacking.

³⁷ Instituto Nacional de Estadística e Informática (2014). Pg. 9. and Rodríguez, R. (2019).

4. Administrative Analysis: Capability of ATU

On December, 2018, the Authority for Urban Transportation (ATU) was created as an specialized technical organization under the Ministry of Transport, with the purpose of integrating the uncoordinated transportation initiatives on the jurisdiction of Lima and Callao, in order to reduce commuting time, transportation costs, traffic jam, use of private transportation means, and polluting emissions.³⁸ ATU's mandate is to plan, regulate, manage, supervise and promote the efficient operation of the Integrated Transportation System of Lima and Callao.

The fragmentation in the Transportation System that ATU seeks to solve is evidenced by the lack of comprehensive Master Plan that covers the overall transportation system, plus the lack of connection among various transportation means such as BRT, regular buses and Metro, and lack of coordination between initiatives of Lima Municipality and those of the Ministry of Transport. This results in an inefficient, slow and expensive public transportation system, and a higher demand for private Microbuses. Another aspect is the fragmentation of transportation statistics, which are generated by different divisions within Lima Municipality and the Ministry of Transport.

Henceforth, and as per its creation law, ATU will absorb the responsibilities of the Urban Transport Management function in Lima Municipality, the BRT management function in PROTRANSPORTE, the Urban Transport General Management function in Callao Municipality and the Metro management function in the AATE. This reform is expected to lead to an integration of the different transportation means, their routes, methods of payment, and the creation of a single collection system (*Sistema Unico de Recaudo*).

Consistent with this unification, ATU's Board of Directors is integrated by eight members designated for five years and composed by two members proposed by the Ministry of Transport, one of them presiding the Board, one member proposed by the Ministry of Economy, another one by the Ministry of Housing, and four proposed by the Provincial Municipalities according to their population size. Due to its relatively recent creation and the ongoing transference of functionalities and physical transference of offices and equipment, ATU is not yet fully operative, however, it is expected to operate in full force from June 2020.

³⁸ MTC (2018)

IV. Policy Recommendation

1. Landscape of Potential Solutions

Policy alternatives to improve public transportation service that have received recent attention from the media include the installation of Cableways and expanding the capacity of road itself. We evaluate these and other policy alternatives according to Lima's unique topographical features and connection to broader transportation strategy.













Firstly, the Cableway project proposed by mayor-elect Jorge Munoz aims to install a funicular transportation system like those in Medellin, Colombia or La Paz, Bolivia. The planned route is from San Juan de Lurigancho to Independencia, which is near city center. It needs an estimated investment of \$89.4 million USD, apart from annual operation costs. This is 300 times of annual transportation budget of Lima, which is \$0.3 million USD on average.

Cableway would facilitate the connection to the main roads of those citizens who live in hard-to-access hill, who are low-income population. The political support expected for this policy is limited to its potential beneficiaries, who would enjoy a more comfortable and faster commute, provided the fare remains affordable. This alternative fails to address the overall waste of time in the system, the traffic congestion and the multiple obstacles to transit, so it is not technically correct. Moreover, it is financially costly, which would hamper its implementation. In comparison to La Paz, which is located at 3,600m, shaped with steep slopes, and thus face many limitations with traditional public transportation, Lima is mostly on flat terrain of the Peruvian coastal plain.

A second policy alternative to decongest the traffic jam in Lima is the construction of tunnels and bridges, as well as a peri-urban viarail. Building more roads or expanding existing roads is costly and hard to incorporate without hindering the transportation flow during the construction period. Though it could decongest the traffic in the center area by providing roads which don't unnecessarily go through it, it would bring great discomfort in the short-term, by hindering even more the already saturated transportation system during the construction phase. It is, therefore, politically supportable in the long-term but would face complaints during its implementation. Furthermore, it is an expensive alternative that does not address many of the inefficiencies in the current system, but rather postpones solving the root cause by temporarily alleviating its effects.

Since these two alternatives do not properly address the highly interrelated problems identified: (1) Waste of time due to traffic congestion, and (2) Obstacles to transit, such as different fare collection methods and lack of information on the best routes to take; we propose a package of relatively low-touch policies to address them in the short-term. Our policy package is centered around Information, Transit and Standardization (ITS).

Table 3. Summary of Policy Alternatives Analysis

Policy Alternatives	Technically Correct	Administratively feasible	Politically supportable
Status quo			
Installing Cableway			
More/Better Roads			
Bus ITS package			

The ITS policy package -consisting of BIS, increased information sharing, unification of payment methods, transit discount, standardization of buses and streamlining of routes- can alleviate the transportation system problems in Metropolitan Lima immediately, as their implementation does not require large investments or face strong political opposition.

This set of measures are technically correct as they directly address inefficiencies in the system that result in an excessively long and expensive commute. The limited information on arrival times increases the perceived “wasted” time at the bus stop. A Bus Information System (BIS) provides real-time bus arrival information to users while improving efficiency of bus operation by monitoring and managing bus intervals. Although the costs of BIS vary depending on number of bus fleets, level of Automatic Vehicle Location (AVL) technology, and other technical components, the cost would not amount to that of the Cableway project.³⁹

On the issue of information sharing, ATU can utilize existing mobile apps. The widely known Google Maps does not provide information on the bus routes, while two other local apps⁴⁰ provide limited information on bus routes but are mostly unknown by the citizens, and therefore underutilized. Collaborative effort to increase awareness on these resources will strengthen the policy effect.

³⁹ U.S. Department of Transport (2003)

⁴⁰ Nishiyama, A. (2019)

The technical standardization of fare collection system and payment method is necessary to ensure user convenience. BRT and Metro are equipped with transportation card technology, but regarding which technology should be applied as a standard needs a separate review. Integrated fare system between public transportation means will be the technological base for adopting the transit discount policy as well, which would translate into a more affordable public bus transportation system.

Lastly, to improve the perception of chaos which currently characterizes traditional minibuses, a path towards higher formalization must be taken. The standardization in the colors of minibuses, though seemingly irrelevant, could facilitate communication of routes as well as translate into an increased perception of formality in the system, resulting into behavioral changes of the users as well as the drivers towards a more law-abiding disposition.

Brief evaluation of potential alternatives against three key dimensions of Technicality, Administrative and Political environment showed that ITS package is comparatively reasonable policy alternative. We plan to provide assistant legislative and administrative measures to improve the efficiency of the policy and strengthen implementation process.

