

IMPACT OF TRANSIT ORGANIZATION ON RIDERSHIP

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ABSTRACT

This research evaluates the hypothesis suggesting that organizational characteristics of transportation institutions have an impact on their transit system's ridership.

It is important to emphasize that this research is not oriented towards the estimation of ridership, but to identify if organizational characteristics may be used or discarded as part of a set of estimators.

The methodology used includes:

- A literature review used to gather background information related to organization and transportation theoretical frameworks.
- Inspection of study cases to identify organizational characteristics that may have had some influence in their ridership performance.
- Development of a questionnaire for an on-line survey, using the study cases and literature review as background. The survey was used to identify variables available to test the suggested hypothesis.
- A correlation analysis using Eta correlation ratio was performed in order to identify relations between ridership and organizational characteristics of the sample. Variables having the highest correlation and with appropriate results on the corresponding hypothesis test were analyzed through a multiple classification analysis (MCA). The MCA was performed for individual variables and combinations of two and three variables. The MCA models were applied to the originally excluded cases of San Juan, Puerto Rico. A percentile bootstrap model prediction averaging was used in order to obtain a mean annual ridership per service population estimate.

Results from models containing organization's internal environment variables resulted in estimates that, for the case study of PR, were much more similar to the real value than the estimates from models related to capacity or transportation variables only. Therefore, there is not enough evidence to discard that the transit organization has a direct impact to transit ridership.

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It was concluded from the results of the Eta Correlation Ratio and Multiple Classification Analysis that there is a correlation between some organizational characteristics of transit institutions and their transit ridership. Therefore, a framework describing current transportation relationships should highlight the organizational component.

RESUMEN

Esta investigación evalúa el impacto de las características organizacionales de las instituciones de transporte en el patrocinio de los pasajeros a sus sistemas de transportación colectiva.

Es importante hacer hincapié en que esta investigación no está orientada a la estimación del patrocinio, sino a identificar si características organizacionales pueden ser utilizadas como parte, o descartadas, del conjunto de estimadores.

La metodología utilizada en esta investigación incluye:

- Revisión de literatura para obtener información relacionada a los marcos teóricos organizaciones y de transportación.
- Inspección de casos de estudio para identificar características organizacionales que podrían tener alguna influencia en el rendimiento del patrocinio.
- Desarrollo de un cuestionario para una encuesta a través de la Internet. Se usó como base el estudio de casos y la revisión de literatura. La encuesta fue utilizada para identificar variables disponibles para probar la hipótesis sugerida.
- Desarrollo de análisis de correlación, usando la razón de correlación Eta, para identificar tendencias entre el patrocinio y características organizacionales en la muestra.
- Las variables con las más altas correlaciones y que pasaron la prueba de hipótesis como significativas fueron estudiadas mediante un análisis de clasificación múltiple (MCA por sus siglas en inglés). El MCA se realizó para modelos de una, dos y tres variables.
- Los modelos resultantes fueron aplicados al caso de San Juan, Puerto Rico, el cual fue excluido originalmente del análisis. Se utilizó el método de “bootstrap” con percentil para obtener un estimado del patrocinio anual promedio por población en el área de servicio.

La cantidad anual de pasajeros por población de servicio promediado de los modelos que contienen variables de ambiente interno organizacional, para el caso de San Juan, Puerto Rico, resultó en un estimado más cerca de la realidad que el que resulta de los modelos con variables que sólo describen la capacidad o el sistema de transportación.

Los resultados de los análisis de correlación y clasificación múltiple demuestran que existe una relación entre algunas características organizacionales de las entidades de transporte colectivo y el patrocinio a su sistema. Por lo tanto, el esquema que describe las relaciones de transportación actuales debe resaltar el componente organizacional.

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1 INTRODUCTION

Organizations are defined as social constructs created by groups in society to achieve specific purposes by means of planned & coordinated activities (Farnham & Horton, 1996). In the case of transportation organizations, the specific purpose is to facilitate the movement of people and goods.

An Organization has two main components influencing its ability to achieve its purposes: the internal environment that influences the direction of the organization and the energy displayed in its activities, and the organizational capacity or its ability to apply its skills and resources to accomplish its goals (Horton, et al., 2003).

