A Data-driven Strategy for the Development of a Smart Intercity Bus System in Ecuador: A Comparative Public Policy Analysis between South Korea and Ecuador

By

SUNTAXI, Paola Fernanda

CAPSTONE PROJECT

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF PUBLIC MANAGEMENT

2020

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Committee in charge:

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Approval as of August, 2020

ACKNOWLEDGMENTS

This research is dedicated to my father, Carlos Fabián, and my mother, Laura María. They showed me the importance of education and continuous passionate learning not only to become a better professional but to be a more conscious human being and smartly serve our societies.

I would like to express my gratitude to the Korean government for allowing me to study at the KDI School of Public Policy and Management. Coming from a developing country, opportunities to study abroad and learn about effective and proven public policies are limited. Korea is an outstanding leader in the public transport and smart cities fields. Hence, interaction with knowledgeable professors and practitioners was invaluable.

Studying at KDI was an enriching experience, both professional and personal. I would like to also to thank my supervisor Prof. Dr. Lee Taejun, for his lectures about Digital Transformation and comments for this study to open my vision about the modernization of the state through the responsible use of ICT. Besides, Prof. Yu-Min Joo helped me to understand the advantages and shortcomings of developing a smart city society holistically. Both gave me the tools to explore a structural problem in my society with a wider lens and understanding each part´s reality and finding collaborative solutions.

Finally, I am deeply indebted to all of the Ecuadorian and Korean officers who gave me substantial time when I talked with them or helped me with documents, reports, and archival materials. But above all, I am thankful for their vivid interest in this study. I have significantly benefited from the interaction with highly-trained policymakers and staff.

EXECUTIVE SUMMARY

Providing convenient and sustainable public transport systems is one of the most fundamental challenges for any local and national government. Massive transport systems represent a primary means of maintaining economic opportunities, reducing inequalities, and ultimately enhancing the quality of life for people. Studies demonstrate that the deterioration of the public transportation system is associated with a continuous increase in the emission of CO2, traffic jams, illegal services, and road fatalities, which have come a public health problem. Therefore, policymakers have been called to act to improve public transportation systems and make sure that they evolve with the needs of society.

This study explores the case of the intercity bus service in Ecuador and tries to shed light on recommendations to solve the structural problems behind the obsolesce of the service. Overlapping routes, accidents, robberies, unpunctual and poor service, limited coverage in rural areas, and lack of information for trip planning and online sales tickets are some of the issues why citizens have switched to using illegal door-to-door services. By conducting a comparative public policy analysis with the Korean Bus Reform and using guided interviews with Korean and Ecuadorian officers, it was discovered that 1) the lack of long-term vision, 2) the inconsistent rule of law, 3) the limited technology and human resources, 3) the need of a technical savvy, but above all the little compromise of authorities have hampered the smartization of public transportation in the country. Even though there are have been partial solutions and advances, authorities and experts recognize that it is necessary to rethink holistically how the transportation system is designed and operated, especially in the context of the recent pandemic lockdown. According to experts, it is expected that small and financially unstable bus operators will fill for bankruptcy. Therefore, authorities and critical stakeholders should ground a sincere discussion to build a collaborative transport system that benefits all not only those who have influenced the system for particular gains.

The delivery challenges include the tools of the Korean Bus Reform, such as stakeholders' engagement, quasi-public bus operation/management, adoption of an integrated and technical fare system, and centrally-controlled operations. The application of ICT significantly contributed to the successful implementation. Thus, it is recommended to analyze different scenarios and alternatives for a public-private partnership that optimize and accelerate the modernization of the public bus system.

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CHAPTER 1. INTRODUCTION

1.1. IMPORTANCE OF PUBLIC TRANSPORTATION SYSTEM

Providing convenient and sustainable public transport systems is one of the most fundamental challenges for any transportation institution. Massive transport systems represent a primary means of maintaining economic opportunities, reducing inequalities, and ultimately enhancing the quality of life for people. Traditionally public transportation offered a time-intensive alternative that is more appealing for low-income people who cannot afford the purchase and maintenance of a private car. Nevertheless, nowadays, due to congestions and rapid urbanization, public transportation also attracts middle- and high-income users (Glaeser, Kahn, & Rappaport, 2008).

Inter-city buses play the vital role of commuting people from rural areas to urban areas where they can have access to public and private services and job positions that are not available in their local towns. This dynamic has reduced the isolation of deprived areas of the country. Besides, several studies demonstrate that "…intercity buses are environmentally-friendly, economically-viable, socially-acceptable, and safe means of long-distance travel when compared to other intercity modes of travel" (Woldeamanuel, 2012, p.78). The government's selection of the public transport system model is directly related to political factors such as the convenience, safety, and happiness of the people (D. Lee et al., 2012). The overall performance of the system depends on how the system is operated. For instance, at a low cost, high cost (subsidies) or in public, quasi-public, or private settings. Therefore the modernization and effectiveness of the bus transportation system must be considered as a priority in the agenda of policymakers in developing countries as a means of optimizing the road infrastructure but, most notably, bus transportation can lead to improve social welfare without heavy capital investment projects (Martinez, Sanchez, & Yañez-Pagans, 2018).

1.2. STATEMENT OF THE POLICY PROBLEM

Ecuador ranks as one of the countries with the highest rate of road fatalities in South America (WHO, 2018). In 2018, 2.349 people died in car accidents, and the number of intercity bus accidents increased by 3% (ANTTTSV, 2018a). That year, 227 people died and 137 were wounded in intercity buses. From January to November 2019, 977 accidents occurred involving a total of 1,540 buses. In those mishaps, there were 1,142 people injured and 134 deaths (Bazan, 2020).

It should be noted that there are inconsistencies in the accident data reported by the National Authority of Transit (NAT) itself from year to year, and the disaggregation of the data does not allow to perform an in-depth analysis of the intercity accidents causes. The data collection, preparation, and transformation is one the main institutional weakness, not only in the road safety area but also for the monitoring of institutional performance (Fernando & Ortega, 2018; Interamerican Development Bank & Knowledge Sharing Program, 2019). The disaggregation of data is a critical factor in designing specific strategies or forecasting models to prevent car accidents (Sakhare & Prajakta S. Kasbe, 2017).

The number of intercity bus accidents and fatalities is only the tip of the iceberg. On the demand side, users report a decline in the quality of intercity bus services; for example, 70% of the intercity buses collapse on holidays and weekends, and there are recurrent complaints about overpricing, and unauthorized timetables or stops (Pesantez, 2014). The intercity bus is the only mode available to connect all the cities in the country by mass transit. Just eight cities out of 221 in Ecuador have regular commercial airline service; there are no railways (MTOP, 2016). Therefore, the bus companies sense that they have a captive market, which is a considerable disincentive to improve their services (Ko, 2014; Yaulema, 2017).

On the supply side, bus companies prioritize profits over the convenience of passengers. Bus companies insist on providing bus services along several inefficient or oversaturated routes

(ANTTTSV, 2018b). When some bus companies' representatives were interviewed, they reported that the requests prevent others from using that schedule or route in the future. Only a few justified a citizen a need for mobility[1]. By December 2019, the NAT had 87 requests of technical studies to approve new bus services, 67 new itineraries, and 18 new bus lines[2]. It can be inferred that the information about the planning, management, and operation of the intercity bus system relies on the goodwill of the bus companies and not on any scientific process. Furthermore, there is no evaluation of the efficiency or profitability of routes nor a demand forecasting process[3].

This practice favors bus companies and some users who live or worke near the established bus routes, causing the quality of bus services to deteriorate over time (ANTTTSV, 2018b). The frequent stops in the bus routes made run times excessively long and added to traffic congestion, especially in the main interstate roads. Perceiving bus routes to be excessively lengthy and inconvenient, passengers began avoiding bus services, and illegal services such as door-to-door vans or carpool cars started to proliferate in the last three years (ANTTSV, 2019).

E-ticketing is not available because bus companies have not agreed to share a unique platform or disclose their operations planning, and the government has failed to enforce the implementation of a standardized online system. E-ticketing contributes to a decrease in wait time, fare evasion, and human resources. It is also a useful tool for evaluating profitability of routes and timetables. Additionally, it contributes to creating differential categories such as direct or luxury service (Alenoori & Mirbaha, 2016; Patnaik, Chien, & Bladikas, 2005). Furthermore, the lack of this E-system restricts: 1) the users to access important trip information

[1] Interview with bus companies' representatives for Capstone Research. Topic: how to improve and modernize the intercity bus system. J. Lara (personal communication, November, 2019). M. Ortiz (personal communication, January, 2020). H. Cevallos (personal communications, April, 2020).
[2] Interview with Director intercity bus unit at the NAT, April, 2020.
[3] Ibid2.

and make informed transportation choices; 2) the bus companies to better understand and optimize their operations (Anderson, 2003).

According to transport experts (personal communication, Jan. 10, 2020), one of the main problems is the business model; 80% of the bus companies are organized as cooperatives, which means that the bus belongs to an owner and not to an enterprise. Therefore, most of the bus companies have a family or subsistence business model (Chauvin, 2006; Yaulema, 2017).

In line with the last statement, the NAT conducted a national survey in 2018 to 18,175 drivers, where 76% informed that they work more than 10 hours per day (fewer drivers, fewer social benefits to pay). 40% of them reported not have vacations in more than one year, and 30% are paid per route or day; so, if they do not work, they do not have a regular income. Furthermore, there is no adequate infrastructure for rest stops along the roads, and 35% of them sleep on the bus to save money (ANTTTSV, 2019b). A research of the University of Guayaquil establishes that 45% of the intercity bus accidents are related to occupational health plan issues such as tiredness, hypertension, diabetes, alcohol problems, and malnutrition (D. Castillo, Herrera, & Muñoz, 2013). Operations management and enterprise values are positively correlated in preventing work-related diseases and accidents which are very prevalent in this profession (Brunoro, Sznelwar, Bolis, & Abrahao, 2015; Useche, Gómez, Cendales, & Alonso, 2018)

Currently, the Ecuadorian government has experienced a weakening of reliability in its policy design and execution due to the absence of fundamental data needed for the effective establishment and evaluation of transport policies. The lack of collecting and reprocessing data has led to the deterioration of the whole intercity bus system regarding an increase in bus accidents, lack of coverage, and the creation of illegal companies that provide a better service. Under this lose-lose situation, it is necessary to explore the most appropriate strategies to develop a smart intercity bus system in Ecuador.

1.3. RESEARCH QUESTIONS

The following research questions will be considered for this capstone project:

1. What are the governance arrangements being implemented by the Korean government to execute sound bus transportation reform?
2. What strategies and technologies are being used by the Korean public transportation system to guarantee smart mobility?
3. Which initiatives could be applied to intercity transportation in Ecuador based on the experience of South Korea?
4. What is the best customized public-private partnership model to attract future investments?

1.4. OBJECTIVES

General

- Analyze and compare the governance and technologies of the Korean intercity bus system to Ecuador's to identify the best practices and give policy recommendations to develop a smart intercity bus system.

Specific

- Analyze the public transportation reform in Korea to understand the context, strengths, and weaknesses of the current bus system.
- Scan the technologies used to plan, operate, and monitor the Korean intercity bus system.
- Identify the critical success factors of the intercity bus governance and business model.
- Provide customized recommendations to the National Authority of Transit to develop a smart intercity bus system.

1.5. METHODOLOGY OVERVIEW

This capstone aims to conduct a comparative policy analysis on Korea´s bus reform as a part of process of policy learning. Scholars and practitioners use policy learning to discuss instances where governments adopt a particular policy based on the evaluation of a policy in place elsewhere. Comparing public policies over space and time often requires simplifying the context of the policy implementation to try to understand the explanatory factors for certain decision-making and the behavior of actors (e.g., not considering externalities, or cultural influences) (Schmitt, 2012). The major critics of this methodology cite the complexity to determine the critical factors of a successful or failed policy and the overestimation of the impact. These peculiarities might compromise the validity or generalizability of the findings. However, this method is widely used as an ex-ante insight in the policy design phase, especially in cases of proven best practices or already evaluated policies (Geva-May, Hoffman, & Muhleisen, 2018; Schmitt, 2012).

This study aims to discover the success factors of the Korean Bus Reform and analyze which strategies or solutions might be considered by the Ecuadorian government to modernize its intercity bus system. Since the context and institutional arrangements of both countries differ, it is essential that the research design assures credibility, dependability, transferability, and authenticity. Thus, the author has selected a framework of research methods and techniques that allow learning from the Korean experience and communicate these findings to Ecuadorian policymakers and government officials.

Research Design

Table 1 present the research design and the flow of the study by numbers. It was essential first to understand the Korean case in order to design the exploratory instruments for the Ecuadorian case. The case studies are based on a literature review, field trips, and in-depth interviews. The research design seeks to conduct a systematic approach and verify the findings

from the literature review. Then, the comparative analysis aims to find the determinants of change as well as the key differences between the two cases. Finally, these insights served to design a customized data-driven strategy and recommendations.

Table 1. Diagram of the Flow of the Study

	CASE STUDY	
	KOREA	**ECUADOR**
PREPARATION PHASE	**Data Collection Method**	
	Literature Review: the Korean case has extended literature about Bus Reform and ITS systems ❶	Literature Review: the Ecuadorian case has limited public transportation; most of the studies are focus on urban transportation. Therefore, the primary source would be Bills, National Authority Reports, denounces and journalistic investigations ❼
	Field Trip: Direct observation on intercity and urban bus operations, ticketing system, bus terminals and stops, the technology used on buses by drivers, differentiated fares and monitoring centers ❷	Field Trip: Direct observation at National Authority offices (public transport unit) and monitoring center. Bus terminals. ❽
	Semi-structured questions: Questions aligned to the objectives of this study ❸	Semi-structured questions: Questions based on the critical success factor identified in the Korean Case ❾
	Avoid leading, double-barreled questions Present facts as background information for complex questions Sequencing: Macro (the rule of law) to micro (the specific function of departments and units, service)	
	Sampling Strategy	
	Sampling method: Key informants	
	Who are the best informants: Transport experts in the field of public transport and road safety ❹	Who are the best informants: Transport experts, consultants, transport unit officials, representatives of bus companies
	Unit of Analysis	
	Base on the organizational chart The community members' practices would be the unit of analysis The research questions would help to narrow the case study, one of which may be their perceptions of different aspects of their practices in responding to public transport issues.	
ORGANIZATION PHASE	**Categorization and Abstraction**	
	Categories: 1) legal framework, 2) law enforcement, 3) bus system management, 4) service characteristics, and 5) technology in place. No overlapping category ❺	
	Interpretation	
	Descriptive analysis of critical success factors ❻	Exploratory analysis: categories and transport governance (stakeholder analysis) ❿
	Representativeness	
	Trustworthiness: crosscheck literature review and results on interviews ** All interviews are recorded	Trustworthiness: crosscheck with government officials interviews (policy side) with bus operators (implementation side). Crosscheck information from interviews with journalistic/ academic investigations Comparative analysis: stakeholder analysis, power matrix, analysis of Korean strategies ** KEY DIFFERENCES
	Representativeness: experts familiar with the research topic, who then evaluate whether the results match reality. A deductive approach is used, double-coding to assess the quality of categorization.	

REPORTING PHASE	Reporting Results
	1. Ecuador Case, since it is a unit of comparison for policy learning. Context, demographics, and categories 2. Korea Case: explore critical success factor by categories, report base on success factor 3. Comparative analysis: what strategies by each category are feasible to implement in Ecuador 4. Data-Driven Strategy for Smart Mobility: deductive analysis from the interviews what are the enablers to modernize the public transportation system in Ecuador 5. Conclusions and Policy recommendations

Source: The Author

Target Population: Korean and Ecuadorian government transport officials or consultants with knowledge in public transportation management and infrastructure (key informants approach). In the case of Ecuador, not only the government side was explored, but also the supply side or bus operators, *see Table 2 list of interviewees and research topics*. A few bus owners were included; however, due to time constraints, bus users were not included. For further research, the users' perspective would provide insightful information about what are the most valuable service characteristics.

Theoretical sampling and Appropriateness: The selected target is appropriate for the research objectives since both groups are expected to know about past and current public transport issues as well as critical success factors. The key informants were identified from the organizational charts of their institutions or due to their roles as researchers. After contact with them and knowing the capstone objectives, interviewees refer to other colleagues. It was essential to know bus operators´ perspective about the smartization of public transportation since, in some reports and research projects, bus operators are perceived as a strong resistance for change. The categories of the study were 1) legal framework, 2) law enforcement, 3) bus system management, 4) service characteristics, and 5) technology in place.

Anonymity and Confidentiality: Since this study is a comparative analysis of public performance, it does not involve controversial topics; furthermore, the main aim is to look for best practices, so anonymity was not an issue. Regarding confidentiality, all interviewees were asked for permission to record and use their expert criteria as inputs of this study. Some

interviewees ask not to quote when it comes to political influence analysis. Besides, this study crosschecked their views with reports or newspaper articles.

Data Collection: the primary source of the consultation were government reports and recorded semi-structured interviews. This type of interview involves the implementation of several predetermined questions and/or special topics for the specific expertise of the interviews. The research design aims to cover all the areas presented in the theoretical sampling by finding a consultant or a government official working in that area; for instance, lawyer for the analysis of the rule of law, bus operators for the operations analysis, high authorities for transport governance analysis. The questions were typically asked of each interviewee in a systematic and consistent order, but it was allowed the freedom to digress; that is, the interviewers are permitted (in fact expected) to probe far beyond the answers to their prepared and standardized questions.

Interpretation of the Data: the data was collected and ordered by the theoretical sampling, and the Korean Bus Reform success factors highlighted in the literature review. Furthermore, the stakeholder analysis also contributes to confirming the view of the interviewees in the field of transport governance. Finally, the exercise in evaluating the strategies applied by the Korean government confirmed the interview findings and provide solution ideas to Ecuadorian experts for their current problems. These interactions create a nourish debate about public transport enablers for a public-private partnership.

Table 2. List of Interviewees and Research Topics

Name	Public Transportation Expertise	Research Topics	
		General	**Specific**
Álvaro Guzmán	Executive Director of the NAT Ph.D. Transportation Governance	• Right and wrong of Transportation law • Long-term public transportation vision • Law enforcement evaluation and consequences • Stakeholder analysis and conflict management • Evaluation of the supply and demand public transportation • Road safety • Transport subsidies and fares • Transport Facilities and integration with urban transportation • SWOT Analysis of the NAT • ITS system • Externality COVID19 • **Appraisal applicability of the Korean case´s in Ecuador**	• Transport Governance • Strategic projects for public transport improvements • ITS system PPP • Organizational chart NAT
Juan Emilio Rodriguez	Expert in Land Transportation and Mobility in Latin America (World Bank, and the Inter-American Development Bank) - Leader of the Sustainable Mobility Studies Team in Ecuador		• ITS system PPP • Public Transportation business model • Intercity bus service evaluation
Hugo Cevallos	Ex Vice-minister for Land Transport and Road Safety Minister of Transport and Public Works Master in Transportation and Logistics		• Public transportation infrastructure • ITS system • The political view of the sector • Land Transport Reforms
Adrián Ortega	Director of the Department of Transport Licenses and the Public Transport Unit of the NAT Master in Sustainable Transportation		• Interaction with bus owners Performance evaluation of public transport unit
Alan Peñafiel	Director of the Department of Transport Studies and Fare of the NAT Master in Planning and Transport Engineering		• Fare system and sustainability of public transportation
Carla Guzmán	Legal Director NAT Lawyer specialized in Public Administration		• Transport Governance • Law reforms
Karla Vaca	Head of the Public Transport Unit Geography Engineer		• Interaction with bus owners • Planning and operational procedures • Evaluation of public transportation
Andrés Urquizo	Analyst Public Transport Unit Geography Engineer		
Juan José Lara	Intercity Bus Owner	• Public transport Business model	• Problems of public transportation • Bus operations and drivers • Fare system • Role of transport federations • Requests to the government
Mariano Ortiz	Intercity Bus Owner		
Joaquín Calero	Urban Bus Owner		
Choi Dong-Gyu	Team Leader Smart City Division Daejeon Metropolitan City	• Key Success Factors for the Modernization of Korea Public Transport System • Joint Revenue system • TOPIS • Rural areas coverage • New projects	Characteristics of smart mobility Public transportation sustainability
Kim Seong-lyong	Local Bus Policy Department Daejeon Metropolitan City		• Bus Reform Act • Transportation Rule of Law in Korea Subsidies
Han Dae-Hee	Tram Policy Division Daejeon Metropolitan City		• Sustainability and walkability projects
Byongho Choe	Head of Transport Safety Research Office Korea Transportation Safety Authority		• Road Safety Control to bus operators Law enforcement
Sungmin Hong	Transport Safety Research Office Senior Researcher Sungmin Hong		

Source: The author

1.6. RELEVANCE OF THE KOREAN CASE

The Korean bus reform considered a worldwide outstanding case due to its holistic view nature that included: improvements to management and institutional arrangements, technological innovation, changes to the business model, and enhancement of the environment (Ko, 2014). Besides, the opportunity of fieldwork and interviews in-situ with Korean officials was a plus for this research. Currently, there is not a study that provides recommendations and lessons learned from Korea in the public transportation field for Ecuador, even though, cooperation between the two countries has increased in the last few years. There have been four visits of Ecuadorian officials to Korea without any specific results[4]. Thus, this capstone intends to provide to the National Authority of Transit an overview of the Korean bus reform and give recommendations that consider the weaknesses and strengths of the NAT and the current inter-city bus system.