2. Policy Proposal

The study aims to utilize ITS to provide necessary information to users, improve bus operations, and make the bus system more affordable. The policy goal is to improve efficiency of bus operation and user convenience by monitoring and managing real-time location of buses through BIS, while leveraging existing platforms to facilitate users choosing the most efficient bus route to arrive to their destination. BIS' reliable bus arrival information will be provided to citizens at each bus stop through built-in display or through a mobile app. This will reduce the perceived and actual wait time of transit riders⁴¹ and allow the transportation center to manage bus fleets better. The policy has high technical correctness since the solution is well-defined with clear components of what would take to make it work and performance is promised when the system is adopted without glitch. In the case of Baltimore, United States, after the city introduced BIS and BMS, the timeliness of local bus, commuter bus, train and subway increased by 25%⁴².

⁴¹ Watkins, K. (2010)

⁴² Maryland Transit Administration

Moreover, it is politically supportable considering that BIS shows user satisfaction of average 90% among cities around the world and naturally leads to better bus fleet management. The system provides various information such as estimated time of arrival and route information for passengers. Current bus operators would not feel like they are in harm's ways, since it does not directly limit their operation but rather improve management capability. The system has incentive for bus operators since it helps reduce total cost by maximizing the efficiency of bus operation such as reducing low-operating fleets and fuel cost. Also, the system will monitor and manage driver patterns with Fleet Monitoring & Control (FMC) program to ensure bus safety and timeliness.

Lastly, it is administratively feasible considering the recent establishment of ATU, a legal organization under central ministry of Transport, entitled with unified authority to devise and enforce transportation policy for Lima Metropolitan area. ATU is headed by former minister of Transport who is in good terms with Prime Minister and general congress, so the legal and financial resource needed for the project can be procured with less difficulty. Since the administration can also benefit by statistics and data accumulated from the system to generate public transportation policy, as well as real-time traffic information to monitor and react appropriately to emergency situations, there is a motive for the administration.

V. Implementation Strategies: ITS Project

1. Information: Providing Real-time Bus Information by establishing BIS

Lima is currently operating simple form of Bus Information System in BRT buses. Metropolitano has installed GPS-based On Board Unit (OBU) without the fee collection function. Each OBU communicates the location and status of the bus with the Xerox bus operation center in real-time. Xerox bears all the expenses related to bus operation management and service such as transmission fee, and compensates the operation cost with the fare revenue. Arrival information is displayed on the LED board in the station. However, the information is limited to the route name and scheduled time, not reflecting real-time information. In addition, the information is only provided within the station. Therefore, there is a need to 1) improve the quality of the information provided to customers, 2) expand the scope of BIS to regular buses, and 3) start utilizing the data in improving the transportation service.



Figure 12. On Board Units in Metropolitano



Figure 13. On Board Units for Bus and Taxi

In order to adopt Bus Information System without a glitch, three functions should be established.

Data collection. The physical configuration of the Bus information system is physically divided into a BIS center, a roadside base station including a communication device and an information providing device, and an in-car terminal also called as OBU.⁴³ The bus information system installs wireless transceivers on buses and bus stops to identify the real-time bus operating situations.

Bus location data is mainly collected from OBU which include both Bus Information feature and Automatic Fare Collection Feature. OBU is set up with a stable data-collection system utilizing GPS technology which collects bus location data at regular intervals. The device transmits and receives buses' location information and driving information with the information center.

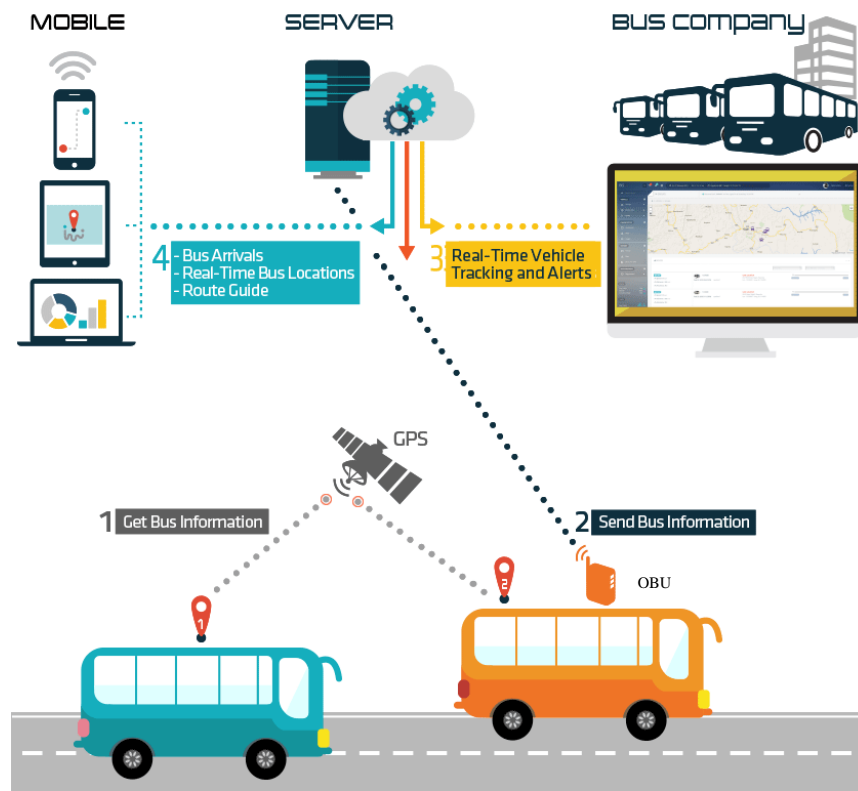


Figure 14. Physical Configuration of the BIS⁴⁴

⁴³ Intelligent Transport Society of Korea (2014)

⁴⁴ Franklin Wireless

Data Processing and Analysis. This is performed from the moment of collecting raw data in OBU. The center server has to handle very large amounts of data, including the location and time of the bus fleets. In order to maximize system efficiency, collected raw data should mostly be processed by OBU and then sent to the information center. Therefore, OBU must be equipped with GIS and route information to design a function of “in-vehicle server” that can perform various calculations⁴⁵.

Based on the bus location monitoring performed for each vehicle, the center will perform the function of generating the average operating time for each bus stop, the interval between bus fleets at the stop and the estimated arrival time.

The estimated arrival time is calculated based on the bus’s travel time of each section (distance between each bus stop), and the travel time average is estimated by applying the ‘moving average method’ that utilizes most recently collected information among the information history. Estimated arrival time is updated whenever the vehicle undergoes a stop or traffic jam. By comparing the actual traffic speed for each section with the specified threshold, the severity of traffic jam is calculated by distinguishing the congested sections and continuously updating the data.

Data Provision. For public transportation users, Bus Information system provides real-time arrival times of each bus via LED board at bus stops, ARS and mobile application. Furthermore, it can provide optimal route and transportation means for users considering transfer.

From operator-oriented view, the information can be used to manage fleets. This is called BMS (Bus Management System). Bus driver can check OBU, whose user interface consists of basic driving information screen that shows fleet interval and estimated time for the driver, as well as time management screen which shows route map, travel distance, and remaining distance. BMS can provide optimal dispatch time to bus companies as well. This function compares each fleet’s operation schedule and actual driving status and creates an optimal vehicle operation schedule, helping operators plan and manage their bus operation. Bus companies are also provided with real-time bus operation information, estimated time of arrival, occurrence of unexpected situation, traffic violations, etc.

For public administration, valuable data which can be utilized to establish traffic policy can be collected and summarized through BIS. For instance, real-time bus operation records such as vehicle ID, its daily

⁴⁵ Intelligent Transport Society of Korea (2014)

trips, speeds, hours, dispatch intervals are accumulated through BIS. Law enforcement authority can spot the traffic violation of buses, traffic management office can monitor bus routes and change of stops with space database. Integrated bus operation management center can monitor real-time information of buses operating in Lima and Callao, able to deliver messages to bus operators and drivers if necessary.

2. Transit: Assuring Fast and Convenient transit by consolidating payment methods and systemizing fare collection

In order to assure easy and convenient transit in Lima Metropolitan area, three measures in the fare collection sector are needed.

Consolidating payment methods between different means of transportation (BRT, CC, Metro).

In order to consolidate payment method among individual bus operators, it is necessary to gradually introduce transportation card system as well as coordinating existing electronic transportation cards. Card operators must first agree to IC standards, and to match communication standards and terminal technologies. For example, Xerox, Lima's BRT transportation card operator, and GyM, that of the Metro can coordinate their technology for the integrated use of heterogeneous cards. Interviews with BRT and Metro operators did not disclose details of technology due to security reasons, but the authority can urge them to coordinate different technology.

Card-based electronic transportation fare collection system is convenient for users if they can carry one card that enables to pay in various transportation means, assisting smooth transit. Based on the system, clear fare plans and transit discount can be introduced easily. This will improve of public transportation service, facilitating the use of various public transportations. From the operator's point of view, computerized fare collection can simplify the fare management process.

Lima has passed the introduction period for the transportation card, so it must further disseminate the card usage through standardization and by installing necessary infrastructure to various transportations. In the case of Bogotá, Colombia, the city's transportation corporation named TransMilenio S.A, has placed an international open competitive bid for its AFC/ BMS construction, maintenance and operation to unify the bus fare collection system.⁴⁶

⁴⁶ UNDP Special Unit for South-South Cooperation (2015)

Table 4. Implementation Phases of Transportation Card

Timeline	Features	Plan Detail
Introduction period	Introduction of transportation card	<ul style="list-style-type: none"> - Introduction of transportation card service - Various transportation card operators emerge
Development period	Dissemination and development of transportation card related technology and infrastructure	<ul style="list-style-type: none"> - Spread the transportation card usage - Standardize transportation card - Equip basic infrastructure to enable the dissemination - Various services based on advanced technology
Maturity period	Stabilizing Transportation card industry and services Improvement of the Industry	<ul style="list-style-type: none"> - Nation-wide compatibility requirements - Multifunctional card utilization and Advanced infrastructure construction - Start of application business through the convergence of technology

Establishing laws/regulations to systemize fare collection. In order to secure the unity of current and future public transportation fare collection system, a standard and guidelines for toll collection system operators should be implemented. Peru does not have legal regulation associated with transportation card. In Lima, large-scale transport infrastructure project such as BRT and Metro was initiated without pre-set standards. As a result, there is no guideline for transportation card companies to abide by, and for transport authorities to supervise and manage the service and technology.

The Peruvian government needs to enact laws on the use of transportation cards for efficient public transportation system. Necessary standard can be drafted by ATU with the support of expert taskforce, including those from industry, academia and research. After the standard is set, it can be used directly in future traffic card facilities. Compliance organization should verify whether the transportation cards and equipment installed by public transportation operators meet the national standard, and grant certification that enables usage.

In the case of South Korea, although private sector first introduced the transportation card, the government took charge in the early 2000s to systemize it by establishing relevant laws/regulations and certification organization. Prepaid transportation card operators are regulated by the Electronic Financial Transactions Act, and postpaid transportation card operators are regulated by Credit Finance Law⁴⁷. Kore's bus system is like Lima's BRT, where a transportation card operator has a separate profit

⁴⁷ Audouin, M., Finger, M. & Razaghi, M. (2015)

model from transportation companies. In addition, in the case of Korean subways, IC transportation cards were introduced in the similar manner as the Peru Metro to promote the convenience of customers.

In reality, intermingled interest of various transportation card operators, the problem of distributing profits, and additional cost from the change of existing transportation card system poses as practical difficulties in developing and enforcing a standardized card. In order to overcome these barriers, it is helpful to establish a coordinating mechanism that reconcile disputes between user and business operators, among business operators themselves, and address technical system errors.

Financing transfer discount. Lima should compare various fare collection system before deciding which they will adopt considering the future financing of transfer discounts among different public transportation means. After Seoul adopted single payment method for all means of public transportation, it also incorporated transfer discount feature in the new system. The problem was that it meant a loss in revenue. The city planned to resolve the issue without increasing basic fares or overburdening its budget by adopting the distance-based fare system⁴⁸.

ATU should consider following factors when reorganizing the fare system. Firstly, the total public transportation fare income after the reform should be same or higher than the current total public transportation fare income. Subsidies to match current earnings for bus operators would be a burden to a city budget, so it is necessary to maintain the fare income in the current fare system after the public transport fare system goes through reorganization. Secondly, the average fare that a user pays should remain similar to the current fare system. It is difficult to gain public support when the fee burden of users increases after the reform without any noticeable benefit. Thus, social benefits such as more convenient public transit, reduced waiting hours, or increased safety must result from the reform.

⁴⁸ Intelligent Transport Society of Korea (2014)

3. Standardization: Assisting Easy recognition and Simple use by standardizing the design of Buses and bus stops along the official routes



Figure 15. Lima's Bus line "36"⁴⁹

Standardizing the design of Buses for easier recognition. Lima's traditional buses design is uninformative and confusing. Habitual commuters recognize buses by their size and color and refer to them by a number. The pink bus in the picture is line “2703” and it is popularly known as “36”, as this is the most visible number on the vehicle front. The main roads covered on the bus route should be shown on both sides of the vehicle but are sometimes covered by advertisements. Users who try to navigate the overcomplicated bus system typically stick to buses whose routes are already familiar to them, unaware of potentially more efficient routes. Tourists give up using Lima's public buses discouraged by its complexity and lack of information. Applications like Moovit and TuRuta have attempted to solve this information gap by displaying different options of bus routes and their associated estimated travel time. However, they display route alternatives using as bus identifier its formal line number (“2703” in the example above), unknown for the user. A better bus design would improve the user-experience and the perception of organization in the system. Clearer communication of bus routes in both the vehicle appearance and apps would enhance efficiency in the use of buses. These benefits could be further realized by an association between these app companies and ATU to increase usage.