1.7. LIMITATIONS OF THE STUDY

There is little consensus on how to define smart mobility, and the activities related to this concept. As such, the definition and activities analyzed in this study might not suit the particular vision of every local government or government organization. However, it is believed that this study serves as a benchmarking exercise that helps to identify sounded smart mobility strategies, regardless of definition.

Another limitation relates to existing academic literature that links Intelligent Transportation Systems (ITS), with intercity bus systems. Although the link between these two elements might seem straightforward, most of the literature refers to urban city bus applications. In the case of Korea, there is a categorization between trunk lines (long-distance lines – intercity) and branch lines (urban circuits), see *Annex 4 Bus lines operations arrangements in Korea*.

[4] Interview with Senior officer National Autority of Transit, April, 2020.

According to Korean transport experts[5], even though the Bus Reform started in Seoul Metropolitan City, many other cities have adopted its model. Hence, the Korean Government has decided to escalate the Seoul Bus Reform nationwide. The target of the integration for nationwide public transport is analyzed straight intercity buses and ordinary intercity buses, which were causing a sustained decrease in passenger demand and an increase in the financial burden of local governments. The Seoul and Daejeon trunk lines already have implemented the model of an integrated system as systems of routes, fares, information, transfer facilities, and administrative management. The unified management of urban and intercity buses had led to the modernization and integration of the whole land transportation (freight, buses, and private vehicles). In short, the urban model has already been escalated to the intraregional bus system; even though there are other stakeholders such as provincial governors and the traffic flows differ the bus management system and technology are the same.

In the case of Ecuador, the Korean vision might serve to elaborate a sounded National Bus Reform Act that mandates the integration of urban and intercity buses and improve the land-use planning and transport facilities design. However, this vital multidisciplinary integration will not be covered in this study. Instead, the study will focus on the strategies used by the Korean government to modernize bus operations.

The analysis and policy recommendation are based on management practices and results; the financial analysis is not examined in detail because the strategy and technology decision will depend on the government vision for the public transportation sector. In the case of Ecuador, this vision has to be constructed through a consensus of all the stakeholders.

Finally, this exploratory study did not consider specific ITS application elements in the field by interacting with the ultimate beneficiaries. This particular knowledge is essential to improve the design of future policies and programs; however, due to time constraints, this

[5] Interview with Senior officer Daejeon Bus Policy Department, October, 2019.

element was not explored. The knowledge produces by users, and the influence of high-level mandated bodies of other fields such as land and infrastructure, should be considered for future research.

1.8. STRUCTURE OF THE CAPSTONE

This dissertation will be divided into four chapters. Chapter two will present the diagnose and assessment of the inter-city transportation system in Ecuador. Also, it will synthesize the Korean public transportation reform in order to understand the context and identify resources and practices. These elements will serve as inputs to compare the Korean state-of-the-art public transportation system and analyze which strategies could be implemented in Ecuador. Chapter 3 will introduce the key enablers of a data-driven strategy for the development of an intercity smart mobility system in Ecuador. Finally, Chapter 4 will state the conclusions and the policy recommendations of this study.

CHAPTER 2. COMPARISON ANALYSIS OF PUBLIC POLICY BUS REFORM IN ECUADOR AND SOUTH KOREA

2.1. THE DEVELOPMENT CHALLENGE IN ECUADOR

The Republic of Ecuador is located in the northwest part of South America, sharing borders with Colombia and Peru. Its total area is 283.560 km^2, about 2.8 times larger than the Korean Peninsula. In 2017, the total population was 17 million inhabitants; the National Institute of Statistics and Census (INEC) estimate that the population will grow 19 million by 2030. Its official language is Spanish and the country is divided into administrative districts comprised of the the capital city, Quito, and twenty-four provinces.

Table 3. Overview of Ecuador

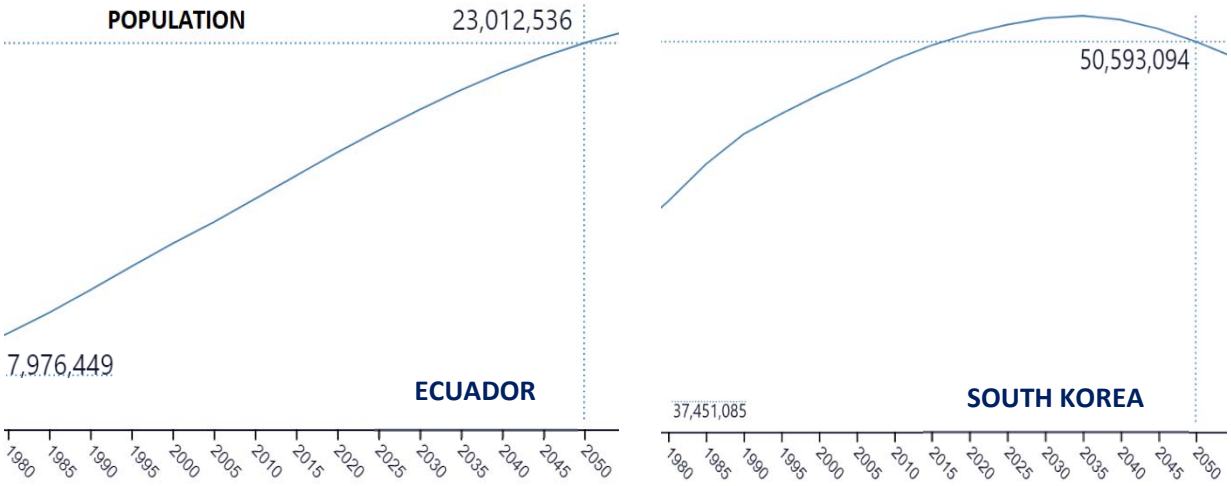
TYPE	DESCRIPTION
Country Name	The Republic of Ecuador
Location	South America
Area	283.560 km² 19% of the national territory for protected areas
Climate	Subtropical, different depending on the altitude
Capital City	Quito
Population	**2019:** 17.300.0006 people **Density:** 61 hab./km² **Estimation 2030:** 19.8 million people
Main Cities	Quito (2.2) million people); Guayaquil (2.2 million people); Cuenca (329.928 people)
Ethnic Groups	Mestizo (71.9%); white (6%), black (7%); indigenous (12%); others (3%)
Language	Spanish (Official Language)
Religion	Catholic (80.44%); Christians (11.3%); others(8.3%)

Source: The Ecuadorian National Institute of Statistics and Census

From the 1990s, the population of Ecuador has grown at a steady rate; in addition, over the last two years, more than 2 million foreigners have stayed, legal or illegally, in the country due to the Venezuelan crisis (Agencia EFE, 2019; INEC, 2010). The population jumped to over 17 million in 2018, doubling the number of inhabitants of the period between 1970 – 1990 (the period in which the current public transportation model was designed). Urban sprawl, suburbanization, and illegal land invasions have aggravated the population concentration,

especially in three of the twenty-four provinces: Pichincha, Manabí, and Guayas. These three provinces make up the 47% of the population and register the highest numbers of commuting trips and road fatalities. Meanwhile, at the local level, the urban areas of Quito and Guayaquil grew from 1 million inhabitants in 1990 to almost 3 million in 2019 (Agencia EFE, 2019; INEC, 2010). Figure 1 presents the comparison of population trends between Ecuador and South Korea; this demographic indicator is significant when comparing the transportation needs and designs of both countries.

Figure 1. Comparison Population Forecast 2050 Ecuador vs. South Korea



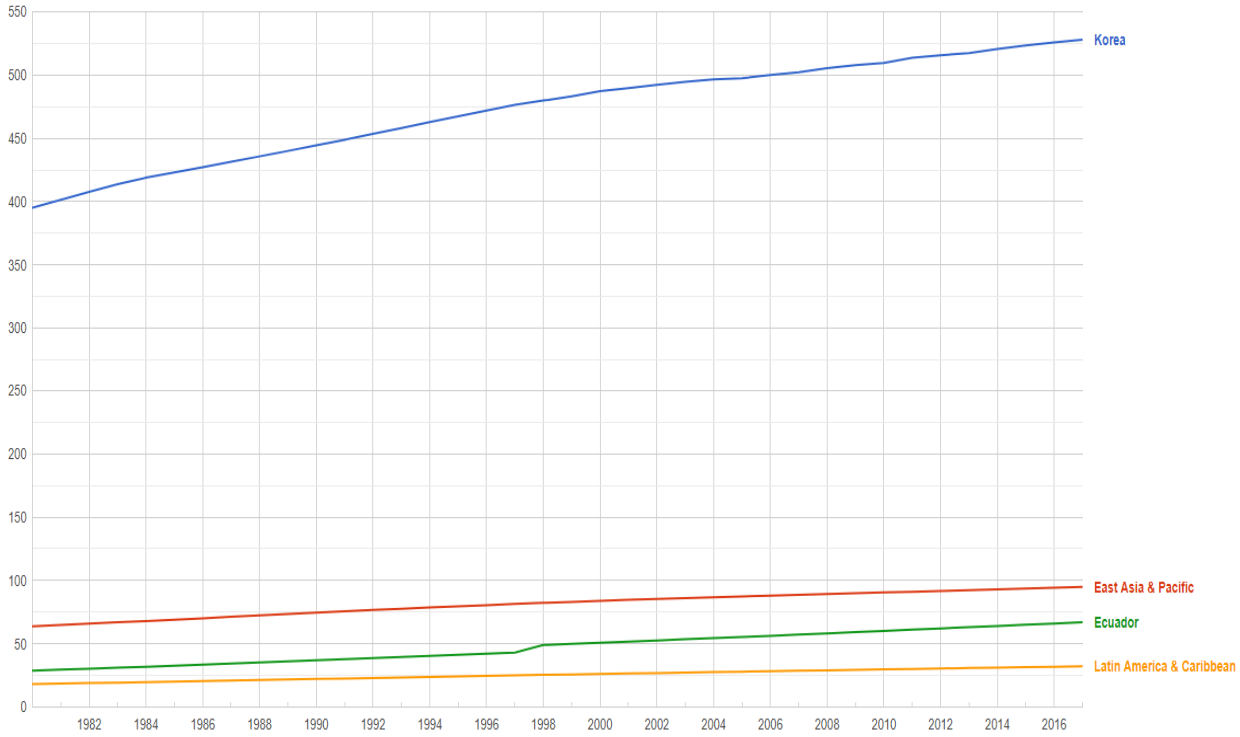
Source: World Bank Data

According to the National Institute of Statistics, by using regression analysis, it is expected that by 2050, the population in Ecuador would be 23 million, 5 million more than 2020 (INEC, 2010); only half of the future population of Korea. Even though the population size affects the size of the market/demand for bus services, this is not an attribute that influences the policy analysis because the capacity and effectiveness of the bus system depend on demand management. The number of the population is a variable that serves to interpret and evaluate the number of users and trips, percentage of coverage, and forecast demand (Zhou, Dai, Wang, & Zhang, 2016). The Korean case can serve as a model to cope with high-density urban transportation as well as intercity bus integration to other modes of transportation.

Population Density and Transportation

The density rate in Korea is one of the highest in the world; see Figure 2. This specific characteristic does have an impact on public policies. In general, densities dot not serve as a standard economic variable in economic analysis, and two countries with different densities of population and infrastructure but similar in macroeconomic parameters can still be comparatively. High population density decreases the natural endowment per capita but eases the development of infrastructure. The trade-off between scale economies and transport costs leads to an optimal area served. In the countries, with low population density, competition might not even emerge because even monopolist companies can become bankrupt due to low demand density, especially in an environment of with high transport costs (Yegorov, 2015).

Figure 2. Density rate comparison Ecuador vs. South Korea



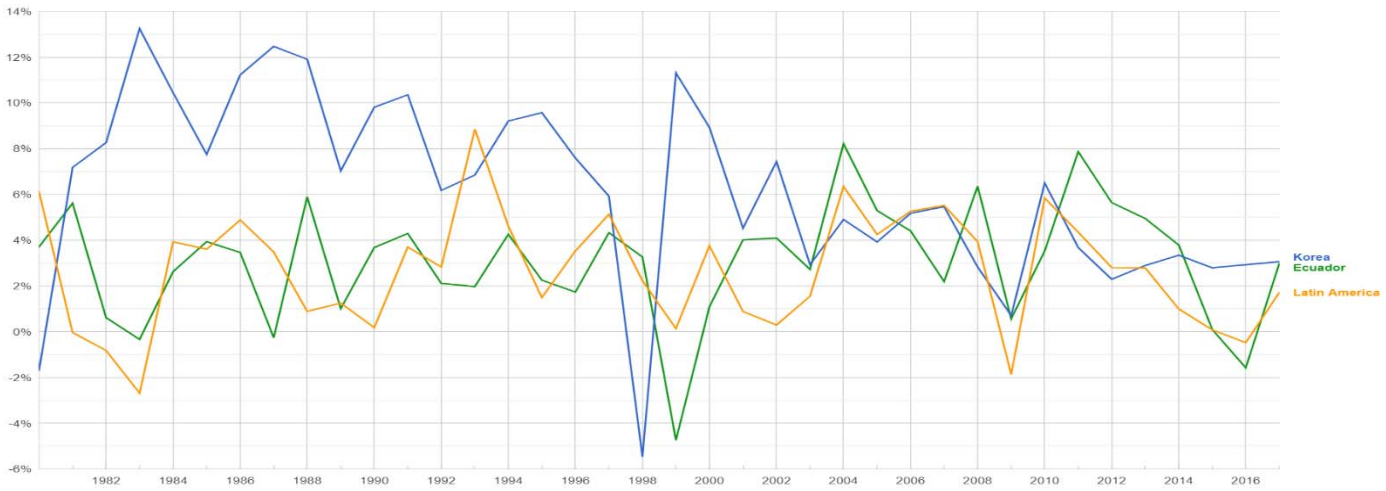
Source: World Bank Data

In the case of Ecuador, the population density will play a key role in two places: (1) the design and adaptability of mass transportation modes and service standards and (2) the business model for infrastructure and transportation provision and maintenance.

Gross Domestic Product and Fuel Subsidies for Public Transportation

In Ecuador, the GDP per capita (current USD) has continued to grow over the last ten years from 3.350 billion USD to 6.198 billion USD, with an average growth rate of 2.1 %, see Figure 3. The decline peaks are directly correlated with the oil market behavior. Ecuador exports oil but import fuel, the imbalance between energy exports and imports does not influence the transport system because of subsidies. The prices for gasoline, diesel, liquefied petroleum gas (LPG), and electricity have been subsidized since the 1970s by up to 85% (Armijos, 2015). In 2012, the country ranked fifth globally in energy subsidies (expressed as a percentage share of GDP); in 2014, it was ranked third in Latin America. Within the last ten years, Ecuador's officially reported fossil fuel subsidies caused a substantial strain on the public budget, equivalent to US$ 2.3 billion per year (7% of public spending or two-thirds of public deficits) (Schaffitzel, Jakob, Soria, Vogt-Schilb, & Ward, 2019).

Figure 3. Average GDP Growth Rate Ecuador vs. South Korea

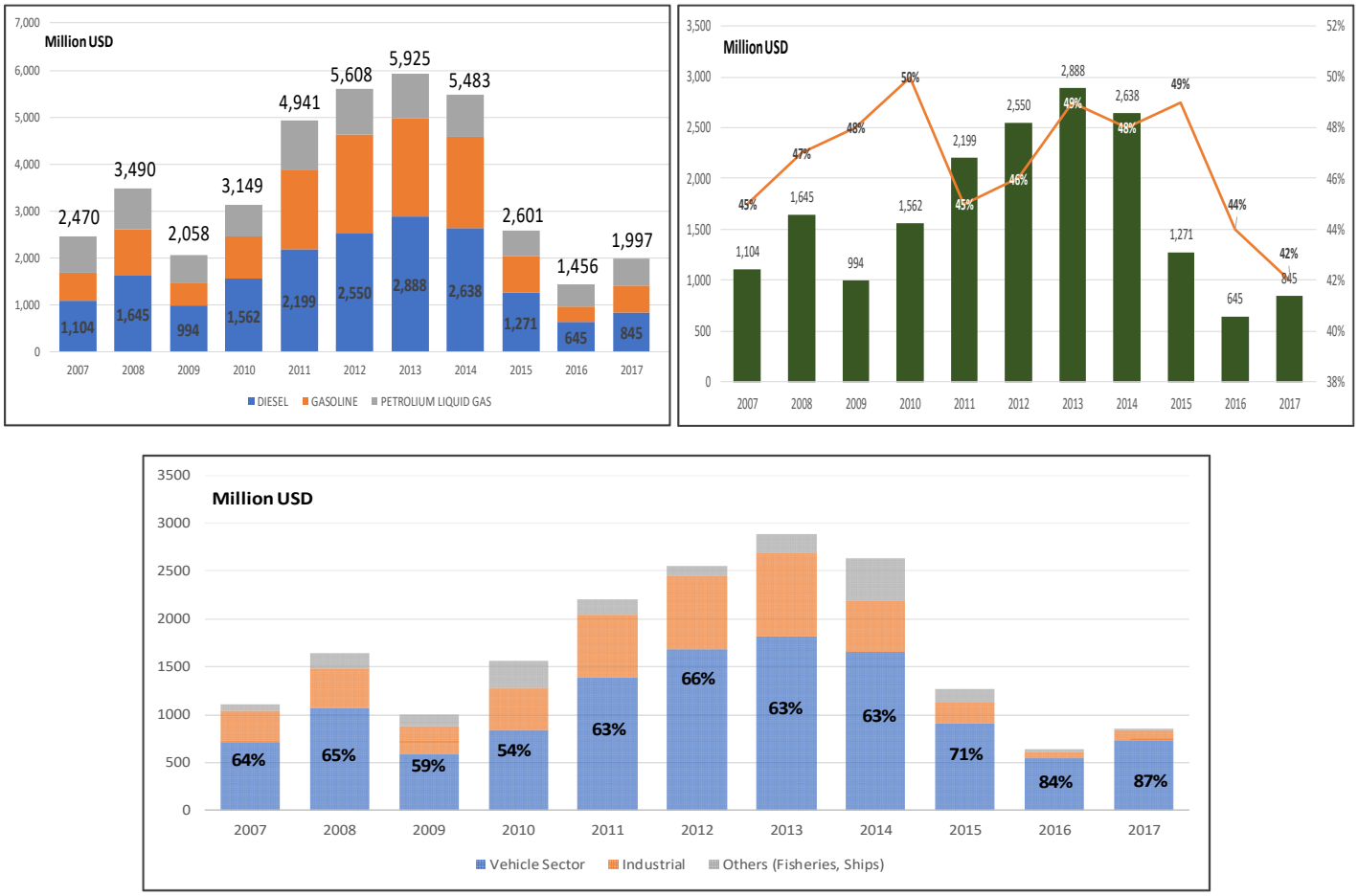


Source: World Bank Data

The government has announced the elimination of oil subsidies in the second half of 2020 (Cardenas, 2020). This policy was already presented to the National Assembly in October 2019. Subsequently, the citizens and transportation sector went on a ten-days violent national strike, so the government decided to take a step back and announce a better policy design that

does not affect the primary sectors. The immediate elimination of subsidies and the valuation of fuels at the international price would have an initial shock that would lead to an increase of 13.3% 'in the Consumer Price Index (CPI) and, in the long term, an increase of 31.8% (Armijos, 2015).