⁴⁹ Soto Hernandez, D.

Formalizing Bus Routes. We propose to adjust bus routes to connect different means of transportation in the same station while reducing routes overlap. As stated earlier, Lima's transportation is characterized by high fragmentation, an oversupply of minibuses and an overlap of routes, which result into heavy traffic jam. The current layout of routes must be improved to decrease the vehicle fleet and as a result relieve the traffic congestion. Therefore, ATU must officialize bus routes following what has been done with the Complementary Corridors, in which main avenues allow one line of bus only and smaller buses serve as feeders for them. Informal buses utilizing designated routes must be penalized. Minibuses to serve as feeders must also see a simplification of routes and converge to the bus stops defined in the large avenues to improve connection across buses.

The transition to this formalized system must be done carefully to decrease potential resistance to change from the different agents involved. ATU can seek to incorporate current private bus operators into the formal system by providing adequate incentives. Following Mexico City's case, private operators could decide between collecting a lump-sum payment for giving up their vehicles or collecting regular paychecks that amount to 80% of their former earnings while working on the routes with state-owned buses. To ensure undersupplied routes in the periphery are covered, ATU can incentivize bus operators by packaging less attractive routes with more profitable ones. As for the users, while riding a single bus from departure to destination might increase their comfortability, shorter bus routes will benefit them by allowing higher frequency and reliability of buses.

Standardizing bus stops along the official routes. Based on the Broken Windows Theory⁵⁰, the current chaotic perception of the bus transportation system is potentially encouraging law trespassing. Drivers conduct recklessly while passengers ask drivers to pick them up at places other than bus stops. Currently, in parts of the periphery there is no visible sign to recognize bus stops apart from a crowd standing on a corner. Standardizing them and increasing their visibility could improve the overall perception of formality and organization in the system. Comfortability of strategic bus stops could be increased through provision of shelter or benches. These measures would facilitate and incentivize the use of formal bus stops. In consequence, drivers would no longer stop erratically along the route, which would reduce traffic congestion.

⁵⁰ The Broken Windows Theory states that any visible sign of civil disorder, such as a broken window that stays unrepaired, will motivate further disorder. Kelling G. & Wilson J. (1982)

4. Stakeholder Management: Gathering Support for the Reform Initiative

To ensure successful implementation, in addition to providing reliable project design, we plan to make favorable environment for the change with minimum resistance from stakeholders. The major stakeholder is bus transportation operators, and it is of utmost importance to get them on board. In order to improve effectiveness of BIS, Lima's current privatized, fragmented, and unregulated bus operation should be under more direct public control. We studied the case of Seoul's complete overhaul of its public transportation system as a useful precedence. Seoul changed its privatized bus system into semi-public one while adopting BIS system to ensure the effect.

Introduction of semi-public bus system. Like Lima's current bus transportation system, Seoul's existing system allowed bus companies most of the control while the city intervened only in issues related to licensing bus companies and increasing bus fares. Under the new semi-public system, the ATU would have sole rights to designate bus routes, enforce bus companies to follow its directives, and to centrally gather revenues and distribute it to companies⁵¹. At first, bus company owners were concerned that the semi-public system would infringe upon their property rights and profits. But the city government alleviated this concern to drastic change by devising an agreement through several workshops, discussing and reconciling various opinions. The city and bus operators agreed that the city would guarantee bus companies' management rights and provide reasonable compensation to the bus companies⁵².

Participation of stakeholders in the early planning stage. Hence, Lima's transportation authority should plan to bring in national and local stakeholders early in the project planning stage to ensure inclusive project design. People with the most experience, such as government officials, public and private bus operators in Lima, and companies with expertise in BIS will provide input into the design and planning of the new BIS system. In the name of Bus Reform Planning Committee, this communication channel will be open throughout the project, to allow stakeholder concerns to be voiced and resolved before it becomes the major roadblocks. Private partner who receives contract to construct and operate the BIS system will be selected through a transparent and competitive bidding process.

⁵¹ Ko, J. (2014)

⁵² Seoul Metropolitan Government (2006)

Constant coordination throughout the process. Besides stakeholder engagement in the project, constant coordination between key players is crucial. Coordination would enable active process of co-creation, building trust and ownership. It would be best if the entity fully in charge of coordination process is established within ATU. For example, Seoul, Korea had Transport Operation and Information Service (TOPIS) as the interim coordination entity while BIS system was developed, which later became highly efficient traffic control center⁵³. Lima's coordination entity would share updates and engage inputs from ad-hoc Bus Reform Planning committee composed of representatives from mayor's office, transport and taxation authority, public and private bus operators, and the private firm accountable for implementation. It would later become the control center that collects bus information from the public operator who links districts of Lima from Chorrillos in the south to Independencia in north, and private operators who run services from each end station, linking isolated districts. Then it will customize the information to feed it to citizens through cell phone application or electric bulletin boards on each bus stop.

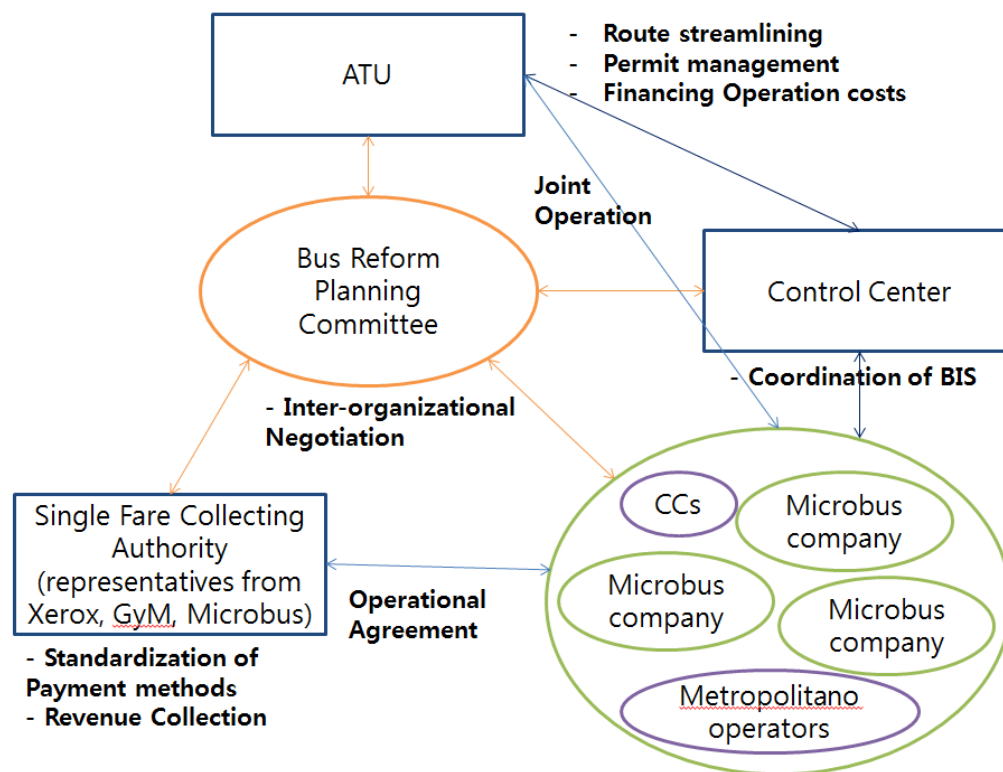


Figure 16 Coordination map in planning executing the Reform Initiative

⁵³ Seoul Transport Operation & Information Service - TOPIS.

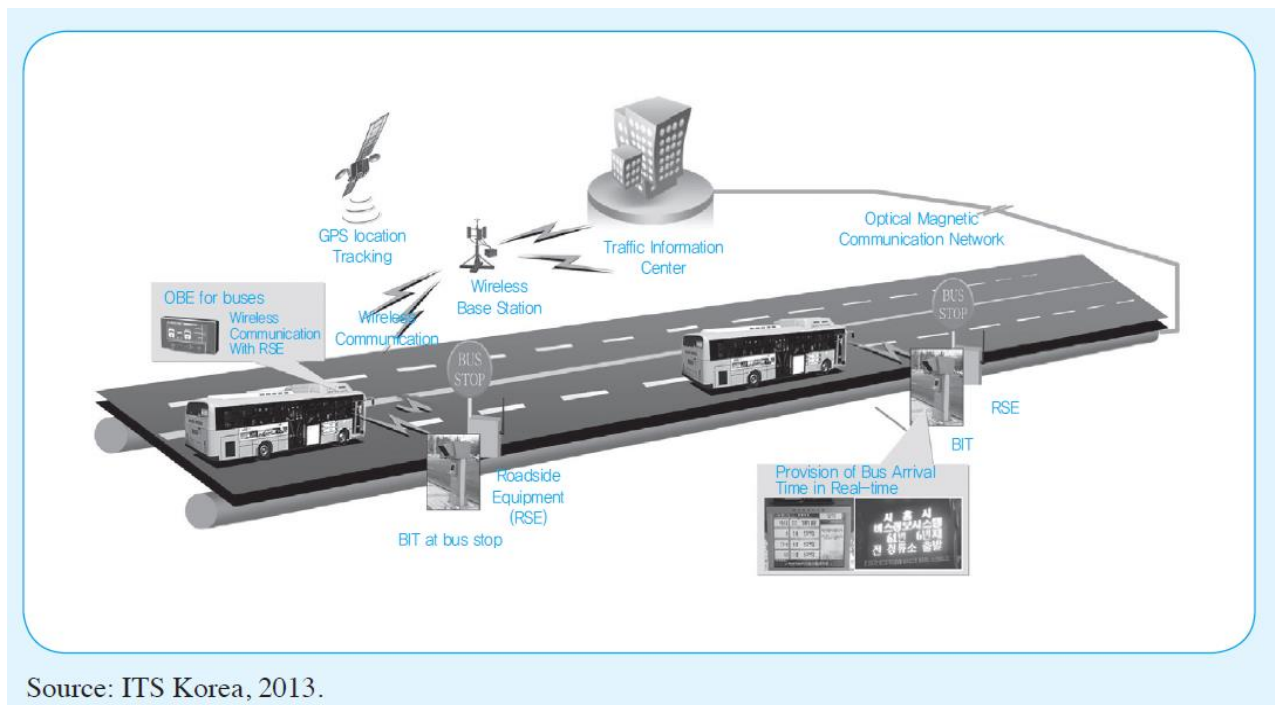
VI. Appendix

1. A Blog post quote on Microbuses' reliability

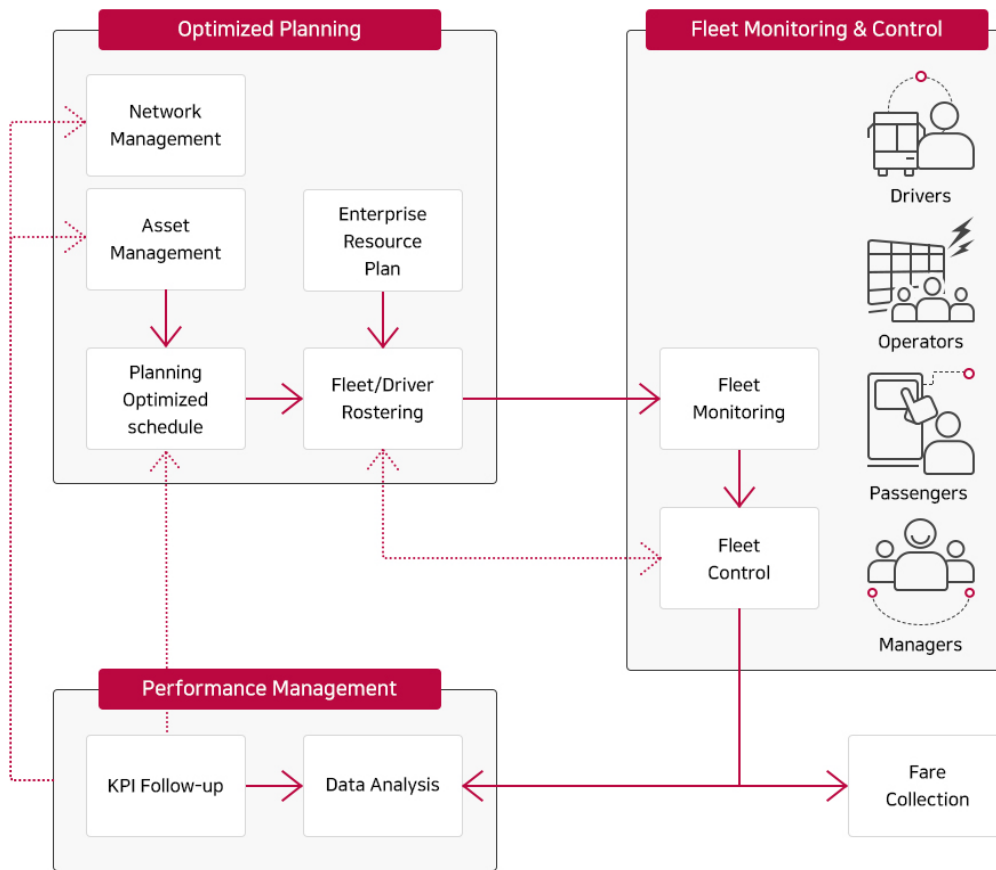


“Another option are micros, some type of minibuses which appear out of nowhere and nobody knows well where they go”.