Figure 4. Fuel Subsidies in Ecuador: a) Evolution of fuel subsidies; b) Percentage of diesel subsidies vs. total of fuel subsidies; c) Percentage of vehicle subsidies (Diesel)



Source: J. G. Castillo & Solórzano, 2019

Urban and intercity buses use diesel for their daily operations, making up at least 40% of their companies' costs (Armijos, 2015; J. G. Castillo & Solórzano, 2019). Diesel is the fuel derivative in which the Ecuadorian State has spent the most in the last decade, representing, on average, 47% of total spending on fuel subsidies; gasoline represents 30% and liquefied petroleum gas 24%, see Figures 4 a) and b). The government has proposed a progressive elimination of the subsidy with an annual reduction rate of 1/3 (33%), for a total elimination of

the diesel subsidy in 3 years, see Figure 4 c) (J. G. Castillo & Solórzano, 2019). However, several authors have warned about the potential for high social impact because 80% of the population uses urban and regional buses (Schaffitzel et al., 2019). So, it is believed that the government will not implement policies that would affect the public transport sector. Nevertheless, the calculation of bus fares should be changed. Ecuador is one of the countries with the cheapest public transport in the region, and the fare does not cover the real cost of the operation. This point will be discussed in detail in the tariff section.

Intercity Road Network

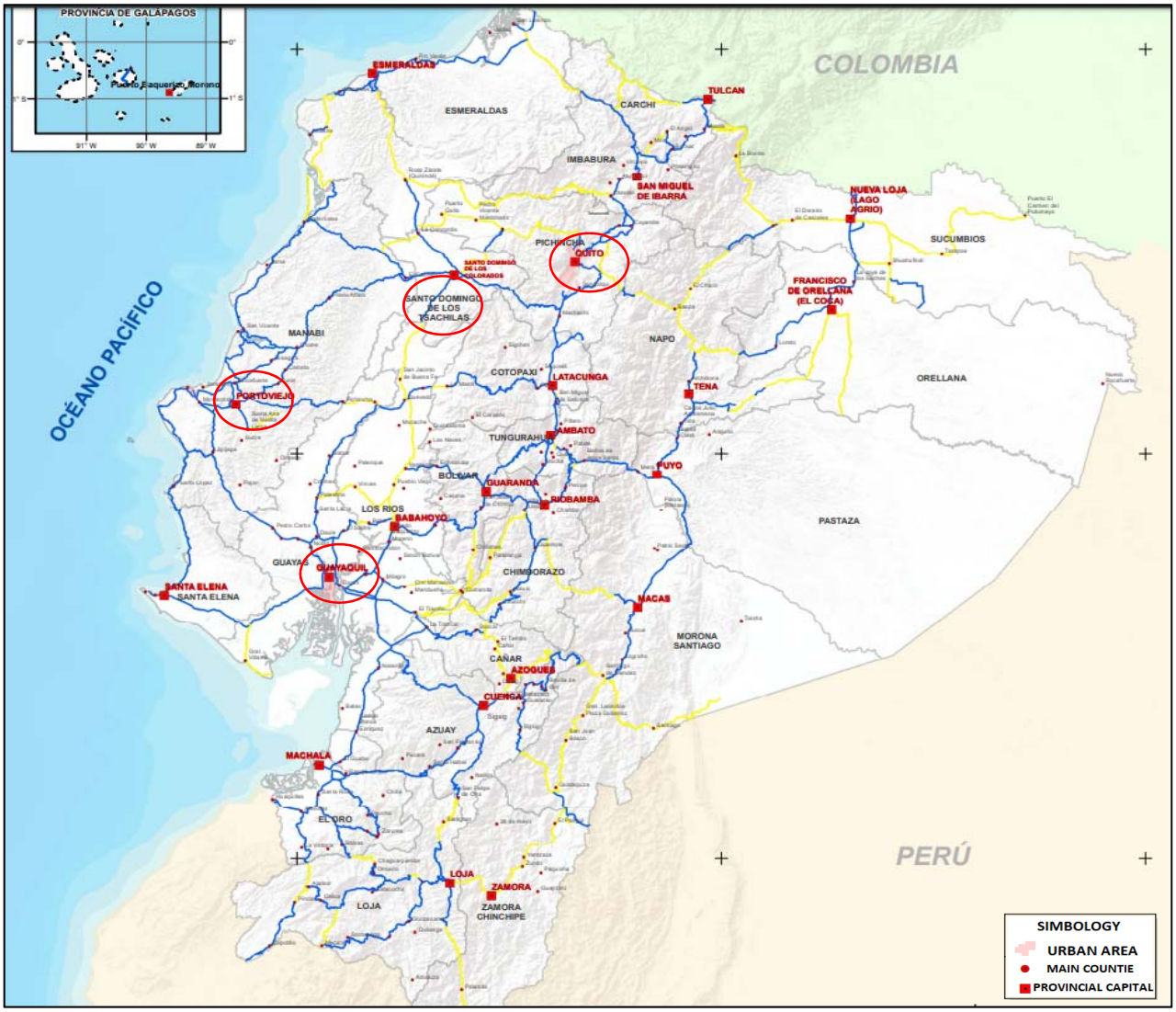
The national road network includes all public property roads subject to the current legal quasi-public model. The national network is comprised of the state highways (primary and secondary roads), the regional road network (tertiary roads), and the county road network (neighborhood roads). The total length of the state highways and tertiary roads is 10.160,36 km, see Figure 5. The primary roads, or arterial corridors, include routes that connect border crossings, ports, and provincial capitals forming a strategic mesh. Its traffic comes from secondary roads (collector roads); therefore, the main highways must guarantee high mobility, controlled accessibility, and adequate geometric standards. In total, there are twelve primary roads with approximately 66% of the total length of the State Road Network.

The inter-regional transportation mode uses the highways to mobilize people from the capital to the head counties of the provinces. The roads with the highest demand flows (private cars, freight, and public transportation) are the E35, E30, and E40. There are no exclusive lanes for public transportation or freight. In the last eight years, these highways have been expanded due to high traffic demand. However, there are road sections that remain as bottlenecks and black spots[6] that need to be corrected (Cheol, 2019). Geography (high mountains) makes the

[6] An accident black spot is a place where road traffic accidents have historically been concentrated. It may have occurred for a variety of reasons, such as a sharp drop or corner in a straight road, so oncoming traffic is concealed, a hidden junction on a fast road, poor or concealed warning signs at a cross-roads.

geometric design of roads challenging, as the highway that connects the highlands with the coastal region has many curves and cliffs. Also, the bus stops and facilities are deficient along with the network. Almost 75% of the buses are allowed to pass through the Panamericana highway, meaning that the provinces of Pichincha, Guayas, and Manabí have the highest demand for public transportation. Meanwhile, in the rural sector, citizens use illegal services to move because bus companies do not want to operate non-profitable lines[7] (Fernando & Ortega, 2018; IDB-KSP, 2019).

Figure 5. Constructed Roads Ecuador – Intercity Bus Network



Source: Minister of Transportation and Public Works (2018)

[7] Interview with Ex Vice-minister for Land Transport and Road Safety MTOP April, 2020.

2.2. GOVERNANCE OF THE BUS TRANSPORTATION SYSTEM

This section will explore: 1) the legislature or laws and their enforcement; 2) stakeholders of the intercity bus system; 3) the institutional arrangements of the NAT to cope with the requirements of the transportation system; 4) and bus service and fare. Transport governance authors often select these governance elements as basics, and they are also mentioned as success factors of the Korean bus reform (S. M. Lee & Lim, 2013)Sik et al., 2014; AASHTO, 2016; CEPAL, 2016; Docherty et al., 2018). Finally, we will analyze the current situation of public transportation in the context of the cancellation of trips due to the COVID-19 pandemic.

Public Transport Law

The Traffic and Land Transportation Law has guided the planning, regulation, and control of public transportation in Ecuador since 1963. Even though there have been numerous reforms, the competencies of the transportation system's governance is vaguely delimited. For instance, crucial transit responsibilities such as road safety, control, and transport planning have been granted to multiple organizations, creating a complex system that has made transport governance somewhat unmanageable (Chauvin, 2006; IDB-KSP, 2019). After the last reform in 2015, there have been several modification requirements from the transport federations, civil organizations, and deputies. Thus, in 2018, the National Assembly even created a temporary commission to analyze all requirements for law reform. As of 2020, this commission continues to operate, which is a clear sign of how complex the multilevel analysis is[8]. The justification for the continuous needs of reforms are 1) the law is subjective and contradictory; 2) it does not respond to the dynamism of the operations, and 3) there are legal loopholes. For instance, commercial and public transportation are considered in several parts of law, even though the

[8] National Assembly Report: "The Occasional Transit Commission is created and will be made up of 13 assembly members". For more information on obtaining material refer to https://radiohuancavilca.com.ec/politica/2018/07/12/comision-ocasional-de-transito-estara-integrada-por-13-miembros-el-pleno-acepto-la-excusa-de-tres-asambleistas/

logic behind its operations are different[9]. As a consequence, the vision of public transportation as a common pool resource that contributes to social welfare is diffused with a vision of business and rentability.

According to the National Assembly Debate Web Log[10], past partial reforms did not analyze the impact of a change in the whole legal body, and some multilevel actors are not considered. The urban and intercity bus systems are separated without mandatory integration of its operations nor regulation. Public transportation experts and government officials agree that some of the reforms obey the political interests of influential stakeholders that care more about profits than the needs of modernizing of public transportation[11], *see Annex 1: Summary of interviews with Ecuadorian Transport Experts*. For the latest reform in 2020, the commission has not considered fundamental technical considerations such as centralized e-ticketing, M&E systems, mandatory use of big data, citizen-centered public transportation planning, modernization of the organizational structures of control bodies, but most importantly, it has yet to consider the resources needed to implement and operate the law's mandates[12].

Finally, the law only captures general guidelines; therefore, specific norms and regulations must be developed to ensure enforcement of the law. However, this mandate has created a mesh of norms and regulations at different levels (local, regional, and national), making the regulatory system complex, confusing, and challenging to apply.

Law Enforcement

Over the past few years, the lack of resources, the complexity of the law, and inability on the part of the compliance staff has consequently led to a perception of law enforcement as

[9] Article: "Traffic Law reforms will be approved in February 2020". For more information on obtaining material refer to https://confirmado.net/2020/01/08/reformas-a-la-ley-de-transito-se-aprobaran-en-febrero/

[10] National Assembly Web Log: "Draft Organic Reform Law to the Organic Law on Land Transport, Traffic and Road Safety". For more information on obtaining material refer to https://www.asambleanacional.gob.ec/es/multimedios-legislativos/35141-ley-organica-reformatoria-la-ley-organica-de-transporte-0

[11] Interview with Ex Vice-minister for Land Transport and Road Safety and Executive Director NAT,(April, 2020).

[12] Ibid 8.

symbolic or negligible in the Ecuador (De la Torre, 2017). A regulatory system must be enforceable. This characteristic requires regulations that are appropriate under specific operative circumstances and technology due to the amount of information and mobility data. Effective administrative and enforcement procedures are also crucial (S. M. Lee & Lim, 2013).

In short, the lack of vision and poor enforcement had led to unreliable bus service, poor driving standards (which affect safety and traffic congestion), maltreatment of passengers, violence between bus operators, dangerous on-the-road behavior, and new illegal mass transportation services. Besides, the regulatory task is substantially more significant due to the large number of individual owner-drivers and the intervention of political figures in the behalf of some bus operators. Korean transport experts have recognized that the use of technology such as radars, GPS, electronic controls, and smart cards have increased the levels of compliance with the law for bus operators and citizens[13] (Kim & Kwon, 2005; S. Lee & Lim, 2013)

Stakeholders Analysis – Transport Governance Scenario

The contribution of the transportation sector to economic growth and sustainable development depends on the role of stakeholders and their involvement. In public transportation, the challenge is to find a fair balance between responsibilities and obligations for the private bus companies and government surveillance (Badr, Farchi, & Mabrouki, 2016). This section maps the critical stakeholders that influence the intercity bus system. The analysis is based on the Badrs et al., 2014 framework, interviews with transport experts and government officials, media abstracts, and reviews of legal bodies and projects. Table 4 presents a multilevel stakeholder mapping picture of the complexity of the sector.

[13]Interview with Korean Transport Experts, (October, 2019).

Table 4. Intercity Bus System Stakeholder Mapping

LEVEL OF ACTION	*STAKEHOLDER*	*FUNCTIONAL IDENTIFICATION*
NATIONAL	President of the Republic	The highest governmental authority for the mediation of macroeconomic conflicts between the state and the transport unions (e.g., subsidies, fare increases, imports, taxes). Public concern and enforcement to reduce road fatalities.
	National Assembly representatives	The highest legal authority for approval and reform of laws that regulate the public and commercial transport sector. Public interest in road safety issues.
	Minister of Public Works and Transport (MTOP)	The supreme authority for the land transport system (public and commercial). In charge of (1) the budget approval for the National Authority of Transit; (2) the creation, reform, and follow-up of public policies; and (3) the presentation of accountability reports to the National Assembly. The minister is the head of the Transport and Transit Board. The Board monitors and approves the management of the NAT. Other commission members are the Ministry of Education, the Ministry of Health, two city mayors (one representative of large cities and one representative of small cities), one representative of the President of the Republic, the Sub secretary of Transportation, and the head of the National Authority of Transit.
	The National Authority of Transit (NAT)	The maximum regulatory authority of the land transportation system In charge of (1) the implementation of the public policy approved by the MTOP; (2) the creation and update of the norms and regulations for transport operations; (3) the controls to commercial mode operators (tourism, trucks, and heavy trucks), intercity bus operators and bus terminals; and (4) the planning and monitoring of intercity bus operations.
	The National Police	National control authority for road safety. In charge of the law enforcement (controls in-situ), traffic flows, and road accidents investigation.
	Minister of Finance	Responsible for the budget allocation to national projects and subsidies
	Intercity Bus Federation	Representatives of all bus operators and owners. Official spokespersons for negotiations with the government (e.g., norms, transport planning, subsidies, sanctions, service improvement).
	Media	The media help encourage citizens to take advantage of public transportation that is available but also influence public opinion about bus safety. In the last years, the media has been criticized for spotlighting the risks of using public transportation but not informing about the safety and service improvements.
	Citizens (costumers)	Users of the service. There is no a formal organization that presents to the authorities the citizens 'needs or evaluation of the bus service.
	Other transport unions tourism, heavy trucks, school buses)	The representatives of the other modes are prominent political figures that defend their interests. Sometimes, in their view, the expansion of the bus service diminishes their services, especially for tourism and school transport services.
	Professional drivers unión	Spokespersons that represent the interests and rights of bus drivers.
	Vehicle manufactures and importers	Businesspersons who play an essential role in the configuration of technical norms and economic advantages.

PROVINCE/ REGIONAL	Regional bus federation	Representatives of province bus operators and owners. Official spokespersons for conflict management among operators due to overlapping of routes and timetables.
	Bus operators/ Companies	Supply-side of the system. Their obligations are stipulated in 10-year operating contracts (no standardized contract model and no service levels included). Bus operators are influential figures in the national union federation and also with politicians.
	Bus owners	Supply-side of bus operators. 80% of the intercity bus fleet belongs to individuals, not to companies. Each bus is seen as an individual business; this vision limits the capacity to optimize the operations of the whole intercity bus fleet.
	Driving training centers for professional drivers	These organizations should ensure the development and update of driving skills for professionals drivers; however, over the last five years, there have been corruption scandals about the issuance of illegal professional driving license. Therefore, the image of the driving center and the NAT has been diminished.
	The National Commission of Transit	Regional control authority for road safety. In charge of law enforcement (controls in-situ), and traffic flows.
LOCAL/CITY	Mayors	In charge of the urban planning and bus operations of their cities. The decisions in these fields do affect the intercity bus service because of the integration with urban buses and traffic flows. In charge of the approval of norms and controls for the city.
	Bus Terminal Administrators	In charge of the dispatching and timetable control of the buses. There are only four out of 24 bus terminals with automated controls and information. It is not mandatory to report the ticketing sales and timetable compliance of the bus companies that operate in their facilities.

Source: The author based on the stakeholder analysis framework, Badr et al., (2016) and interviews with Ecuadorian Experts

According to Badr et al., (2016), the basis on which stakeholders possess power relative to an organization or system is likely to change depending on the impact of stakeholders. Therefore, it is necessary to understand the power and dynamism of the actors. Using the stakeholders mapping, ***Figure 6*** presents the results of the power matrix for the intercity bus system; in order to see the stakeholder power matrix refer to Annex 2. The stakeholder analysis demonstrates how external actors are politicizing the institution. The power matrix pictures the characteristics of conflict management for future bus reforms; it is evident that transport unions and politicians vastly influence any decision or strategy to reform the public transportation system (urban and inter-city).

Figure 6. Graphic results of Intercity Bus Stakeholder Power Matrix

Source: The author base on, interviews with experts and government official, newspaper reports, televised interviews, and internal staff meetings
Measurement Scale used: 10 (High Power/Influence) 1 (Low Power/Influence)

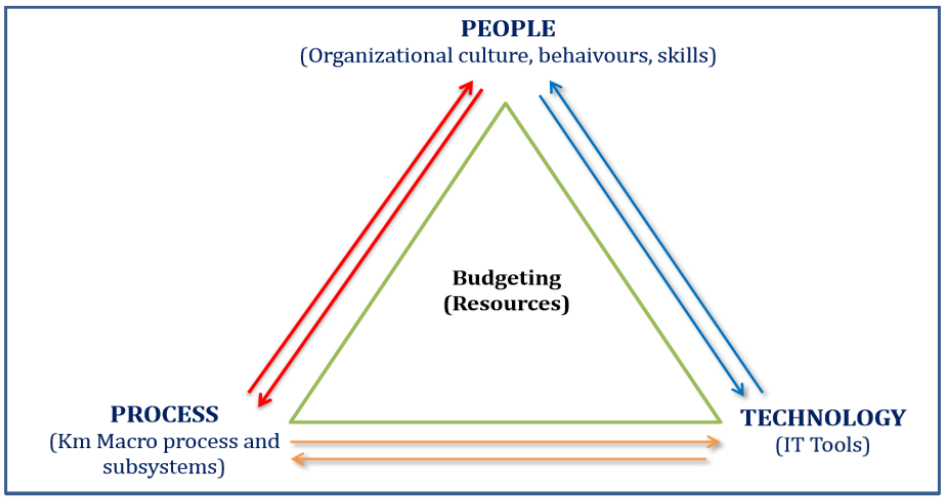
Transport experts pointed out that the politicization of the decisions had prevented the opportunity to conduct significant changes for improving the intercity bus system, *see Annex1*. For instance, with the GPS project, bus companies knew that the NAT would find out about illegal operations, and they feared penalties and but also the cancellation of operations that represented critical profits for them. Chaos allows political actors to influence the system and the lack of performance information limits technical evidence for public policies[14].

[14] Interview with Transport Expert World Bank and IDB and Executive Director NAT,(April, 2020).