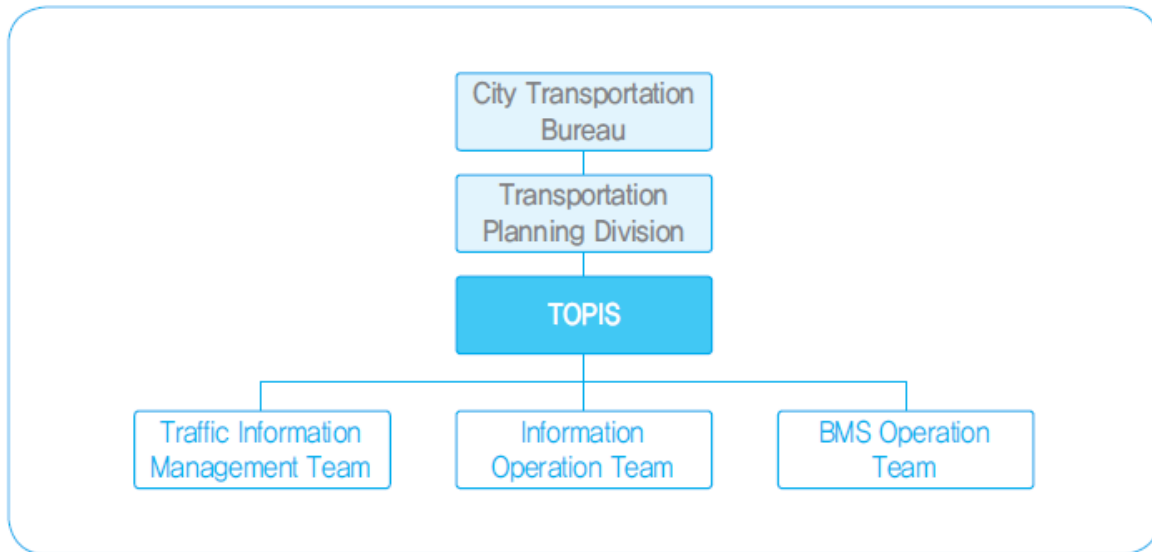
2. Conceptual Design of Bus Information System (BIS)



3. BIS Solution Architecture



4. Organizational Chart, Composition of Roles and personnels - Seoul's TOPIS



Source: Seoul's Master Plan for the ITS, 2008.

Components	Personnel Composition	
Total	About 35	-
Operation of the BMS	About 25	Maintenance (bus stops, on-board terminals) Management of bus operators
The Automatic Traffic Enforcement System (Illegal parking and stopping)	About 3	Detection of traffic violations (Illegal parking and stopping and violation of bus-only lanes)
The Automatic Traffic Enforcement System (violation of bus-only lanes)	About 3	Supporting the operation of bus-only lanes

Source: The Government of Seoul, Seoul's Master Plan for ITS, 2008.

5. Expected concerns from Bus Companies and ATU's possible response

Expected Concerns from Bus Companies	ATU's possible response
<ul style="list-style-type: none"> - The reform would violate private property right 	<ul style="list-style-type: none"> - Guarantee of operation licenses to companies meeting the standards - Companies will be given choice to keep operating under joint revenue management system or get compensation for exiting - Guarantee reasonable profit with standard operation cost - Improvement on collective revenue management
<ul style="list-style-type: none"> - Demand to maintain current system 	<ul style="list-style-type: none"> - Current system would further weaken bus industry (increased use of private vehicles, profit reduction, bigger cost, difficulties in fare increase)
<ul style="list-style-type: none"> - Opposition to the bus route tender system 	<ul style="list-style-type: none"> - Existing companies would be guaranteed entry - Transparent, pre-agreed, just bidding system
<ul style="list-style-type: none"> - Lack of building consensus among citizens, bus companies, and other interest groups 	<ul style="list-style-type: none"> - Collect extensive opinions in the early planning stage - Continuous discussion with transportation experts, civic groups, representatives of bus industry, and reflect it on policy making - Communication and information sharing throughout the reform process
<ul style="list-style-type: none"> - The reform will withdraw some bus routes 	<ul style="list-style-type: none"> - The reform aims to increase bus ridership by improving bus service and decreasing car usage - Over-competitive lines will be streamlined in terms of who operates the line, bus routes will keep their coverage
<ul style="list-style-type: none"> - The reform will reduce jobs 	<ul style="list-style-type: none"> - Loan support system to enhance financial status of bus companies and improve employee's welfare (raised wages, retirement grant system, etc) - Special training classes and certification for those who want transition
<ul style="list-style-type: none"> - Too disruptive change 	<ul style="list-style-type: none"> - Will start with pilot project and scale up progressively after evaluation

6. Problem Diagnosis and Recommendations

Classification	Problem	Recommendation	
		Short-term	Long-term
Bus Information System / Bus Management System	<ul style="list-style-type: none"> ◦ Limited information provided ◦ Applied only on one scope of bus 	<ul style="list-style-type: none"> ◦ Adopt BIS / BMS baseline facility to regular buses ◦ Link to information platform (leverage what Moovit has) ◦ Diversify information attributes and provision range (ex. real-time info, transit info) ◦ Enhance bus operation efficiency by allowing bus operators access to the data 	<ul style="list-style-type: none"> ◦ Establish Integrated traffic management center under ATU
Fare collection system / Payment method	<ul style="list-style-type: none"> ◦ Different rate system is applied to each transportation means ◦ Obscure fare structure of regular buses ◦ No transfer discount when using multiple means ◦ Incompatibility of transportation cards between BRT and Metro ◦ Not able to use electronic cards on regular buses 	<ul style="list-style-type: none"> ◦ Systemize fare collection among public transportation means ◦ Integrate BRT-Metro transportation card ◦ Introduce transportation card in regular buses 	<ul style="list-style-type: none"> ◦ Adopt transfer discount system (Establish the way to calculate appropriate fee level proportional to distance)
Operating System / Route Adjustment	<ul style="list-style-type: none"> ◦ High number of Microbuses, most of them aged (large number of small businesses) ◦ Lack of general bus facilities due to privatization ◦ A large number of unauthorised routes operating ◦ Many redundant routes, focusing on surplus routes => Excessive competition, Profitability decreases, accidents and noises 	<ul style="list-style-type: none"> ◦ Standardize bus designs as the requirement for registration/renewal of license authorization ◦ Establish official bus stops ◦ Find ways to integrate bus operators ◦ Adjust oversupplied bus routes (transparent bidding, match surplus routes with undersupplied routes as a package deal) 	<ul style="list-style-type: none"> ◦ Complete reorganization of the bus operation system (Improvement of existing bus facilities) ◦ Integrate operation of bus operating company ◦ Reduce aged vehicles ◦ Complete readjustment of bus routes (ex. according to bus types)
Regular monitoring of the project based on these performance milestones and appropriate timelines is needed for successful implementation.			

7. Sri Lanka Case Study – Learning from Failure⁵⁴

The years of formation of the bus transportation system in Sri Lanka were characterized by unregulated competition (1907-1938). The fragmentation of responsibilities and wrong incentives led to chaos in the system. In order to increase revenue, local authorities issued multiple route licenses to bus owners to operate any route of their choice: some routes had an excessive supply of buses while others did not have enough to meet demand. The bus operators of congested routes experienced high competition and pressure to keep fares low. This system resulted into poor vehicle conditions, unsafe driving and a general lack of comfort and safety for users.

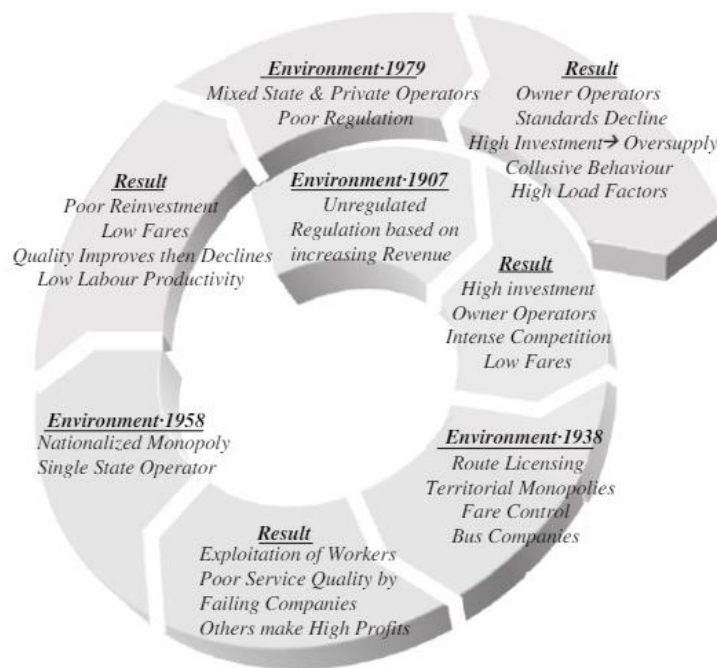


Figure 17. Sri Lanka: History of Bus Transportation System Reforms⁵⁵

In response, the government created a central registration of vehicles and licensing; and encouraged operators to merge. One bus was allocated to one route, constituting routes into regulated territorial monopolies (1939-1957). Fares were regulated by the government according to the route and the number of passengers, which resulted into a diversity of fares. The government imposed minimum fares to protect the railway from bus competition, and maximum fares to protect the users from rising

⁵⁴ This section is based on Kumagare et al (2018).

⁵⁵ Retrieved from Kumarage et al. 2008.

cost of living. This regulation of fares did not allow some operators to acquire new buses to replenish their fleet. These measures contributed to decrease the competition among operators but none of them addressed the quality of the bus operators: lack of timetable, low quality of service, unsafe driving, among others. Additionally, the regulation on fares did not allow some operators to replenish their fleets with new buses.

The revitalization of the economy that followed the end of the war led to an increase in the number of passengers and a consequent shortage of buses. In 1958, the government nationalized the bus service and created a state monopoly: the Ceylon Transport Board (1958-1978). At the beginning, the CTB displayed high levels of professionalism, the vehicles were appropriate and the driving safe. However, politicians attempted to attract voters by implementing populist measures in the transportation sector. Bus fares were set so low that in some cases they did not cover the operating cost. The coverage of buses was expanded to reach less profitable rural areas. Leaving Transportation susceptible to politization resulted into vehicles breakdown and lack of reliability in the service and public dissatisfaction.

Privately owned and operated buses were reintroduced in 1979, in a mixed state-and-private system (1979 to date). Between 1979 and 1983 the demand for buses increased. However, previous operator companies did not re-enter the market, given the lack of trust that the previous nationalization had generated. Instead, many new owner-driven buses joined the market, but they were unable to provide the same standard of service as the state operator. The lack of experience of these owner-drivers led to inefficient management of buses, revenue loss, high accident rates; and the oversupply of buses brought intense competition back to the sector. Currently, over 75% of the public transportation is provided by privately owned buses, and the remaining 25% publicly owned are the source of large deficits.

During different periods the bus transportation system of Sri Lanka faced similar challenges as Lima's transportation system faces now. Among these problems are the oversupply of buses, overlap of routes, high competition, low fares and low quality of service. As seen in this case study, each reform of the transportation sector failed to address the causes of inefficiencies and account for the incentives of the different stakeholders, was guided by ideology rather than problem-driven or highly politicized. Based on the results of these reforms, this SYPA brings a different set of proposals to address the chaos of the bus transportation system in Lima.

VI. References

- Abal, E. (2019, February). Moverse por Lima: información sobre Transporte en Bus. *Una Idea un Viaje Blog*. <https://unaideaunviaje.com/moverse-por-lima-informacion-sobre-transporte-en-bus/>
- Audouin, M., Finger, M. & Razaghi, M. (2015). *How Seoul used the 'T-Money' smart transportation card to re-plan the public transportation system of the city; implications for governance of innovation in urban public transportation systems*. 8th TransIST Symposium Conference.
- Consorcio de Investigación Económica y Social. (2010). *¿Cómo influye el sistema laboral de las empresas de transporte público en la problemática del tránsito?*
- Compañía Peruana de Estudios de Mercado y Opinión Pública. (2019, May). *Lima Metropolitana Report*.
- El Comercio. *Pico y Placa restringirá flujo vehicular en cinco ejes viales* (2019, July 23) Retrieved from <https://elcomercio.pe/lima/transporte/pico-placa-restringira-flujo-vehicular-cinco-ejes-viales-municipalidad-lima-ecpm-noticia-657103-noticia/>
- El Peruano. *Ley que crea la autoridad de transporte urbano para Lima y ley 30900* (2018, December 27). Retrieved from <https://busquedas.elperuano.pe/normaslegales/ley-que-crea-la-autoridad-de-transporte-urbano-para-lima-y-c-ley-n-30900-1727064-7/>
- Franklin Wireless. *Bus Information System*. Retrieved from <https://www.franklinwireless.com/about-us/technology/bus-information-system/>
- Guardia, K. (2019, November 6). *Por cada bus del corredor azul hay 17 informales según Transitemos*. Gestio. Retrieved from <https://gestion.pe/peru/por-cada-bus-del-corredor-azul-hay-27-informales-segun-transitemos-noticia/>
- Guevara, R. (2017, December 28). *Exploring BRT in Lima, Peru*. Multiple Cities. Retrieved from <https://www.multiplecities.org/home/2017/12/28/exploring-brt-in-lima-peru>
- Instituto Nacional De Estadística e Informática (2014). *Una Mirada a Lima Metropolitana*.
- Instituto Nacional de Estadística e Informática (2017). *Censo de Población y Vivienda*.
- Instituto Nacional de Estadística e Informática (2018). *Producto Bruto Interno por Departamentos*.
- Intelligent Transport Society of Korea. (2014). *2013 Modularization of Korea's Development Experience: Establishment of Intelligent Transport Systems*.