Institutional Arrangements – Bus System Management

Processes, budgets, technology, and people are the primary institutional arrangements to operate or implement structural reforms in any organization or system, *Figure 7*. These four factors create a significant information flow that promotes organizational change and leads to improvements or modernization (Ostrom, 2009) (Prodan, Prodan, & Purcarea, 2015).

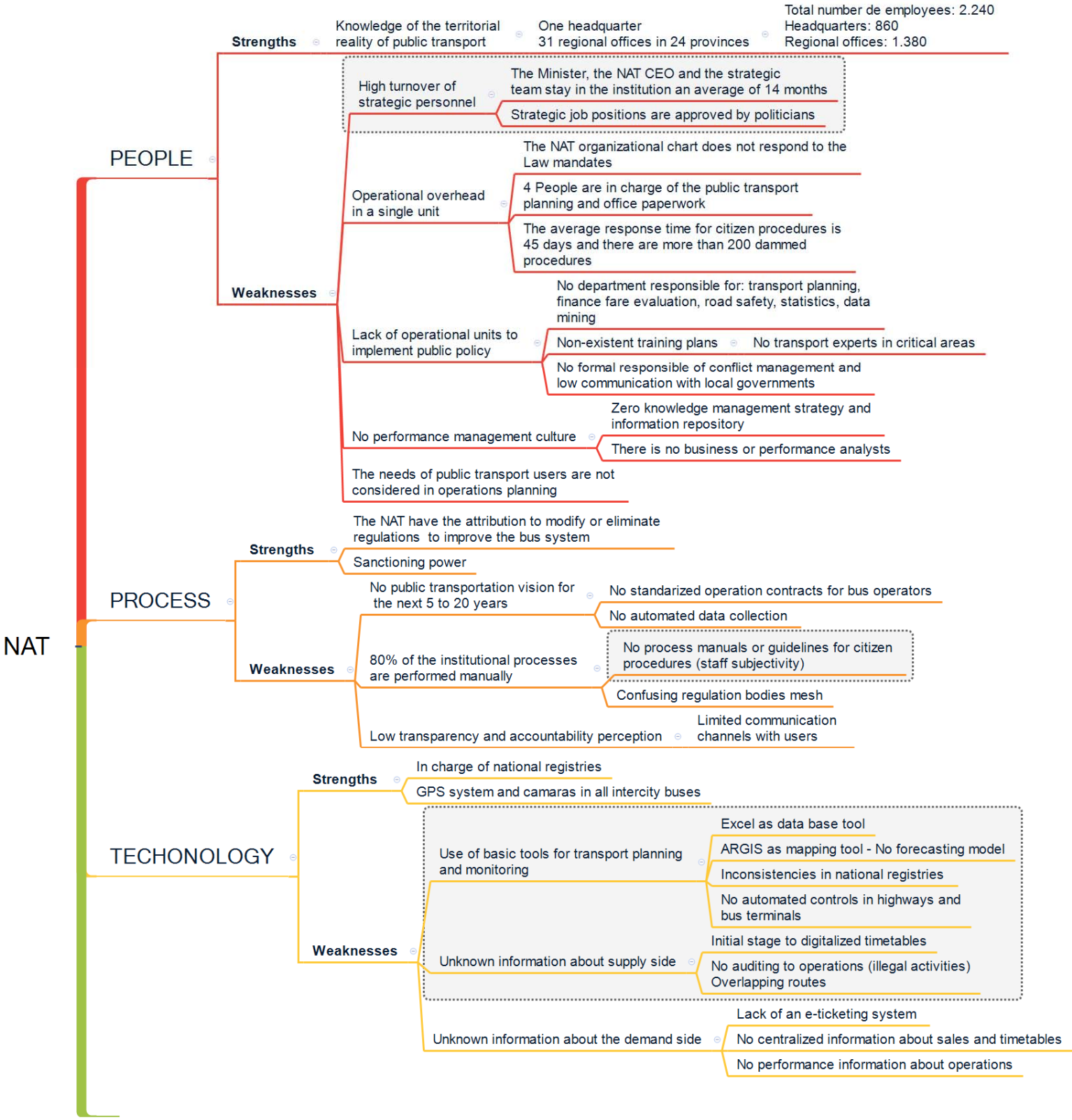
Figure 7. Institutional Arrangements Pillars



Source: Adapted by the author from Ostrom, 2009 and Prodan et al., 2015

This section will explore the institutional arrangements of the NAT since this institution is in charge of the intercity bus system, and it is recognized as the leading player in the transport arena. Figure *8* synthesizes the findings associated with the organizational chart, *see Annex 3,* and the weakness and strengthens identified by government officials and an expert diagnosis conducted by the Inter-American Development Bank.

Figure 8. The National Authority of Transit Institutional Arrangements



Source: The author based on interviews and reports

PEOPLE. Ecuadorian policymakers and transport experts agree that there is a gap between the formulation of transport policy and the implementation process. The overload of operational activities leaves no room for the execution of innovative projects that improve institutional management. Besides, there is not performance culture, and decisions are not based on KPIs or scientific evidence. As mentioned in Chapter 1, the organizational chart does not respond to the new transport law mandates, *see Annex 3*. Following the IMF mandate to shrink public expenditure, the NAT has reduced its staff from 2.240 people in 2018 to 1.978 employees in 2020. Currently, five people work in the public transport unit. Furthermore, there is no training or career development (weak capacity building). A lack of public officials' expertise in transport due to job rotation, political pressures, and dearth of coordination among departments results in insufficiency in policy prioritizing, over-reliance on political actors, and untechnical management of the intercity bus system[15].

The most critical point is that the highest authority in the institution and the strategic staff (directors and coordinators) stay in their job positions for less than 1.5 years. The high turnover does not allow continuity in projects, and institutional priorities are often changed. In the last ten years, only 2 out of 8 CEOs have had a background related to the transport field. Additionally, the links with academia or investigation institutes is incipient; the NAT does not use the research results, and academia does not know the study's needs of the NAT, see Annex 1: Summary of interviews

PROCESS AND TECHNOLOGY. Even though the NAT is accountable for the performance of the intercity bus system, national registers, driving license issuance, and the control of transport actors, NAT's technology is basic, and the institutional systems are not integrated. Due to the amount of operational information, transactions, and citizen procedures, the modernization of its systems should be a must. The first step is to work on harmonizing the

[15] Interview with Executive Director and Senior officers at the NAT,(April, 2020).

norms of the core processes and create manuals that eliminate subjectivity in the execution of these processes. Then, road safety, transport planning, monitoring, and evaluation should be prioritized in the modernization. Benchmarking similar institutions, most of them have migrated to a big data solution to control and evaluate the mobility in and across cities. Automated data collection on the demand and supply side is critical to improving the bus service and road safety. However, in Ecuador, the implementation of such a tool has faced challenges such as political willingness, lack of technical savvy, and operational coordination among government institutions[16].

BUDGETING. The Ministry of Transport and Public Works approves the budget for projects and recurrent expenses. 60% of the NAT's budget is destined for the payment of the personnel, 25% for operational expenses, and 5% for institutional projects (ANTTSV, 2018; ANTTTSV, 2019c). The Transportation Law does not oblige the allocation of resources for the improvement of the public transport system or road safety activities. Therefore, the NAT must rely on grants from development organizations or private-public associations to implement partial solutions to structural and technical problems. Due to the high road fatalities rate, civil organizations have proposed the creation of a specific tax or fund to conduct road safety projects[17]. However, this initiative has not had the support of the transport sector or politicians. The constraint in resources has an impact on time, scope, and quality. If we associate this characteristic with the high turnover of strategic personnel, the result is a negative vicious cycle that diminishes the efficiency and quality of public transportation.

Service: Business Model and Fare

Depending on its operating method, the operating system can be classified into 1) private, 2) semi-public or 3) public, Table 5 presents a quick overview of the main characteristics of the

[16]Interview Ex Vice-minister for Land Transport and Road Safety and Executive Director of NAT,(April, 2020).
[17] Ibid 8.

different operating systems that define the business model and the level of government intervention to assure the effectiveness and optimization of the bus system.

Table 5. Types and Characteristics of Bus Operation Systems

Category	*Type*	*Characteristics*
Private system *Private companies own all assets and are responsible for all management processes*	**Purely private system**	Under this system, private companies operate bus services using their assets and investments. This system is preferred when, either, there is little demand for public transportation, or there is sufficient demand to guarantee steady revenue and profits for bus operating companies. As buses become the major mode of public transportation, governments enforce tariff regulations; it becomes increasingly difficult for companies to shut down unprofitable bus routes. This system was in place in Korea until the end of the 1990s.
	Subsidized private system	In this system, governments subsidize part of private bus companies' operating costs in order to ensure the stability of the supply of bus services for the general public.
Semi-public operation system *Public-private partnership on bus services and management*	**Route management system**	The government (national or local) has the power to grant or deny licenses to operate certain bus types or routes. Bus companies may operate their services only by obtaining such licenses, which are valid only for fixed periods. In granting these licenses, however, governments often manage the revenue of bus services as well.
	Revenue management system	The government collects and manages the revenue from bus services and settles the costs and profits afterward, compensating unprofitable bus routes/operating companies for their losses—***current operation type in Korea.***
	Commissioned management system	The government provides financial subsidies (e.g., for purchase of vehicles and compensation of losses) for bus operator cooperatives, corporations, or other private bus operating entities that are commissioned to operate bus services along designated routes. London And Japan are examples of this system.
Public operation system *Public entities own and manage assets and services*	**Governmental system**	Local governments may operate bus services and routes (e.g., Prefecture of Tokyo in Japan and the City of Gwacheon in Korea).
	Public enterprise system	Governments (national and/or local) may set up an independent corporation responsible for the management and operation of public bus services (e.g., RATP of Paris, France).

Source: Return Bus Services to Citizens: Switching from a Private Operation System to a Semi-Public Operation System (K. S. Kim & Kim, 2012)

Currently, the Ecuadorian intercity bus operation is semi-public with a route management type. Under the route management scheme, the central and local government possesses the route license and operating rights. Bus operators are granted the operating right from the government through contracts, and operate the route for ten years. Legally, bus operators are constituted as cooperatives or transport companies. There are 174 companies, 138 constituted as cooperatives (mostly financially insecure and small in size), and 36 as transport companies, the total fleet is 12.214 bus units. However, in practice, most of the carriers are conglomerates of bus owners,

who use these denominations to operate legally, without transferring the private ownership of their vehicles to the company administration (individual management revenue) (Chauvin, 2006). Even though 80% of Ecuadorians use public transportation (captive market), the professionalization of the companies has been negatively affected by the lack of incentives and law enforcement[18].

A significant number of bus terminals are located outside the downtown, and the connection facilities with urban transportation are not well designed. 38% of the intercity buses arrive at places or terminals when urban transportation is not operating (4: 00 a.m.to 6:00 a.m. or 11:00 p.m. to 3:00 a.m.). Contracts are not standardized and do not include clauses addressing service levels. 25% of contracts do not have a defined route, just the initial and last stop, and some contracts do not include timetables, especially for rural area operations. Rearranging bus routes is also tricky as they are operated in a province-centered way. The distinction between types of buses, such as rural buses, city buses, and intercity buses raises difficulties in transfer and information integration for management subjects and fares. There is a severe demand-supply mismatch.

There is no website for timetables, ticket prices, or in advance online purchases. Users do not have the information to do smart planning for their trips. Only large operators have online sales of their routes and frequencies. 63% of passengers also have the perception that the service is highly insecure due to accidents and robberies[19].

[18] Interview with Executive Director and Senior officers at the NAT,(April, 2020)
[19]Interview with bus unit officer sat the NAT, (April, 2020).

Table 6. Fare Comparison Intercity Bus and Other Modes

Mode Comparison	*Estimated driving (hours)*	*Distance (Kms)*	*Fare (USD)*	*Price per km (USD)*	*Max occupancies (persons)*	*Max. Gross Revenue (USD) per trip*
Taxi Downtown to interregional bus stop	0.6	19	8	0.42	4	32
Uber (illegal service) Downtown to interregional bus stop	0.6	19	7	0.37	4	28
Urban Bus Downtown to interregional bus stop	1.25	18	0.25	0.01	70	17.5
Intercity Bus Quito – Riobamba	4	202	5	0.02	32	160
Particular car or minivan (illegal service) Quito – Riobamba	3.25	202	16	0.08	6	96
Intercity Bus Quito – Guayaquil	8.5	418	12	0.03	32	384
Particular car or minivan (illegal service) Quito – Guayaquil	7.5	418	45	0.11	8	360
Intercity Bus Quito – Cuenca	9	452	14	0.03	32	448
Particular car or minivan (illegal service) Quito – Cuenca	9	452	55	0.12	8	440
Intercity Bus Quito – Loja	11.25	662	22	0.03	32	704
Particular car or minivan (illegal service) Quito – Loja	12	662	80	0.12	10	800

Source: The Author based on market research

The fare of the intercity bus is very low in comparison with other modes. However, a significant segment of people nowadays prefers to pay more to have door-to-door service. The fare price has not been revised for more than ten years. In most routes, the intercity value of passage per kilometer traveled is 3 cents of USD. At the same time, informal carriers charge high fees that exceed 100% of the real rate, and there is no control or penalties (Collaguazo & Vilatuña, 2014), *see Table 6*. The NAT has admitted that 80% of the fares have not been set using the Consumer Price Index or inflation rates. For instance, the fare for the same route differs between two different bus operators because the current methodology considers the passenger demand of each company and their cost structure (inefficiency subsidies). There is

no fare by distance or service category. Bus companies secured profits mainly from running on "golden routes," crisscrossing major roads even in downtown areas. Securing and maintaining these profitable routes are priorities for powerful bus companies because of the revenue loss that would result from losing them (Chauvin, 2006; Yaulema, 2017). In the last five years, bus companies have strengthened the promotion and sale of their parcel courier service, making it an essential source of income. A consequence of this new business product is that some buses are dispatched with only 30% of its passenger capacity because of the courier service. Financial analysis is one of the weakest points of the NAT and reduces its negotiation power because it lacks information about the profitability of the sector[20].

Current Situation of Public Transportation in the context of COVID-19

Intercity bus trips were canceled last March 2020 due to the public health crisis. More than 3,000 professional drivers have been fired, and bus operators have requested financial aid from the government to avoid bankruptcy. Additionally, buses should not operate at maximum capacity, personnel must use masks, and the bus be cleaned after each trip. These conditions will change the operation cost dramatically, and operational efficiency will not be an option anymore. Therefore, the NAT should take this opportunity to suggest strategic alliances and fusions of small companies. But most importantly, it is time to sit together with all stakeholders to reorganize all the routes, eliminate unnecessary frequencies, and build a cooperative intercity bus system. The survival of the intercity bus companies will depend on the negotiating capacities of the NAT and the willingness of bus operators to share administrative expenses, build economies of scale, and optimize and centralize operations.

[20] Interview with National Director of Land Studies and Projects at the NAT (April, 2020).

2.3. BUS REFORM: THE KOREAN CASE

The study of Korea's economic and social transformation offers a unique opportunity to better understand the factors that drive development, efficiency, and productivity. In the transportation field, Korea is one of the outstanding leaders in public transportation (S. M. Lee & Lim, 2013). Before the bus reform, Korea presented some of the same problems as Ecuador: an inefficient bus system, unprofitable operations, a non-citizen-centered route planning, and political and citizen pressure, among others (D. Lee et al., 2012; Sik, Chul, & Seok-Hwi, 2014). Table 7 presents the main problems that lead to the bus reform and the factors behind the decision to switch from a private bus operation system to a quasi-public one.

Table 7. Factors and Policy Directions Behind the Korean Bus Reform

Bus Reform	Problems and Issues	Basic Policy Directions	Policy Measures
Improve management	Lack of mid-/long-term bus policies Poor management: lack of transparency and loss in operating revenues Lack of incentives for efforts to create profits Financial difficulties due to rising operating costs and dwindling ridership	Streamlining management; reforming operational system; beefing up public interest in bus operation and management	Adoption of a quasi-public bus operation/management system; adoption of a route-bidding system; strengthening the city's supervisory function
Improve routings	Monopolized routes unable to cope flexibly with changes in demand Profit-motivated route selection, causing bypassing, detours and overlapping lines resulting in passenger inconveniences and discomforts	Establishment of demand-oriented route decision; expansion of new routes; strengthening inter-route linkages	Improvement of routing systems, focusing on intercity vs. feeder lines establishment of Bus-Metro fully-integrated system
Improve punctuality	Lack of punctuality and speed; irregular time intervals; unpredictable arrival times; slow speed and operating time	Recovery of trunk line function; adoption of a bus-priority system; streamlining and expansion of bus-exclusive lanes	Adoption of Bus Rapid Transit (BRT) system; installation of bus exclusive median lanes
Improve services	Dissatisfaction among bus users Low level of service quality; deteriorated facilities and vehicles; inadequate operational services; poor bus information services; insufficient bus operation at night; lack of intermodal linkages	Upgrading and diversifying buses; improving bus information services (BIS); extension of bus operating times and intervals; improve fare system; expansion of bus infrastructures	Introduction of NG and low floor buses; establishment of Bus Management System (BMS) and T-Money system; adoption of the distance-based fare system

Source: Adapted from S. M. Lee & Lim, 2013, and J.-H. Kim & Kwon, 2005

The majority of citizens did not expect the government to find an effective solution for chronic transportation problems because authorities' early actions were mainly short-run measures that turned out unsuccessful and further worsened the problems in the long run. Nevertheless, the 2004 bus reform led to improvements in structural problems that made Korea to a leader in the field in only six years. Nowadays, the Korean case is one of the most cited when reviewing best practices in bus reforms; authors and policymakers agree that the primary change catalyst was the decision to implement a quasi-public bus system and the use of technology (Kim & Kwon, 2005; S. M. Lee & Lim, 2013; Ko, 2014; Sik et al., 2014; Chen & Xu, 2017)

Introduction of the Quasi-Public Bus System – Bus Management System

The revenue management of the quasi-public bus system secured the government's right to adjust bus lines, introduce technology, and manage the system technically. The revenue pool management system collects all the fares of bus operation, regardless whether the routes are profitable or unprofitable, and redistributed them based on operational performance; thus, bus operation and revenue management (finance) are separated. Bus companies whose expenses exceeded income got reimbursed for their losses, and others get back their surplus. In other words, the surplus of profitable routes is used to compensate for the deficits of unprofitable lines.

The quasi-public bus system is also comprised of three significant components: public management, private operation, and operational infrastructure. First, public management meant that the government could accommodate bus routes to respond to people's mobility demands. An evaluation system was also established to examine operational performance, service level, and contract fulfillment. Second, private operations meant that the consortium of existing and new bus companies took control of the actual operations by settling expenses and managing vehicles, facilities, and employees. The third component operational infrastructure consisted of

two significant elements: (1) infrastructure such as public garages; (2) and the government's financial support for operating the exclusive median bus lane systems, the implementation of a central control room, and bus signal priority systems.

For this purpose, the government established a fare settlement center and other organizations taking responsibility for managing the bus operation revenue, bus operation information, providing subsidies (Kim & Kwon, 2005; S. M. Lee & Lim, 2013; Ko, 2014; Sik et al., 2014; Chen & Xu, 2017).

Table 8. Korea Bus Management System

ACTORS	SUPERVISORY ORGANIZATIONS		ROLES
BUS TRANSPORT COOPERATIVES	Seoul Bus Transport Business Cooperative (consultative body for joint revenue management)		- Joint management of city bus fare revenues - Conclude collective labor and wage agreements and mediate negotiations - Conduct training of city bus drivers
PRIVATE COMPANY	Korea Smart Card		- Issue and manage Seoul City T-Money cards - Ensure maintenance of transit card operating system, including terminals and collection system - Integrated settlement of metropolitan public transport revenues
GOVERNMENT	Bus Management Department	Bus policy team	- Policy development for effective bus operation - Supervise the implementation of the quasi-public bus operation system and guide bus cooperatives - Improve bus structure, deal with labor-management relations, operating bus drivers' qualification system - Evaluate bus services and survey public satisfaction level
		Management improvement team	-Estimate standard bus operating costs and conduct managerial and accounting analysis - Establish operating cost estimation guidelines - Evaluate managerial soundness and promote measures to improve management conditions - Conduct a balance of payment analysis and devise financial support plans
		Financial support team	- Provide financial support and gasoline subsidies to city buses - Supervise the management of cash revenues and check the operating frequencies
		Route team	- Readjust bus routes and take steps to improve route efficiency - Manage the routes and bus dispatches by district - Manage bus statistics and analyze the data on bus operations
		Operations management team	- Manage city bus operations - Improve bus stops and install relevant facilities

		Community bus team	- Manage community bus operations, evaluate services, and readjust fares
	Traffic Information Center (TOPIS)	Bus information team	- Build and operate BMS for city and community buses - Manage bus routes and bus stop databases - Collect and analyze bus stop arrival and departure information - Bus information service operation and management - BMS safe operations training and evaluation

Source: Adapted from ¨Korea's Best Practices in the Transport Sector¨ by S. M. Lee & Lim, 2013, page 82

Table 8 captures the multilevel organizations and functions of the new bus management system. This table might serve Ecuadorian officials redesigning the NAT's organizational chart. Currently, 370 employees work in the government bus departments and 76 in the Korean Smart Card Division[21]. Having only four analysts for planning and operational transport activities is a zero-sum game for all the stakeholders, especially now that there are conditions to rethink and redesign the whole urban and intercity bus system.

Conflict Management – Collaborative Transport Governance

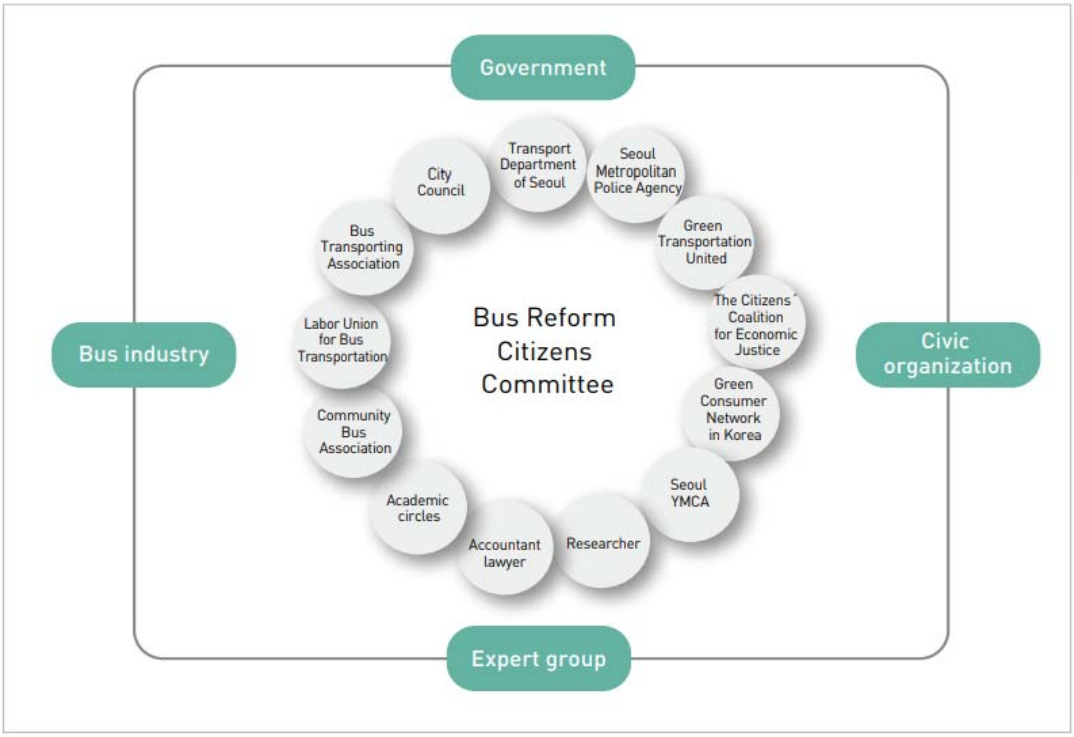
Changes to bus management brought resistance from influential stakeholders and created conflict among the local and national governments. Therefore, the transport authority created a multidisciplinary committee and the Transport System Reform Support Taskforce. The Committee involved a diverse group of stakeholders, including bus companies/proprietors, bus drivers, district administrators, police, city council members, ordinary citizens, and business communities. This committee gave credibility to all the decisions made for the reform and serve as a mediation arena to solve conflicts and bring consensus, see Figure 9, Committee Members.

The committee made persistent efforts to agree on technical terms with interested parties. During negotiations, the committee held workshops with representatives from bus companies,

[21] Interview with Senior researcher of Transportation Policy Division Daejeon Metropolitan City, October, 2019.

academics, and local officials. Measures taken in the negotiation process included official letters sent to 16,000 bus drivers; 27 special training sessions for drivers and guarantees of the financial stability of bus companies. The committee was an essential force in crafting an agreement through the cooperation of national actors such as the police, ministries, local governments, and bus operators[22]. Later, compromises and consensus were created with local and regional governments to make progress on midterm inter-regional bus operations, fare adjustments, centralized user websites, bus-exclusive median lane installations, and the implementation of infrastructure facilities. Nevertheless, the main agreement reflected the long term vision and goals of public transportation; sustainability, efficiency, equity, integrity, safety, and participation (J.-H. Kim & Kwon, 2005; Sik et al., 2014).

Figure 9. Members of the Bus Reform Committee



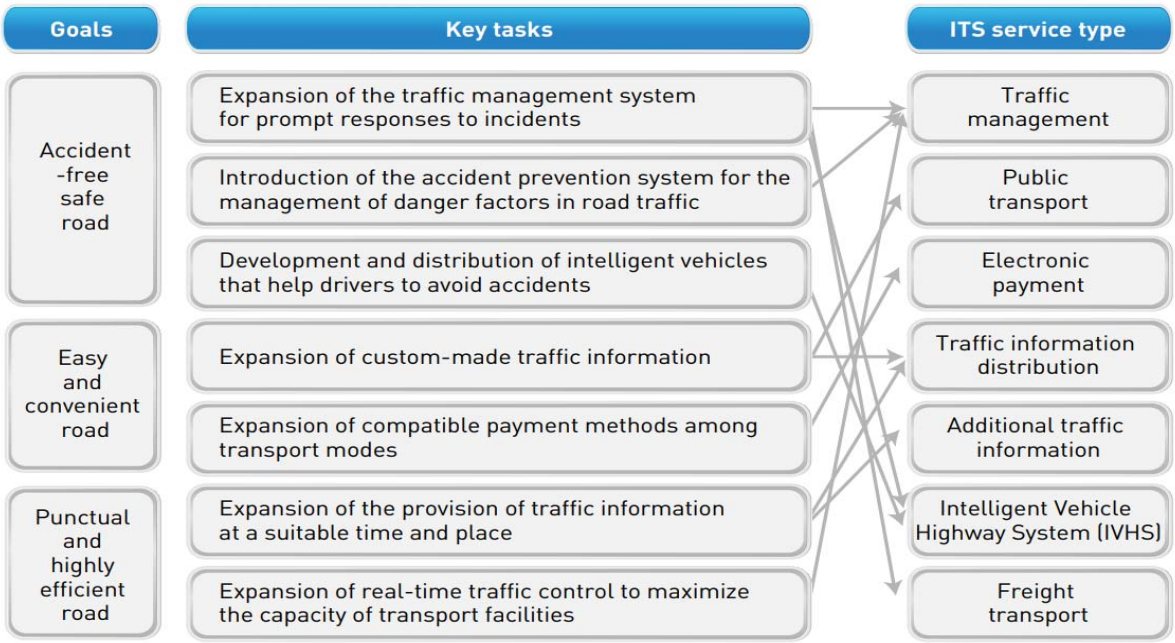
Source: Reprinted from ¨ Conflict Management and Governance in the Transport Sector in Korea¨ by Sik et al., (2014, page 49)

[22] Interview with Korean Transport Experts (October, 2019)

Technology: The Key Pillar to Build Up Smart Mobility In Korea

Korea understood that the use of technology and big data would be critical factors to transform the bus system and catch up with leading countries in the field. Consequently, the government decided to improve the quality of life of citizens by using advanced ICT and providing comprehensive, citizen-centered and sustainable smart services based on an analysis of the preferences and goals of users and operators. From 2004 to 2008, Korea implemented and spread the Intelligent Transport System (ITS) to all the transport networks. The ITS included communication systems, control, and information processing technology. It helped users and operators to make more reasonable decisions about traffic conditions based on real-time information. Thus, the changes to public transport management resulted in improved punctuality and offered reliable operation information became available. Also, facilities such as automatic payment for road charges, e-ticketing, and public transport fares were implemented (J.-H. Kim & Kwon, 2005; D. Lee et al., 2012).

Figure 10. ITS Korean Plan Goals



Source: Reprinted from ¨ Korea's Best Practices in the Transport Sector¨ by S. M. Lee & Lim, 2013, page 269

Figure 10 depicts the Korean ITS Plan, which was adopted from local governments to regional administrations; to make it work, the government installed computer terminals in the buses and put in place wireless communication systems between the buses and a central control center. The IT industry and the development of a satellite-based integrated transport management system led to the effective implementation of the quasi-public bus operating system.

The ITS platform is integrated by a sophisticated network of sensors, card readers, CCTVs, portals, satellite positioning, monitors, analytical software, and servers. The central government and municipalities invested around 6 billion USD in the implementation of the: 1) optimization traffic management, 2) electric fare collection, 3) integration and distribution of information, 4) provision of tourism information, 4) efficiency of cargo transportation and 5) monitoring of vehicles and roads. The private sector also invested an estimated of 10 million USD into the integration of the new government system (S. Lee et al., 2014).

2.4. COMPARATIVE PUBLIC POLICY ANALYSIS

The modernization of public transportation in Korea presented some similar political, technical, and financial problems as found in Ecuador. From the preceding section and interviews with Korean specialists, we can conclude that The Korean bus reform's success depend on a strong political will and the adoption of technology at the national and local levels. Table 9 recaps the structural problems found in Ecuador and similar problems and solutions that Korea applied. By using the case study method, Ecuadorian transport experts and government officials analyzed what strategies applied by Korea could be implemented in Ecuador and under what conditions. These findings might serve as information for future strategic plans or as inputs for project design. Nevertheless, it is highlighted that partial reforms have a negative impact in the long run; therefore, the government should seek to modernize the whole transportation system, urban and intercity.

Table 9. Comparison of Public Policies and Strategies Ecuador and Korea

Ecuador Problems and Issues	Korean Policy Measures or Strategies	Applicable?	
		Yes	No
Rule of Law and Law Enforcement			
Lack of mid-/long-term bus policies	Creation of consensus on the 20-year vision by the Bus Reform Committee	X	
Partial reforms and legal loopholes Unclear roles and functions of government transport institutions	2004 Bus Reform Act; exclusive law for the modernization of the Bus System	X	
Weak law enforcement	Implementation of ITS	X	
Conflict Management			
Highly politicized sector	Creation of the Bus Reform Committee	X	
Resistance to change High shock externality: cancellation of bus operations due to COVID19	Guarantee of profitability by the government quasi-public bus operation	X	
Unstable bus drivers salaries	Conclude collective labor and wage agreements and mediate negotiations		X
Instiutional Arregements			
Inadequate NAT organizational chart High turnover of strategic personnel)	Creation of the Bus Management Department (integrated by six units), Traffic Monitoring Center and Korea SmartCard	X	
Operational overload, no performance or data-based culture	Implementation of ITS		
Bus Management – Service			
Lack of incentives for efforts to create profits and improve bus business	Joint management of city bus fare revenues, quasi-public bus operation	X	
Monopolized routes unable to cope flexibly with changes in demand Profit-motivated route selection, causing bypassing, detours and overlapping lines	Readjust bus routes and take steps to improve route efficiency, dispatches by region Manage bus statistics and analyze the data on bus operations	X	
Lack of punctuality and speed; unpredictable arrival times	Manage bus routes and bus stop databases Collect and analyze bus stop arrival and departure information	X	
Traffic and irregular time intervals	Creation of median exclusive lanes		X
Poor bus information services and no e-ticking system	Adoption of a route-bidding system; and e-ticketing system	X	
Lack of intermodal linkages No integration between urban and intercity facilities (operations and bus terminals)	Improvement of routing systems, focusing on trunk vs. feeder lines	X	
Untechnical calculation of fares and subsidies for bus operators inefficiencies (no managerial accounting management)	Adoption of the distance-based fare system Standard bus operating costs and managerial accounting Conduct a balance of payment analysis and devise financial support plans	X	
User dissatisfaction and perception of insecurity	Evaluate bus services and survey public satisfaction level	X	

Source: The author, based on the Korean case study analysis of conversations with transport experts

The ITS was recognized as the key enabler for the changes in public transportation in Korea. According to the experts, government officials, and from the reports, most Korean strategies are feasible to apply in Ecuador if there is political will and stakeholders' engage into the reforms of the bus operation. Even though most of the interviewees agreed that the country currently does not have the financial resources to implement all these strategies, they acknowledged that the existing ineffective operation system is resulting in more losses to the government and bus operators than profits and social welfare. It is proven that investment in smart public transportation is related to a decrease in 1) road fatalities, 2) traffic jams (mobilization time), 3) investment in infrastructure expansion and 4) CO2 emissions, but most importantly public transportation is a tool to reduce inequalities and trigger development (K. S. Kim & Kim, 2012). Therefore, it is necessary to conduct a cost-benefit analysis of the reform strategies in order to justify requests that the National Assembly create a permanent fund or tax for the modernization of the public transportation system. Moreover, by implementing the ITS, the government would have information about legal and illegal transport; therefore, the government can effectively control public transit, especially to combat illegal services that reduce the ridership of public transportation.

Some transportation experts have expressed reservation about whether or not the joint revenue quasi-public business model will function in Ecuador. One reason is that the government does not have resources to guarantee profits for the bus operators. However, most of the experts also pointed out the fuel subsidies, and the operational inefficiencies of the bus operators should be used as a negotiation tool[23]. Another reason is that the transport unions, bus owners and vehicle industry are de facto powers that have connections to the political system; making changes to their privileges will demand a unity from the National Assembly, citizens,

[23] Interview with Ecuadorian Transport Experts: H. Cevallos, A. Guzman, A. Peñafiel and A. Ortega (April, 2020)

central and local governments. By taking away the negative incentives of golden routes and individual profits, transport unions will have to focus on the professionalization of the sector instead of fighting over routes and revenues.

The creation of the Bus Reform Committee was critical in coping with conflict management and legitimizing the decisions to modernize the bus transportation system. The role of academia and civil society are critical to guarantee that technical considerations surpass political or elite interests. The committee should design and approve the vision for the public transportation and fare system. The fare system must be transparent and generate a fair amount of profit bearing in mind the reality of the country's conditions due to the COVID-19 pandemic.

The implementation of exclusive lanes and securing the labor conditions for the bus drivers were not considered as applicable for the country due to the geography and changes in the labor code. However, the interviewees agreed that the NAT and National Police could implement facilities for intercity buses to leave and enter into the cites while avoiding traffic jams. For the labor contracts of bus drivers, once the authorities have information about bus operations, they could elevate bus drivers' problems to the Ministry of Labor or Health, depending on the nature of their demands.

Ecuadorian transport authorities have acknowledged the need to make progress on smart mobility. In the case of where no action is taken, public transportation will be hampered by illegal services and the increasing use of private vehicles. Therefore, not doing anything should not be an option. Not only are users (more than10 million people) being affected by the obsolete public transportation, also an important economic sector that employs more than 400.000 people (INEC, 2018). Like the Korean case, the Ecuadorian government should push for Bus Reform Act that mandates the use of ITS and reform the organizational structure of the government transport organizations (an in-depth horizontal organizational reengineering) and find alternatives to finance the modernization of the public transportation system.

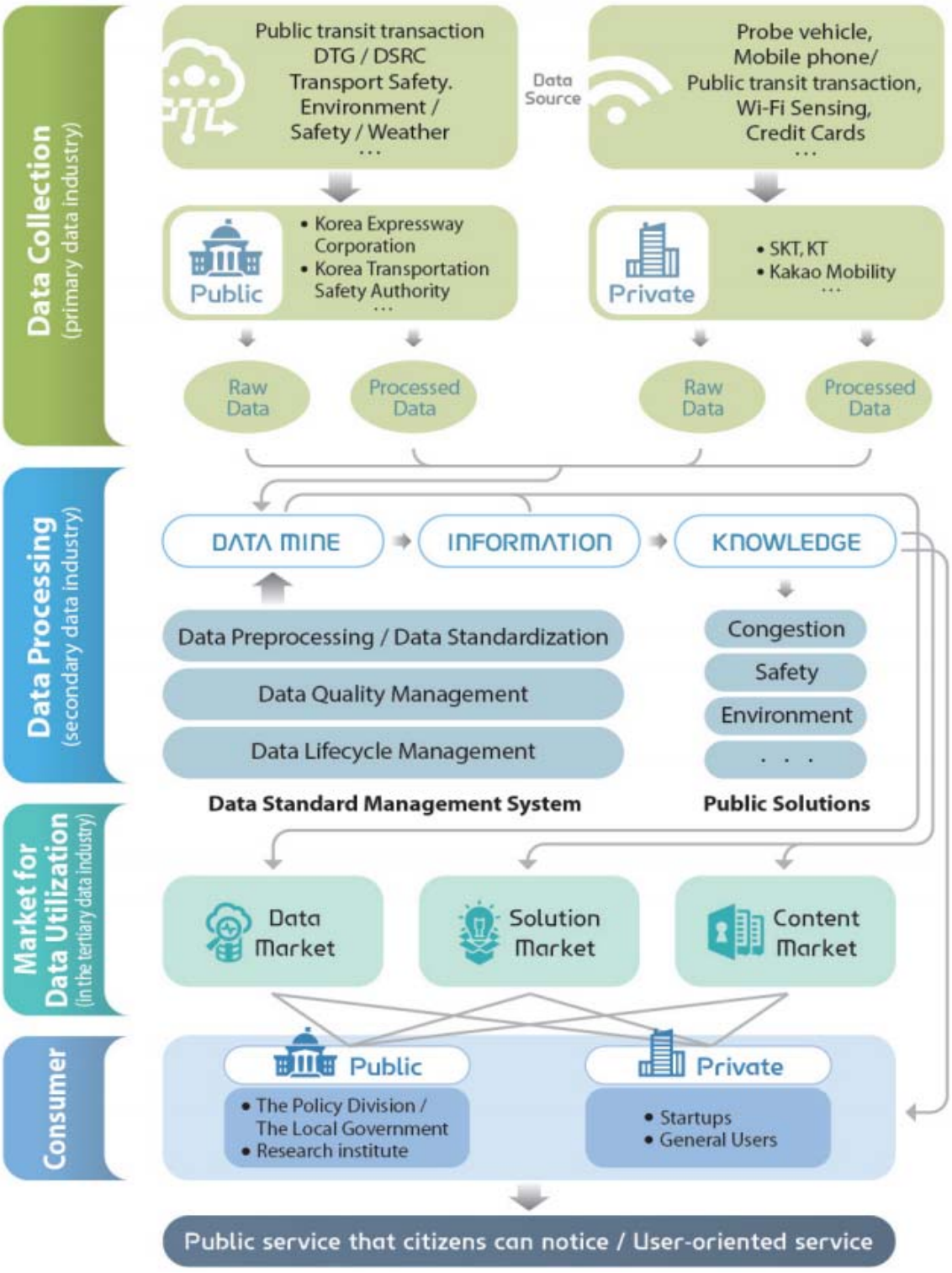
CHAPTER 3. A DATA-DRIVEN STRATEGY FOR THE DEVELOPMENT OF A SMART INTERCITY BUS SYSTEM IN ECUADOR

Chapter 2 highlights how in Korea's case, the implementation of a data-driven bus reform can transform an inefficient bus system into one of the most modern and efficient transport models in the world (Shin Lee, 2017). Thus, this chapter will explore what key enablers the Ecuadorian government needs to consider to ensure a sustainable data-driven culture that results in a smart intercity bus system. Nowadays, Korea is building and operating the Mobility Big Data Platform, which integrates private and public data to depict insightful information about trip purposes and mode preference (comprehensive mobility index). This platform combines data from vehicles, people, public transportation, and spatial information to trigger a data market that serves to startups but also to improve the public transportation system; see Figure 11 Mobility Big Data Economy.