- Jauregui-Fung F., Kenworthy J., Almaaroufi S., Pulido-Castro N., Pereira S., Golda-Pongratz K. (2019). *Anatomy of an Informal Transit City: Mobility Analysis of the Metropolitan Area of Lima*. Urban Sci.
- Jordana T. (2014, May 7). *For Lima, There's No Simple Path to Re-regulating public transportation*. Citylab. Retrieved from <https://www.citylab.com/solutions/2014/05/lima-theres-no-simple-path-re-regulating-public-transportation/8982/>
- Kelling G. & Wilson J. (1982). *Broken Windows. The police and neighborhood safety*. The Atlantic. Retrieved from <https://www.theatlantic.com/magazine/archive/1982/03/broken-windows/304465/>
- Ko J. (2014, May). *Reforming Public Transportation in Seoul*. Retrieved from <https://seoulsolution.kr/en/node/1803>
- Kumarage A., Jayaratne, M. (2008) *Lessons in ownership, regulation and management from 100 years of bus transport in Sri Lanka*. Research in Transportation Economics.
- Lara, J. G. (2018, August 24). *La desconexión del transporte público en Lima: sistema fragmentado, lento y caro*. El Comercio. Retrieved from <https://elcomercio.pe/lima/transporte/desconexion-transporte-publico-lima-sistema-fragmentado-lento-carro-noticia-550176-noticia/>
- Leon Almenara, J. P. (2019, April). *MTC: los retos de María Jara en el tránsito y el transporte / #NoTePases*. El Comercio. Retrieved from <https://elcomercio.pe/lima/transporte/ministerio-transportes-comunicaciones-retos-maria-jara-transito-transporte-notepases-noticia-630559-noticia/>
- Levy, A. (2017, September 29). *Four ways to build a better bus system*. DC Policy Center. Retrieved from <https://www.dcpolicycenter.org/publications/four-ways-to-build-a-better-bus-system/>
- Maryland Transit Administration. Retrieved from <http://mta.maryland.gov/local-bus/advisories>
- MTC. (2018, November) *Nota de Prensa. Congreso de la República aprobó la creación de la ATU*. Retrieved from <https://www.gob.pe/institucion/mtc/noticias/22934-congreso-de-la-republica-aprobo-la-creacion-de-la-atu>
- Municipality of Lima. (2013). *Legislative Decree 651. Decree 080-91-EF. Ordenanza 1599*.
- Municipality of Lima. (2013). *Regional Plan for Concerted Development of Lima 2012-2025*. Instituto Metropolitano de Planificación. Retrieved from <https://sinia.minam.gob.pe/documentos/plan-regional-desarrollo-concertado-lima-2012-2025>

Nishiyama, A. (2019, January 18). *Moovit y TuRuta: las aplicaciones que te guían por el transporte público de Lima*. RPP Noticias. Retrieved from <https://rpp.pe/tecnologia/apps/transporte-publico-en-lima-moovit-y-tu-ruta-aplicaciones-que-te-ayudan-a-moverte-por-la-ciudad-android-e-ios-noticia-1162889>

Observatorio Lima Como Vamos. (2016). *Informe Urbano de Percepción sobre Calidad de Vida en la Ciudad*.

Observatorio Lima Como Vamos. (2017). *Informe Urbano de Percepción sobre Calidad de Vida en la Ciudad*.

Observatorio Lima Como Vamos. (2018). *Informe Urbano de Percepción sobre Calidad de Vida en la Ciudad*.

Piedra, A. (2018). *El Transito una tarea de todos*. IPSOS.

PROTRANSPORTE. (2008). *Contrato de Concesión de la Operación del Servicio de Transporte de Pasajeros Mediante Buses Troncales y Alimentadores en el Sistema de Corredores Segregados de Buses de Alta Capacidad*.

PROTRANSPORTE. (2014). *Concesión del Servicio Público de Transporte de Pasajeros en los Corredores Complementarios del Sistema Integrado de Transporte de Lima*.

PROTRANSPORTE. (2019). *Tarjeta Lima Pass*. Retrieved from <http://www.protransporte.gob.pe/tarjeta-lima-pass/>

Rodriguez, R. (2019) “*Pico y Placa*”: *Así se realiza la restricción vehicular en tres ejes viales de lima*. El Comercio.

Seoul Metropolitan Government. (2006). *Seoul’s Public Transportation Reform*.

Seoul Metropolitan Government. (2008). *Seoul’s Master Plan for ITS 2008*.

Seoul Transport Operation & Information Service - TOPIS. Retrieved from <https://topis.seoul.go.kr/eng/english.jsp>

Soto Hernandez, D. A *Todo Bus Chile*. Retrieved from www.atodobuschile.cl

SUNARP. (2018) *Statistics*.

Tmoney. Retrieved from www.koreasmartcard.co.kr

UNDP (2015). *Bogota - Colombia Transmilenio Case Study*. Special Unit for South-South Cooperation.

U.S. Department of Transport, Intelligent Transportations Systems joint program office. (2003). Retrieved from

<https://www.itsknowledgeresources.its.dot.gov/ITS/benecost.nsf/0/5C83960C15265F8785256EA60042FD3B?OpenDocument&Query=Home>

Vigo, M. (2013, June 17). *Can Lima Finally Untangle Its Transportation Mess?* Next City, Volume 1, Issue 62. 2013. Retrieved from <https://nextcity.org/features/view/slow-jam>

Watkins, K. (2010). *Where Is My Bus? Impact of mobile real-time information on the perceived and actual wait time of transit riders*. University of Washington.

World Bank. (2012, March). *Implementation Completion and Results Report on a loan for the Lima Transport Project*.

Yahoo News. (2017, March). *Fotos: La Pesadilla de Viajar en Combi en Lima*. Retrieved from <https://es-us.noticias.yahoo.com/fotos-pesadilla-viajar-combi-lima-slideshow-wp-210417428/photo-p-p-p-pool-olortiga-photo-202911243.html>