The ITS and bus management system served as pillars for the Big Data Platform; however, some technology was obsolete and had to be updated, resulting in further investments. Following the recommendations of the World Bank, developing countries should take advantage of the latest technology for a quick jump in economic development by harnessing technological innovation [24]. Hence, Ecuador should reflect on the latest technological developments to decide on its ITS. The use of big data can open new revenue opportunities as seen in the Korean case or bring more time effective solutions. However, the decision should rely on the long-term vision for the sector, comparative of cost-benefit analysis for different scenarios, and institutional and, technical maturity levels.

[24] Article: "Leapfrogging: Look Before You Leap". For more information on obtaining material refer to https://unctad.org/en/PublicationsLibrary/presspb2018d8_en.pdf

Figure 11. Korean Mobility Big Data Strategy



Source: Reprinted from ¨ Korea Transport Database¨ by KOTI, 2019, page 8

3.1. THE MANAGEMENT CHALLENGES OF ITS AND BIG DATA

Public transportation managers are now able to gather updated data insights to make better decisions and target more effective interventions; and they can do so in areas that so far have been dominated by intuition rather than by data and rigor (McAfee & Brynjolfsson, 2012; Höchtl, Parycek, & Schöllhammer, 2016). Case studies in the public transportation field have proven that ITS and big data mining "have the potential to influence the internal logic and structure of bureaucratic organizations, thereby changing the process of governance through government" (Höchtl et al., 2016, p. 147). In Latin America, the most outstanding governmental big data initiatives are those executed by municipalities such as Medellín, Sao Pablo, Bogota, Mexico City, and Lima (Mojica et al., 2015; Michell, Jagannathan, Chang, Widorini, & Lee, 2018). Meanwhile, at the national level, the centralization of nationwide public transportation operations has been difficult to implement due to the multilevel actors and the lack of legally binding frameworks (Mojica et al., 2015; Barlow, 2013; Höchtl et al., 2016). One of the first steps to decide for a data-driven strategy is to understand the challenges and design strategies to cope with them. Below are some of the most common challenges an organization faces when designing its technology strategy.

First, like any other change management strategy, big data need the buy-in and a clear purpose definition from the policymakers, critical stakeholders, and technical leaders. Successful big data cases present a common start point; usually a senior team declare and force the use of analytics as a crucial element for all programs, projects, and budgets (Heskett, 2012; Brynjolfsson & McAfee, 2012). Thus, governments must ensure that innovative leaders or managers are in place in decision-making positions. However, most importantly, the continuity of modernization must be secured through mandates and continued advance reports to the citizens and critical stakeholders (Wiig, 2015; Höchtl et al., 2016; Michell et al., 2018).

Second, the actors must select its technology and analytical tools. Currently, there is plenty of enterprise and government solutions offered in the market, these '*tailored applications*' promise to enhance the spheres of public procurement, budget, and public service creation (Wirtz, Weyerer, & Schichtel, 2018). However, the '*fit in process*' of any IT tool demands a complex ITC state-of-art from the senior leaders. One of the first reflections is linked with data collection and the creation of value by infusing data intelligence. Leaders must recognize the data diversity[25] and all its forms, then design a strategy or methodology that captures this data in a structured and non-structured format. Furthermore, public organizations must select between an in-house, outsourcing, o a mixed approach for the data storage, which in turn may affect further strategic decisions (Wirtz et al., 2018). Simultaneously, managers must choose the right platform; this exercise requires (1) a benchmark of similar public organizations locally and globally, (2) a robust analysis of the investment revenue and (3) a clear understanding of the technical support and flexibility of all possible providers or in-house programmers. In the case of the Rio de Janeiro city control system, constructed for the World Cup and Olympics Games, considerations such as the integration of street-level videos, social media analysis, weather forecasting, and public transport tachographs were taken into account (Wiig, 2015). So, the platform choice relied on the ability to integrate all sources of information in different formats, and a user-friendly language for police, traffic, and administrative and operations officers (Sousa et al., 2017).

Third, the actors must assess the exploitation and use of applications and information. The more different government institutions provide and use the information provided by the ITS, the faster and more sustainable the implementation will be. Moreover, demand and supply of transportation data must be reliable and accessible for universities, investigations centers, citizens, and bus operators. The e-ticketing center must provide transport information for the

[25] Data diversity refers to the categories of public data, private data and licensed data in all formats.

educated decisions of users over their trips. Also, the fare system should provide a fare-distance price with different tariffs for direct and luxury service. The revenue management should be transparent and influence the structure of the costs of bus operators. The collection of fines by IoT is another benefit, thus control forces can focus on the eradication of illegal transport services. The opportunities for data mining for other sectors (such as commerce, startups, and land use) should be considered in the design of the legal framework and operative scheme. Finally, the transport suppliers and users must be made aware of the changes in road fatalities, service, time reliance, and finance through periodic public accountability reports (S. Lee et al., 2014; Iliopoulou & Kepaptsoglou, 2019).

Fourth, the actors must consider the financial sources for the implementation and sustainability of the bus system modernization. State ownership and control of the public transport system are necessary in order to protect the public interest and value. Traditionally, there are two primary sources of revenue for public transit: government subsidies and travel fare income. Usually, government subsidies account for just over 50% of the total system's revenues, while revenues from travel fares make up for a little under 50%. However, the implementation of the ITS demands a high-intensity investment in the first stage (personnel, IT architecture, IoT sensors, connectivity, readers, analytics, and predictive software). There are alternatives to push for a public-private partnership for operative areas such as e-ticketing, tolls, fine collection, publicity and marketing spots, and e-commerce promotion. Hence, transit authorities should analyze different scenarios for ITS funding, such as funding from development banks to support the strategies that do not generate revenue. In order to provide analytical tools for alternatives to funding, we will present a canvas business model for the modernization of the bus system.

3.2. ITS AND BIG DATA CANVAS BUSINESS MODEL

The business model canvas breaks a strategy or projects down into easily-understood segments: Key Partners, Key Activities, Key Resources, Value Propositions, User Relationships, Channels, User Segments, Cost Structure, and Revenue Streams. By digging into these elements, an organization can recognize and act on areas that can be improved. It also reveals clear paths on which to build an organizational innovation strategy[26]. *Table 10* presents a quick view of the main building blocks to identify the strategic inputs and outputs for the ITS and big data implementation plan.

Table 10. ITS and Big Data Canvas Business Model Bus System Ecuador

Source: The author

The canvas displays the information provided by the interviews of Korean and Ecuadorian experts as well as the highlights of the Korean bus reform case. Undoubtedly, the participation of the private sector and local government is mandatory. The private sector needs

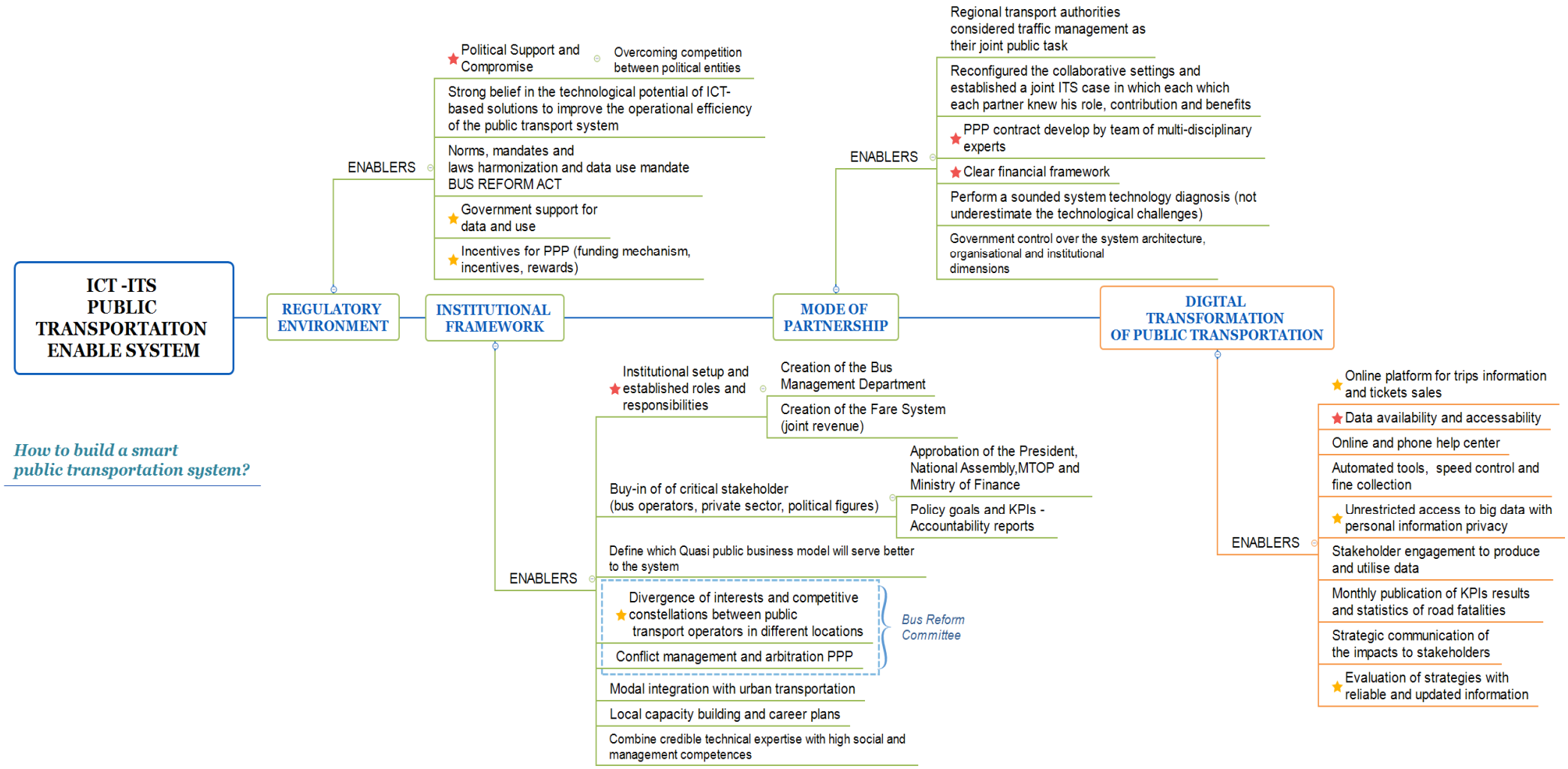
[26] Article Oxford University: "Business Model Canvas Explain". For more information on obtaining material refer to https://eship.ox.ac.uk/business-model-canvas-explained/

to provide the technology and technical savvy for the ITS; there are already tested solutions in the market, so internal development should not be considered as an option. Through development banks and other international organizations, the Ecuadorian government can call for ICT companies to present proposals for and express interest for a public-private partnership. Also, the government can choose to levy taxes or grant permanent funding for enterprises with more than 100 employees as the case of Korea and Barcelona. This fund must be exclusively used for the modernization of the service and later for technological improvements. Even though the participation of the private sector might seem to be the optimal path, there are some factors to enable a public-private collaboration. According to the OECD (2018), governments should promote an open government framework to ensure the widest possible impact of any ICT intervention and the fair participation of the private sector.

3.3. KEY ENABLERS TO ENCOURAGE PUBLIC-PRIVATE PARTNERSHIPS

The active participation of the private sector and the creation of technology-based startups are linked to the state enforcement of mandatory production of data, the improvement of the analytic capacity, and incentives to use and re-use data in all the decision-making process (OECD, 2018). It also requires understanding the process barriers and stakeholders' dynamics so that an adequate government data strategy can contribute to the delivery of public value (OPSI & OECD, 2019). In the transportation field, it is relevant to consider that "transport policies are developed to manage the social, environmental and economic impacts that the increased desire for the mobility of society brings" (Marsden & May (2006. p.2). Therefore, the national transport strategy should encourage the implementation of technology solutions that facilitate social, environmental, and economic evaluations. Under this context, the author has developed an ICT Framework to trigger Smart Mobility, which considered the OECD recommendations for building a sustainable open government, see Figure 12.

Figure 12. **Proposal for an ICT Framework to trigger Smart Mobility in Ecuador**



Source: The author based on 1) OECD Framework for and Open Government Strategy, 2) KSP recommendations to improve Bus Systems and 3) Weber, Heller-Schuh, Godoe, & Roeste, 2014.

The framework presents four building blocks for a comprehensive regulatory intervention, the maximization of the benefits of the ICT, and the motivation for the participation of private companies. At the beginning of a partnership, it is essential to focus on agreed-upon resources and risk sharing, even where the partners may have different reasons for being involved, to ensure that ICT-ITS enhanced outcomes genuinely benefit the mobility of citizens (Weber et al., 2014). Thus, each building block presents enablers that trigger a smart mobility environment and reduce misunderstandings among the parties in the relationships.

First Building Block: Regulatory Environment

The legal and regulatory environment is a critical success factor for the sustainability and continuity of a data-driven strategy in any country (OECD, 2018). In order for public-private partnerships, (PPPs), to be successful, they must be firmly rooted within an overall policy framework of bus reform for the delivery of public services and the administration of government. Ecuadorian authorities must keep in mind that the goals and objectives of PPPs in e-Government will remain limited if there is no a policy framework that supports broader reforms, beyond just improved efficiency in intercity buses. Therefore, PPPs are one crucial part of a much broader framework to separate or link key roles of governance such as land and transport planning, policymaking, road controls, performance monitoring, fares and revenue management, and operations. Without a dedicated effort to realize these broader policy objectives, PPPs will likely be unable to contribute significantly to improving efficiency, productivity, performance, and quality throughout the transport sector.

The structural reform of the Ecuador's legal framework for transportation requires a strong political commitment to put the collective well-being over the interest of de facto power groups. National and local authorities must hold a strong belief in the technological potential of ICT-based

solutions to improve the operational efficiency of the public transport system and push for a legal framework for the modernization of the public transport system in the legislature. The current organization and performance of the system will not survive the consequences of the external shock caused by the COVID-19 pandemic. Now, it is the opportunity to rethink how public transportation services should operate and be sustainable for the next 20 years[27].

Second Building Block: Institutional Framework

The execution of public policies, programs, and projects within a data-driven framework should foster an "agile, entrepreneurial, and quick-policy-win-oriented model" that enables self-learning, flexibility, and experimentation (OPSI & OECD, 2019). The Korean bus reform case demonstrated that technical expertise and management should be at the core of any ITS design and implementation. The creation of specific departments and units to cope with financial, legal, technical, and social complexities, are the backbone of any smart mobility initiative. From the diagnosis of the NAT, see Table 9, the current organizational chart, and the work overload are substantial strategic and operational barriers for the implementation of a data-driven strategy.

The government's expertise should lead to the design and implementation path. Thus, before the decision of the ITS model and PPP TDRs, authorities should understand the realities and limitations of human resources. Also, the creation of a task force for dealing with multilayer conflicts and actors is imperative. Scattered negotiations hamper transparency of the modernization process and risk the investment of public funds.

[27] Interview with Ecuadorian Transport Experts: H. Cevallos, A. Guzman, A. Peñafiel and A. Ortega (April, 2020)

Third Building Block: Mode of Partnership

The digital transformation of any sector in the long term depends mostly on the funding models that countries adopt (OECD, 2018). Then, the goal of transforming transportation with digital technology should be to maximize people's transportation welfare by providing a mix of decent but reasonably priced public transportation services. As a consequence, a team of multidisciplinary experts must develop the ITS PPPs framework. This framework must be based on legitimate and well-established management concepts for developing customized solutions for risk management, capital optimization, and creation of project-specific governance structures in project financing. When these pieces are in place, PPPs can serve both the people and the government. One of the first steps is a technological diagnosis and making sure not to underestimate the implementation challenges. Additionally, the financial and operational conditions must be established in advance and periodically reviewed by a steering committee.

It is essential to keep in mind that the implementation of complex PPPs in e-Government requires the utmost commitment of all partners to advance the broader vision of improved efficiency and services to citizens. It also requires that all partners remain flexible to policy changes that may improve outcomes. Communicating continuously with the public and relevant stakeholder institutions throughout the project implementation process is vital as well.

Fourth Building Block: Digital Transformation of Public Transportation

The transformation of the public transportation system is a long-term strategy; however, to secure funding and ensure the engagement of stakeholders, it is necessary to demonstrate the consecution of key milestones in the short and mid-term. Interventions in the transportation field are characterized by immediate user perception of change in the service. Nevertheless, not only should final users perceive the benefits of the bus reform and the implementation of the ITS, but

bus operators, academia, the managing organizations, and politicians should gain value for their activities.

Governments have a crucial role in the supply and demand of datasets and information. The focus should shift from a data supply and publishing perspective towards the use of open data as a collaborative tool (OPSI & OECD, 2019). Therefore, governments must recognize the value of open government data as a horizontal policy that can lead to broader digital transformation. In Ecuador, it is necessary to have a protocol to collect, process, and produce information that considers the information needs of local governments, management organizations, and citizens (Ubaldi, 2013). So the ITS milestones should be associated with 1) data availability and accessibility enforcement, 2) unrestricted access to data policy, 3) evaluation of strategies with reliable and updated information and 4) friendly-users applications that allow users to plan their trips, bus tickets and commute effectively with other transportation modes.

Finally, even though the implementation of a data-driven strategy such as ITS and big data are necessary to optimize and modernize the public transportation system, nowadays, under the economic shocks due to the pandemic, the authorities should focus on supporting the public transportation sector. As stated in the preceding chapter, now it is time to rethink how the bus system is organized and operates. The bus operators' cooperative model must enforce association and not an unfair competition so the operators can respond as a group to economic losses and create economies of scale. The reorganization and optimization of routes and timetables should be agreed before the actual termination of the state of emergency in July 2020. Public transportation is a public asset that should not be diminished by the use of private vehicles or the proliferation of illegal services. Thus, it is a responsibility of the state to lead a national consensus to rescue and modernize the public transportation system.

3.4. KEY DIFFERENCES BETWEEN KOREA AND ECUADOR CASES

As stated in Chapter 1 Methodology review and Limitations of the Study, the comparative analysis pursue to understand the factors behind a particular policy decision as a learning tool. In order to achieve this goal, complex situations are simplified. Thus each recommendation must be further analyzed into the complex reality of culture, political interests, resources burden, social implications, and environmental impacts. This section seeks to cover some critical distinctiveness between the Korean and Ecuadorian cases that should be considered by the policymakers or government officials when defining a national strategy to reform the public transportation in the country.

Demand-side - Macroeconomic and Demographic considerations: The population and economic growth are correlated to the demand for public transport[28]. Increases in real income may encourage greater use of private transport use and discourage the use of public transport, suggesting that public transport is an inferior good. However, the intervention of the State does play a role in encouraging the use of public transportation. The Ecuadorian government posses powerful tools such as targeting of subsidies, regulations to private vehicles, control of illegal operations, emergency financial support, dictate mandatory improvements in the public transport service, and infrastructure; all this to incentivize the use of public transportation. Another asset is that in Ecuador, the intercity mode is the only legal transport mode that connects all the provinces, captive market. So the financial and operational forecast models should not cope with the multimodal complexity of railways and aircraft, instead with the quantification of illegal operations.

On the demographic considerations, the population of Korea is highly urbanized, and it is three times bigger than in Ecuador. As a consequence, the size of the market affects the level of

[28] Article: "Public Transportation". For more information on obtaining material refer to https://www.economicsonline.co.uk/Market_failures/Public_transport.html

profitability of the bus service and the production of economies of scale. So for any investment, public or private is essential to know the real numbers of intercity trips (demand). The real figures might affect the percentage of subsidies given to bus operators. Currently, in Korea, the operations subsidy range between 10 and 20%[29]; this percentage makes attractive and feasible the joint revenue system. However, in the case of Ecuador because of the demand level, it might not be the case. Any profit percentage under the deposit/discount rate of 9% would not be attractive to the transport sector.

It is expected that the number of trips decreased in the next six months[30]. However, due to the economic recession, experts predict the following phenomena: 1) an increase of illegal services if there is not appropriate controls or 2) an increase in the demand for public transportation if this service offers sanitary safety and remain with low prices.

Subsidies – Supply side: Subsidization of public transport may result in a moral hazard, especially in Ecuador, where there are fuel subsidies and operational subsidies as insurance against inefficient practices. Such inefficiency raises the cost of supply and diverts scarce resources from more efficient uses. For example, bus companies may over-employ, and operate too many buses, which are run at 'half-empty' for long periods. Furthermore, policymakers have to consider in any Bus Reform and fare methodology the new mail service executed by intercity buses. In the case of Korea, mail service is not provided by bus operators.

Policy Design and Implementation: The Korean Bus Reform started as an initiative to improve the urban setting of the Seoul Metropolitan Area. Therefore the policy presented in this Chapter cover an urban setting and not a subregional or national situation. However, as it was pointed out in the Limitation of the Study section, this policy has already been escalated to other

[29] Interview with Korean Transport Experts Daejeon Metropolitan City, (October, 2019)
[30] Interview with Ex Vice-minister for Land Transport and Road Safety and Executive Director NAT,(April, 2020).

cities and the strategies implemented for interregional buses, whose operations area are located in Seoul. Moreover, the use of the ITS system had led to the modernization of the transport sector, not only public transportation. Korean government officials dealt mostly with local stakeholders. However, Ecuadorian policymakers should consider multilevel transport governance actors, local regulations, and regional implications. Therefore, the negotiations and implementation phase might be more complex and more prolonged. Timing is essential because of the short term results that are demanded to the national authorities.

Resources: In the case of Korea, most of the investment was made by the local and national government. The private sector got involved incentivized by the resource availability and technological development boost. However, in the case of Ecuador, and considering the economic and social impact of the pandemic, resources will be minimal. On April 2020, more than 5.000 government officials were fired[31], this cut of personnel will affect to the Minister of Transport and the National Authority of Transit. Hence, government officials will spend more of their time in operational activities rather than strategic projects.

The participation of the private sector is a crucial factor for the smartization of the public transport sector. National authorities should analyze together with bus operators what conditions might be attractive for a public-private partnership. Nevertheless, considering the current economic conditions is expected that investment in technology will not be a priority, though, the reorganization of the bus routes and the elimination of unnecessary frequencies should be a priority.

Technological Development: Korea has a high rate of digitalization, and it is the home base of well-known technology multinationals. The association with the State has reached a

[31] Article "10,000 public servants will be laid off in the first half of 2020" for more information refer to http://www.pichinchacomunicaciones.com.ec/en-el-primer-semestre-de-2020-podrian-ser-despedidos-10-mil-servidores-publicos-segun-miguel-garcia/

sophisticated level of collaboration. In the case of Ecuador, there is a lack of technology and innovative industries in the transport field; also, there is limited connectivity infrastructure in rural areas and highways. As a result, the scale of monitoring centers and IoT sensors should be evaluated to set the minimal functional requirements for the first stage. Moreover, the country should rely on international providers to implement any ITS system. Finally, the local capacity building to operate and update the software for public transportation forecast and management is another critical factor to consider in the project design.

Ethical concerns: Users come first should be the main motto for any policy in the public transportation field. However, since the operation model includes bus companies as a supply force, finding a balance between profits and accessible public service should be the norm. The State does not have the capacity and assets to take over the intercity bus operations, and bus companies as private entities pursue profitability. Thus, the State should calculate the actual price of the service in order to design adequate incentives, cut subsidies to operational inefficiencies, and guide bus companies to transform their competitive model to a collaborative one. For many years subsidies have been a tool to avoid conflict with bus companies or users; nevertheless, the targeting of subsidies should reflect the reality of the transport system and provide real figures for the State Budgeting Planning.

CHAPTER 4. CONCLUSIONS AND POLICY RECOMMENDATIONS

4.1. CONCLUSIONS

Ecuador ranks as one of the countries with the highest rate of road fatalities in South America; according to the statistics from the last two years, more than 1.500 people died or were injured in intercity bus road fatalities. These statistics evidence that there are structural problems in the public transportation system that have not been solved for years. From the demand perspective, citizens have preferred the use of more expensive illegal door-to-door transportation service because of they perceive the buses to be insecure and have low-quality service. The lack of information about routes and timetables, e-ticketing, unpunctual and uncomfortable service, robberies, and poor linkages with other transportation modes also cause the intercity bus ridership to decrease. From the supply perspective, the profitability of the bus system is declining. There is a deepening imbalance of supply and demand; 2) overlapping operation routes, 3) the lack of coverage in rural areas, and 4) inefficient business structure of costs. Additionally, the adjustment of routes is difficult because of the nonexistence of updated information and the particular interests of big bus companies.

Bus companies secure profits mainly from running on “golden routes,” which crisscross major roads in downtown areas. Securing and maintaining these profitable routes are priorities for the bus companies because there is a perverse incentive for passenger-revenue instead of efficiency-revenue. Consequently, most of the bus companies have started a new business line involving courier or tourist transfers. Hence, the incentive to improve the service for passengers has been decreased over the last few years. Nevertheless, the politicization of the sector has become familiar at the operative and strategic level of public transportation.

State ownership and control of the public transport system are necessary in order to protect public transport. However, the development of public transport in Ecuador has resulted in business-oriented partial reforms that benefit bus operators over citizens. Over the last ten years, the transport reforms have failed to put in place foundations that lead to the modernization of the bus system; instead, legal reforms have created a complex mesh of operational norms and separated the urban bus system from the intercity bus system. The development of green transport like public transport, walking, and cycling are not even considered in the national transport policy. Besides, the organizational functions of the transport and road control institutions have not even updated or aligned with the new mandates of transportation law. As a result, there is weak law enforcement, and the operational control is performed in a rudimentary manner.

The Korean bus reform served as a proven reference for the strategies applied to cope with similar problems or issues. The approval of the Bus Reform Act was the starting point for the transformation of the public transport sector. Then, the creation of the Bus Management Department, the quasi-public bus pperation model, and the ITS were additional milestones in the smartization of mobility in Korea. However, soft skills like conflict management by the Bus Reform Committee warrant the alignment and buy-in of all stakeholders. From the interviews with Korean experts and the literature review, it is highlighted that the compromise between actors to implement a data-driven vision largely enables the digital transformation of the bus system.

The application of ITS and big data in public transportation is a profound reform that will revolutionize the service concept, management mechanism, and business model of the public transportation industry. The application of big data in public transportation planning, operation, and management allow targeting better interventions that favor users and key partners. Undoubtedly, it is necessary to create a legal environment for the participation of the private sector.

ITC companies already have the technology and expertise to implement ITS in complex realities. However, the Ecuadorian government must settle the rules of the game to guarantee that the public transportation vision is being accomplished and that there is an integration with other fields such as land use, infrastructure, and local transport governance.

The success of advanced transportation systems does not depend solely on technical resources, such as coherent operational planning, technology selection, and transportation infrastructure, but also upon financial resources to ensure smooth operation for the entities involved. Through financial modeling, it is possible to identify specific issues of the project design, as well as quantify the monetary amounts involved.

Challenges to transport governance outline the need to address the political, legal, and institutional components for improved transport policy implementation. Technology should be considered as an enabler to achieve a long-term vision and not as an end by itself. Under the current context of economic recession and limitation of public transport operations due to the COVID-19 pandemic, the priority should be to evaluate the economic effects to critical stakeholders and define a new optimal paradigm for the reorganization of the routes and the association or conglomeration of bus operators. The government should lead a dialogue among stakeholders and build consensus to strengthen its weakened positions as negotiator. Once the sector has been stabilized, it will the proper time to analyze the reorganization of institutional arrangements reorganization and analyze what ITS solutions are most suited to trigger the modernization of the Ecuadorian transport sector.

4.2. POLICY RECOMMENDATIONS

Based on the findings and conclusions of this study, the author can present some recommendations for the National Authority of Transit. First, there should be an explicit interest and compromise among high-level authorities in the reorganization and smartization of the public

transport system in Ecuador. National and local authorities must hold a strong belief in the technological potential of ICT-based solutions to improve the operational efficiency of the public transport system and push into the Assembly the legal framework for the modernization of the public transport system. The improvement of the public transportation system has a direct impact on citizens´ perception and appraisal of local and national government performance. Improvements can lead to continuous assurance of public administrations and funding for future projects.

The legal and regulatory environment is a critical success factor for the transformation of the public transportation sector. Partial law reforms only serve to hamper the government's image, negotiation power, and effectiveness in law enforcement. Thus, it is necessary to construct a long-term vision that delivers public value and put in place technological and financial enablers. The public transport system should be designed following these essential criteria 1) improve territorial coverage and equity, 2) maximize the utilization of transport infrastructure and bus fleet by reducing the supply and demand mismatch, 3) enlarge the hours of service in high demand periods, 4) search for synergies between urban and interurban transport networks, and 5) improve punctuality, security, and quality of service.

As pointed out by Korean and Ecuadorian transport experts, in order to support the modernization of the bus system, technical savvy and use of technology are mandatory. Hence, it is highly recommended that Ecuador implement a Bus Reform Committee, a Bus Management Department, and design an ITS solution. Even though currently the country does not have the financial resources to implement all these strategies, authorities should consider PPs as alternatives as the existing ineffective operation system creating more losses for the government and bus operators instead of profits and social welfare. It is proven that the investment in smart public transportation is related to a decrease in 1) road fatalities, 2) traffic jams (mobilization time), 3)

investment in infrastructure expansion and 4) CO2 emissions, but public transportation is most importantly a tool to reduce inequalities and trigger development.

Ecuadorian authorities must keep in mind that the goals and objectives of PPPs in e-Government will remain limited if there is no a policy framework that supports broader reforms beyond only improved efficiency in intercity buses. Therefore, PPPs are one crucial part of a much broader framework to separate or link key roles of governance such as land and transport planning, policymaking, road controls, performance monitoring, fares and revenue management, and operations. Without a dedicated effort to realizing these broader policy objectives, PPPs will likely be unable to contribute significantly to improving efficiency, productivity, performance, and quality throughout the transport sector.

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APPENDIX 1: SUMMARY OF GUIDED INTERVIEWS

GUIDED INTERVIEW – ECUADORIAN TRANSPORT EXPERTS
HIGHLIGHTS OF FINDINGS

Interviews Acronyms

Álvaro Guzmán (AG)	Juan Emilio Rodríguez (JR)	Hugo Cevallos (HC)	Adrián Ortega (AO)	Juan José Lara (JL)	Joaquín Calero (JC)
Alan Peñafiel (AP)	Carla Guzmán (CG)	Karla Vaca (KV)	Andrés Urquizo (AU)	Mariano Ortiz (MO)	

● Questions in Spanish ● English Translation

¿Cuál es la visión de desarrollo del transporte público en Ecuador? ¿Existe algún documento en qué se formalice esta visión?
What is the vision of the development of public transport in Ecuador? Is there a document in which this vision is formalized?

- No, there is not a formal long-term vision about public transportation in Ecuador AO, AP, CG, KV.
- There is the Strategic Plan of Mobility 2013-2030, but this document is focused on transport infrastructure, there are only a few paragraphs about public transportation. It does not give a clear vision of what is the vision for public transportation. AG, JR, HC.
- As bus owners, we do not know what the position of the government about our sector is; in the last years, we have not had any discussion about how to develop and protect our sector against illegal service. JL, MO, JC.

La LOTTSV es el marco legal que regula las operaciones de transporte terrestre y tránsito en Ecuador. Esta ley regula varias modalidades y da atribuciones a varias instituciones en un solo cuerpo legal. Revisando las actualizaciones de la normativa en promedio hay una reforma o requerimiento de reforma cada 16 meses, debido a que en la práctica no se ha podido aplicar la norma o hay artículos por aclarar. ¿A qué se deben estos continuos pedidos de reforma de la ley?
The Organic Law of Land Transport and Road Safety is the legal framework that regulates land transport and transit operations in Ecuador. This law regulates various transport modes and gives attributions to various institutions in a single legal body. The Assembly receives continuous reform requirements; according to the Assembly Web Log there are reform requires each year. From your perspective, why are these ongoing calls for law reforms?

- The particular interest of elite groups. AG, HC, AP
- Contradictory law and loopholes due to partial reforms. CG, AP, JR
- The law should be the main guideline and not go to the operative level. AG, AO
- The law is not applied because we do not have enough controls on the road. KV, AU.
- The las are very punitive, and police applied it subjectively. JL, MO.

¿A su criterio cree que es necesario que haya una ley que norme de manera exclusiva al transporte público, urbano e interprovincial? Si/no por qué?
In your opinion, do you think that there is a need to have a law that exclusively regulates public, urban, and intercity transport? Yes/No Why?

- Yes, in the current law, commercial and public transport is regulated. The ultimate goal of public transportation is to serve people not to generate profits. Furthermore, a specific document will allow the introduction of elements of modernization and articulate collaborations with local governments. AP HC, AU, AO.
- No, it is better to have one regulatory body, so people do not get confused. It should be organized by chapters and not detail operative norms. AG, JR.

En varios países el sector de transporte es un actor político que ha ejercido influencia en las decisiones del gobierno. Para usted ¿cuál es el grado de politización que existe en del sector de transporte público? ¿Cómo esta característica influye en el desempeño del sistema de transporte público inter e intraprovincial?

In several countries, the transport sector is a political actor that has influenced government decisions. For example, last year, in France and Chile, citizens and public transport sector perform a national strike to avoid management or fare changes. For you, what is the degree of politicization that exists in the public transport sector in Ecuador? Does politization influence the performance of the inter and intra-provincial public transport system? How?

- There is a strong influence of politics and particular interests in the transport sector; the current system is based on profits by passengers, so the main interest is to protect the market and not optimize resources or serve to citizens. JR, AG, HC.
- Transport unions provide political power and legitimization to politicians, politicians take decisions over the sector, so there is always a hidden discourse. This characteristic has hampered the modernization of the sector with technology because bus operators do perform illegal activities. CG, AP, AO.

El transporte público interprovincial es la única modalidad legal que conecta a todo el país, se podría decir que se opera en condiciones de mercado cautivo. Sin embargo, soy pocas las empresas de transporte que tienen un manejo gerencial adecuado. Además, según reporte moratoria publicado por la ANT, los buses están perdiendo mercado debido a servicios puerta a puerta, pese a que viajar en bus es más cómodo. ¿Por qué el sector ha evolucionado de manera tan lenta? ¿Qué factores están influenciando en la pérdida de mercado?

Intercity public transport is the only standard modality that connects the entire country; it could be said that it operates in captive market conditions. However, according to NAT´s and Superintendence reports a few transport companies have a company management model, there is a concern about not standardized service levels. Also, according to a moratorium report published by the ANT, buses are losing the market due to door-to-door services, although traveling by bus is more comfortable. Why has the sector evolved so slowly and unevenly? What factors are influencing the market loss?

- For many years the intercity bus service was the only option that citizens had. Bus companies did not have the incentive to improve their services. However, nowadays, services as uber and minivans are gaining the market because they adapt better to citizens' needs. Bus companies do not understand that they have to improve their services because the State subsidizes their operations. AG, JR, KV,
- There is a culture in the public transport sector; bus owners cannot conceive to be the owner of a property right; they need to feel they have an asset and not a paper. Thus, the sense of corporation is minimal. AO, CG

- There is an unfair competition among bus operators; their interests do not allow them to improve the whole system. Most of them think that the routes belong to them, and the State cannot do anything to take them back, so they can do whatever they want. JC
- The State has failed to give norms and technical aids to bus companies to improve their business models and operations. AP, HC, MO, JC

¿Cuáles son los principales actores que influyen la gestión del transporte interprovincial en Ecuador? ¿Cuál es el actor que tiene más influencia y por qué?
Who are the main actors influencing intercity transport management in Ecuador? Which actor has the most influence, and why?

- See the stakeholder analysis section and power matrix.

¿Existe participación de la academia en el sector de transporte público y de la sociedad civil en la gestión de transporte público? ¿En qué áreas de la gestión de transporte público se podrían involucrar la academia?
Is there participation of the academy in the public transport sector and civil society in the management of public transport? In which areas of public transport management could the academy be involved?. Same question of civil society.

- There is no involvement of academia or civil society. The National Authority of Transit would benefit from their technical savvy. However, there are not formal projects that link academia with the transport sector. AG, AU, AP, AO, KV.

En gobernanza de transporte hay un factor que determina el éxito o fracaso en la implementación de una ley, proyecto, normativa, se denomina gestión del conflicto, qué es la negociación consciente con todos los actores involucrados o que sean impactados por una decisión. ¿Existe alguna instancia o persona que gestione conflictos en la ANT de manera institucionalizada?
In transportation governance there is a factor that determines the success or failure in the implementation of a law, project, regulation, it is called conflict management, is there a conscious negotiation with all the actors involved or who are impacted by a decision. Is there an instance or person that manages conflicts in the NAT in an institutionalized way?

- No, there are not directly responsible for conflict management in the organization. AP, AO, JL, AU, KV, JC.
- The Executive Director and national directors often face conflict with bus operators, but they do when the conflict appears, not as in a preventive manner. AG, HC, JR.

¿Cuáles son las fortalezas y las debilidades de la ANT en la gestión del transporte Interprovincial?
What are the NAT's strengths and weaknesses in interprovincial transport management?

- Strengths: the presence of the NAT in all the provinces.
    - Analysts know about local transportation problems.
    - Regulation and control power.
- Weaknesses: lack of information, technology, transparency, no procedures or methodologies, no capacity building.

¿La actual estructura orgánica de la ANT responde de manera eficiente a la carga operacional que dictamina la LOTTSV?

How would you rate the level of efficiency that the current organizational chart of the NAT responds to the operational burden dictated by the LOTTSV?

- The current organizational chart does not respond to all the law mandates. Over the past years, the Executive Director has requested changes to the Minister of Labor, but it has not been approved yet. HC, AG, CG.
- There is operational overload and not time to perform strategic projects or update methodologies or norms. AO, AU, KV.

¿Existe una alta rotación de personal en la unidad de transporte público? ¿Cuál es el promedio de permanencia de los analistas? ¿A qué se debe esto?

According to NAT human resources report there Is a high turnover of personnel in the public transport unit and also in strategic position such as Directors and coordinators. What is this about?

- Yes, there is a high turnover of personnel, mainly because when the CEO changes, the whole strategic team is changed. HC, AG, AO
- Political pressure. KV, AU, JR

Describe los procesos de planificación y evaluación del transporte

Describe the transportation planning and evaluation processes

- Bus operators request the analysis of a new route or timetable. The analyst of the transport unit conducts a study to determine whether there is interference with other bus operators or not. There is no digital information about the supply of a particular route. AO, KV, AU
- There is no methodology to evaluate technically or financially a route. AP

¿Qué unidad es la responsable del cálculo de tarifas de transporte público? ¿Conoce cómo se realiza el cálculo de tarifas?

Which unit is responsible for calculating public transport fares? Do you know the methodology behind the calculation of fares?

- The Transport Land Studies Department. There is not a standardized methodology for the calculation of fares. For the same route, the fare can change for different bus operators because you consider the demand and the cost structure of the company. Thus if the company is inefficient, the fare will cover this. AP, KV
- Most of the fares have not changed for more than ten years; all the inputs for the operations have increased their price but not fares. JL, MO, JC
- We do not know precisely how fare is calculated; when a new route and/or timetable is approved, we do not evaluate the financial part. AU.

¿Existe un manual de procesos o metodologías en las que se detalle la gestión de transporte de manera técnica con entradas, salidas, productos, formatos a utilizarse, requisitos?

Is there a manual of processes or methodologies in which the transport management is detailed in a technical way with inputs, outputs, products, formats to be used, requirements?

- No, that is a considerable weakness, many procedures are subjective.
- No, we have failed to write down all the procedures; there is no time to do this, we have to respond to users. We have more than 160 studies to perform and more than 2.000 user procedures to reply.
- The requirements are not specific, officers receive the documents, and a few weeks later they call you or write to you to tell you there is information or documents that are still needed. JL, JC

¿Qué unidad está a cargo de gestión de transporte en ANT? ¿Cuántas personas trabajan en esta unidad? ¿Cuáles son los perfiles de los analistas?
Which unit is in charge of transportation management at ANT? How many people work in this unit? What are the analyst profiles?

- Public Transport Unit, last year there were ten people but due to budgetary cuts, nowadays only four people. The work overload is too high, and there are not technological tools that support the team to perform better. AO, KV, AU.

¿Con qué herramientas tecnológicas cuenta la unidad para realizar su trabajo? ¿Qué capacitaciones han recibido en el último año?
What technological tools does the unit have to carry out its work? What trainings have you received in the last year?

- ARGIS, and Excel datasets. Last year a web portal was implemented with the information on bus operators, but it is not implemented yet. AO, KV, AU.

Actualmente existen contratos de operaciones de 10 años en el que se establece las obligaciones de la empresa de transporte, rutas y horarios de operación. En el caso de que existiera una nueva ley que reorganice el sector, y se dictará la elaboración de nuevos contratos. ¿Qué mejoras se podrían incluir en los contratos?
Currently, there are 10-year operating contracts that establish the obligations of the transport company, routes, and timetables. If there is a new law that reorganizes the sector, and the preparation of new contracts will be dictated. What improvements could be included in the contracts?

- There is not a standardized model of contracts; there are contracts only with the initial and final stop, no route, no timetables. Also, the service level is not included. KV, AU.
- The way bus companies operate must be changed; the contract should promote mandatory elements to implement a business model as a company or cooperative, not as a bus owner. Service levels must be included. AG
- Service levels and capacity building. JR, HC
- No unfair competition among bus operators. JL, MO, JC

Actualmente el reglamento de la LOTTSV permite que las empresas de transporte requieran nuevas rutas y frecuencias, en otras palabras, la planificación de transporte tiene como base la oferta (supply-oriented), sin embargo las metodologías de transporte ha evolucionado hacia una planificación basada en el ciudadano, es decir la demanda. ¿Qué factores o acciones debería realizar la ANT para cambiar de una planificación basada en la oferta a una planificación basada en demanda?
Currently, the LOTTSV regulation allows transport companies to require new routes and frequencies; in other words, transport planning is based on supply (supply-oriented). However, transport methodologies have evolved towards planning based on the citizen's needs. What factors or actions should ANT take to switch from supply-based planning to demand-based planning?

- Information, demand, and supply information. If it is real-time information, the better. AG, KV, AO, HC, JR
- Changes in the law. AP

¿Existe algún reporte periódico o proceso en el que se evalúe la calidad de servicio de transporte público y se retroalimente a las operadoras de transporte sobre puntos a mejorar?

Are there any periodic reports or processes that evaluate the quality of public transport service and provide feedback to transport operators on points to improve?

- No, there is not. Sometimes citizens surveys are conducted, but there is not a real use of this information. AG.

¿Con la actual infraestructura vial del país sería posible implementar un carril exclusivo para el servicio de transporte público interprovincial?
With the country's current road infrastructure, would it be possible to implement an exclusive lane for inter and intra-provincial public transport services?

- No, it will be challenging to expand the road capacity due to geography. However, public transportation should have facilities to enter and leave the big cities. HC
- Yes, but it should be a collaboration with the police, especially for weekends or holidays. AP, AO, AG.

¿Qué mejoras en la infraestructura se debería realizar para mejorar el servicio de transporte público? Terminales terrestre, carreteras, paraderos, paradas.
What infrastructure improvements should be made to improve public transportation service? Terrestrial terminals, roads, stops, stops.

- Bus terminals are located outside the city, the local urban planning did not consider that bus terminal should allow the population to commute and the downtown is a critical area to do so. Even though bus terminals are outside the city, there should be a good integration between intercity and urban buses. There is no integration between urban and intercity buses, HC, AG, JL, JC.

Actualmente estamos en condiciones de aislamiento social y los viajes interprovinciales están cancelados ¿Cómo crees que está crisis afectará al sector de transporte público interprovincial?
We are currently in conditions of social isolation, and interprovincial trips are canceled. How do you think this crisis will affect the interprovincial public transport sector?

- The current organization and performance of the system will not survive the consequences of the pandemic external shock. Now, it is the opportunity to rethink how public transportation services should operate and be sustainable for the next 20 years. AG, AP, AO
- , under the economic shocks due to the pandemic, the authorities should focus on the public transportation sector rescue. As stated in the former chapter, now it is time to rethink how the bus system is organized and operates. The bus operators' cooperative model must enforce association and not an unfair competition to respond as a group to the economic losses and create economies of scale. JR, JL

Existe diferenciación de servicio, es decir rutas directas y rutas con intervalos?
Is there a service differentiation, that is, direct routes and routes with intervals?

- No, there is not a differentiated service. JL, JC, KV

¿Cuáles son los medios de consulta a público sobre horarios y rutas?
What are the means of consulting the public about schedules and routes?

- There is no means for consultation; only a few bus operators have online reservations and e-ticketing. Most of the companies have their counter in the bus terminals or offices located in the big cities—all interviewees.

¿Se reporta a la ANT el nivel de ventas de tickets por parte de las operadoras?
Is the level of ticket sales reported by the operators to the NAT?

- No, even though in the law is a mandate. All interviews.
- No unit is responsible and no capacity to process that data.

¿En qué condiciones se podría implementar un sistema de venta de tickets centralizada presencial y en línea?
What conditions are necessary to implement centralized online ticketing?

- Political willingness, resources, personnel, and technology.

¿Qué organismo debería estar a cargo de este sistema de centralización de tickets?
Which body should oversee this ticket centralization system?

- The National Authority of transit.
- A private operator but the information must be collected and used by the NAT.

Lo sistemas de transporte público a nivel internacional han migrado o están migrando al uso de ITS, smart cards con aplicaciones móviles para el pago de tickets. Este sistema hace tracking o seguimiento a la venta del boleto, check in / check out del pasajero, tiempo de viaje de la unidad de transporte. ¿En qué condiciones de podría implementar este sistema en Ecuador? De implementarse ¿quién debería correr con los gastos de operación, mantenimiento?
Public transport systems at the international level have migrated or are migrating to the use of ITS systems, smart cards, or smart cards with mobile applications for the payment of tickets. This system tracks the bus, have e-ticketing, passenger check-in / check-out, travel time of the transport unit. What are conditions could this system be implemented in Ecuador? If implemented, who should bear the operating and maintenance expenses?

- There have been intentions to implement ITS systems in Ecuador, but resources are limited, and the NAT does not have the technical capacity right now. All officers are overwhelmed with the work and requests of bus operators. There are some dark interests to keep the institution in chaos because controls then cannot be executed.
- ITS system are a powerful tool to modernize the transportation system. However, it is a project that requires continuity and each year, we have new authorities and a new team.
- We have to explore how to involve the private sector, but the State must set the rules of the game, there are plenty of technological solutions in the market, so the private sector must adapt to us and no the other way around.
- There should be a law that enforces the implementation of ITS not only for public transport but also for freight and commercial vehicles. The fee in tolls and sales of tickets can be used to finance the ITS.

Analysis of the Korean Case – See section comparative study Chapter 2.
What is the current partnership relation with Korea and the National Authority of Transit?
What have been so far the results of the four field trips to Korea?

GUIDED INTERVIEW –KOREANTRANSPORT EXPERTS
HIGHLIGHTS OF FINDINGS

Choi Dong-Gyu	Team Leader Smart City Division Daejeon Metropolitan City
Kim Seong-lyong	Local Bus Policy Department Daejeon Metropolitan City
Han Dae-Hee	Tram Policy Division Daejeon Metropolitan City
Byongho Choe	Head of Transport Safety Research Office Korea Transportation Safety Authority
Sungmin Hong	Transport Safety Research Office Senior Researcher Sungmin Hong

What were the key success factors of the Korean Bus Reform?

- Political compromise to approve and execute the Bus Reform Act
- Technology help to gather information and perform an intelligent design of the routes
- Financial Resources
- The Bus Reform Committee

All the experience is well documented in the case of studies. Managers sent information for reading and better understanding the Korean public transport transformation.

Could you explain to me the business model of the bus system?

- We have a joint revenue system, so the government collects the money that comes from tickets, publicity, permits, and then we use a mathematic model to decide the revenue to bus operators according to the conditions of the contracts. We also evaluate the service level and whether or not it is a good bus operator.

What are the main subsides of the bus system?

- The local governments do subsidize transport in each city; we know that public transportation is essential to take care of the environment and avoiding accidents and traffic jams. For example, in Daejeon city, the new tramp service will be subsided over the next five years. There is a specific institution with finance experts that every year evaluate the revenue and fares.

Could you please explain to me how the TOPIS work?

- The function of the TOPIS is well documented, but I can tell you that the information produced by the TOPIS and other monitoring centers in the country has helped us make decisions in real-time and to plan better.

Managers send me information about the ITS systems and TOPIS Seoul.

Could you explain about the institutional arrangements, administrative and operations part behind the bus system management?

- There is specialized departments with highly trained people, financial and operations department are very important to manage information and revenues. Technology helps for data collection to design better routes and frequencies. Information about sales is processed and review constantly for forecast and subsidies targeting.
- It is a complex synergy of professionals, policymakers for policy reforms and legal compromises, operations are monitor in control centers and data use for forecast and avoid traffic jams, quick reaction in case of accidents.

How does operate the intercity bus system?

- Similar to urban bus system on the operation and fare side, but cities agree on the structure of costs and revenue share. Since the nature of the tips differ from urban the amount of subsidies is not that high. There is a few differences between the ticket in train and bus.
- Some companies have different buses, inside the city, outside the city, regional, base on fare by distance and with information about tickets, the financial model distributes the profits.

How is identify citizens' needs of mobility, especially in rural areas?

- We gather information from different sources; however, for rural areas, we perform a specific analysis to see how many people live and mobilize in a village. Now with big data, this job is becoming easier.

What are the new projects to improve the public transport system?

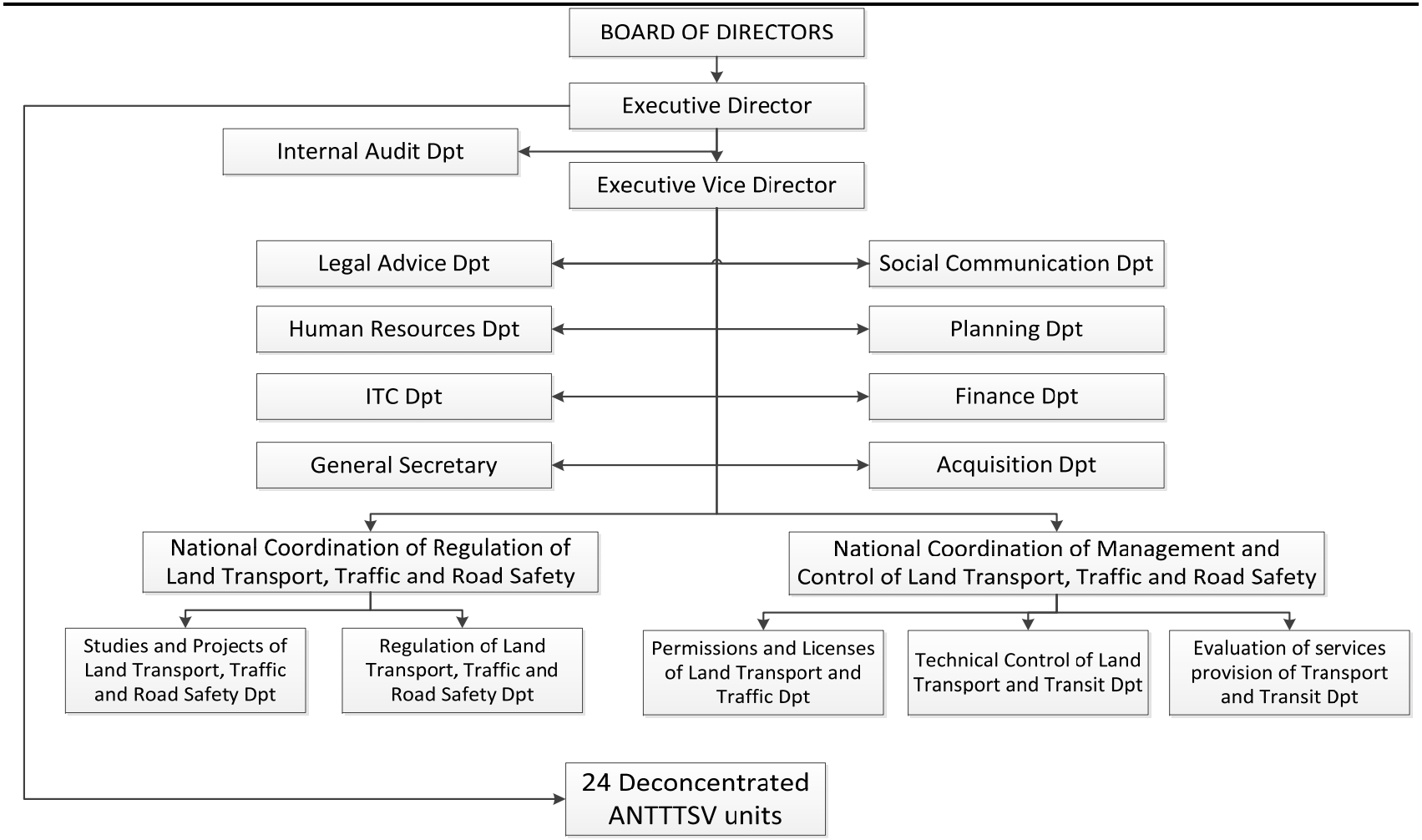
- We are exploring the use of the big data, including virtualization of the system to optimize it. Plans depend on the land use and urban planning.

APPENDIX 2: STAKEHOLDER ANALYSIS -POWER MATRIX

Stakeholder	Influence	Power	Interest	How the Stakeholder can affect the internal organization compliance	How the Stakeholder can enforce the internal organization compliance
President of the Republic	High 9	High 10	Show results in the reduction of car accidents deaths Political status	Demand not to impose strict control to land transport actors who are political actors (constituents)	Mandate the approval of the new organization structure and financial resources
Minister of Public Works and Transport	High 9	High 9	Show results about transparency, performance, and road safety		Demand results and present victories to the media Public recognition to compliance efforts
Minister of Finance	Mid 6	Mid 7	Effective resource allocation	Do not allocate financial resources for projects	Control budget
Congress officials	High 8	Mid 7	Legal accountability of the organization Political and economic interest for their parties sponsors (transport unions) Political status	Demand not to impose strict control to land transport actors Request for special considerations for groups of interest	Demand legal accountability in the road safety field and transparency
Head of Board of Directors	Mid 7	Mid 7	Show results about transparency, performance, and road safety	Do not support the #1 Strategy	Demand results of institutional performance and transparency
Media	High 10	Mid 7	Actions to increase road safety and fight against corruption	Take side to transport unions or associations when strengthening controls	Give voice to car accident victims to increase citizens awareness Public shame to politicians that work for elites and not for citizens
Citizens (costumers)	Mid 6	Low 4	Effective service delivery	Briberies	Whistleblowers
President of public transport union	Mid 6	High 9	No harm to the interests of those represented Political status	Demand not to impose strict control to land transport actors Request for special considerations	Demand road safety actions to his associates Use their negotiating position to improve the culture of the
President of taxis union	Low 4	High 8			

President of massive trucks union	Low 4	High 9		to groups for interest Briberies	organization and support projects (specialize the automatization fo the control process)
President of tourism transport union	Low 4	Mid 5	No harm to the interests of those represented		
President of the professional drivers union	Low 3	Mid 6			
Drivers training centers	Low 3	Low 3			
Vehicle manufactures and car importers association	Low 4	Mid 7	Regulations that facilitate the import, production, and commercialization of new and second-hand vehicles		
Municipalities	Mid 6	Low 3	Legal accountability for their mobility plans	Do not alert or inform about territorial problems in the transportation field Give a platform to transport unions at the local level	Use their political power to have consensus over the strengthen the control of illegal drivers
Police	Low 4	High 8	Road Safety	Not coordinate joint actions to reduce carr accidents	Awareness to people about the consequences of illegal licenses
Inter American Development Bank	Mid 7	Low 3	Implementation of programs that reduce car accidents and increase awareness of road safety	Not provide experts to change the organization chart and improve regulations and policies	Institutional joint analysis with international experts
Civil Society (car accidents victims)	Low 2	Low 2	Timely attention to car accidents victims during and after the event Severe penalties for drunk and irresponsible drivers	Demand results in the short-time	Rise the voice against corruption acts
Integrated emergency system (911)	Low 2	Low 1	More compliance on regulations to avoid car accidents		

APPENDIX 3. ANTTSV ORGANIZATION CHART



APPENDIX 4. ORGANIZATION OF BUS LINES IN KOREA

A Conceptual Drawing of the Bus Hierarchy by Functions

Categories Classification of Bus Routes and Operational Features

Trunk lines	➡	Blue Bus (Trunk route bus)	➡ • Interregional connections among the central and secondary business districts and outlying areas • Ensuring mobility and reliability
	➡	Red Bus (Metropolitan trunk route bus)	➡ • Connections between satellite cities in the Seoul metropolitan area and central or secondary business districts • Meet the demand for personal car travel crossing city limits
Branch lines	➡	Green Bus (Branch route bus)	➡ • Connect between trunk routes and urban railways • Meet demand for travel within districts, and secure accessibility
	➡	Yellow Bus (Circular branch route bus)	➡ • Circular branch routes within the city center or secondary business districts • Meet demand for travel within central or secondary business districts

Criteria for Reorganizing the Bus Routes by Functions

Categories	Intercity Route Functions	Urban Route Function
Roles of routes	• Handle demand for intercity long-distance travel • Support urban railways on high-demand routes • Provide bus services to areas without urban railway services	• Connect trunk buses and urban railways • Operate around regional travel modes
User accessibility	• Provide walking access of bus services to 50% or more of bus riders	• Provide walking access of bus services to 90% or more of bus riders
User convenience	• Operate mainly on bus-only lanes to ensure speedy travel for long-haul passengers	• Mostly short-haul operations to reduce headway and ensure reliability
Operating road conditions	• Operations mainly on trunk roads	• Operations mainly on local distribution roads
Route curvature	• Maintain a direct course between departure and arrival points to the maximum extent	• Allow curved routes for some local distribution roads and roads in residential districts
Service diversification	• Provide long direct route services to remove transfer inconvenience in downtown areas • Provide metropolitan trunk services by considering demand for travel crossing the city limits	• Provide circular branch route services for specific areas by considering demand for shopping and business travel in commercial and business districts
Inter-route relations	• Allow duplicate operations of branch buses on major corridors to meet high travel demand. These and trunk route buses play mutually complementary roles	• Ensure that branch routes are not overlapped
Route supply	• Provide optimum number of routes and buses by considering the prospects of personal car users making modal shifts	• Provide an appropriate number of routes and buses by considering the function of ensuring connections to trunk route modes of travel
Operating conditions	• Designed to operate buses mainly on bus-only lanes to secure the reliability of trunk route buses	• Designed to operate mainly on local distribution roads. However, branch buses are allowed to use bus-only lanes to the extent that they do not negatively affect the operation of trunk route buses