Transportation performance for a particular physical, economical and institutional environment is a function of the resources consumed, the level of service offered, the transportation options, and the volume of users (Manheim, 1979). Transportation flows, which are composed of the volume of users and the level of service of the system, are influenced by the transportation system and the activity system (Manheim, 1979).

This research evaluates the impact of characteristics of the two components of transit-related organizations on their transit system's ridership or volume of users. The evaluation is done under the theoretical background of the Transportation Relations (Manheim, 1979), including the modifications proposed by Florian (McNally, 2007) and González, and the Framework of Organizational Assessment (Horton, et al., 2003), from which a hybrid framework is derived, and through the use of several statistical tools including Multiple Classification Analysis.

Following sections of this chapter presents more information related to the hypothesis, motivation, expected contribution and objectives of this research.

1.1 Motivation

UITP (UITP, 2007) shows the top six cities that experienced an increase in Public Transit (PT) market share between 1995 and 2001 (see Table 1-1). They are London, Madrid, Austria, Singapore, Hong Kong and Paris. Those cities are from different countries with different transportation systems, portion of gross domestic product devoted to transit, area, and climate, political, economic and cultural characteristics. However, they all shared the common success of increasing their transit share.

Table 1-1: Cities with Increment in Transit Share

	Year	London *	Madrid	Vienna	Singapore	Hong Kong	Paris
Market share of motorized and mechanized journeys by Public Transit	1995	23.9%	27.2%	43.2%	44.2%	71.8%	27.1%
	2001	26.8	30.2	46.6	45.7	73.9	27.5
Annual number of journeys on public transport per inhabitant*	1990-95	345	250	490	480	545	260
	1996-01	390	290	495	485	525	310
Average annual investment (percent of gross domestic product)	1995	1.13	0.88	1.07	0.44	0.37	0.45
	2001	0.64	0.81	0.62	0.84	1	0.32
Length of exclusive rights-of-way (kilometer per millions of inhabitants)	1995	172	84.5	174	22.5	17.5	149.5
	2001	176	92.5	185	29.5	22.5	151.5
Public Transit speed (kilometers per hour)	1995	31.3	28.5	24.9	27	26.4	31.6
	2001	34.6	30.7	27	28.6	26	30.9
Public Transit vehicle x kilometer/ hectare per inhabitant	1995	145	67.5	87	110	146	71.5
	2001	157	85	106	112	172	84
Public Transit vehicle x kilometer per hectare	1995	7,850	4,500	5,850	10,300	46,700	3,400
	2001	8,650	4,750	7,100	11,500	49,200	3,400
* Traffic including non-residents							

Table from UITP (2007)

Hence, what do those successful providers have in common? One aspect that may vary among different providers is their organization. Characteristics describing the organization

includes: their vision, goals, objectives, procedures, hierarchical structure, work environment, power structure and relation to other institutions and responsibilities such as planning, and participation concerning multi-modalism, among others. Such characteristics, although executed through highly technical resources, are established through policies and are executed within an environment which is highly influenced by human values. Therefore, is it possible that what Hardin (1968) described as a “non-technical-solution problem” applies, to some extent, also to the provision of PT services? Hardin (1968) described a technical solution as “one that requires a change only in the techniques of the natural sciences, demanding little or nothing in the way of change in human values or ideas of morality”. Therefore, is possible that, in order to have a successful PT service, it is necessary to modify as well human values, specifically those influencing transit organizations.

This possibility is supported by the document produced by the Committee on Management and Productivity of the Transportation Research Board as part of Transportation in the New Millennium in 1999 which indicates that, historically, agencies have responded directly to the public by providing technical solutions, and that this response will no longer be sufficient.

1.2 Hypothesis and Scope

The main research question is: Do the transportation organization have an impact on their transit ridership?

The hypothesis of this research is that, for the study population, transportation organization has an impact on their transit ridership. The hypothesis will be tested through Multiple Classification Analysis applied to organizational data collected from a survey. The survey was distributed to transportation organizations.

The study population is composed of transportation organizations that report to the National Transit Database (NTD). A sample consisting of 15 organizations, or 2.11% of the population of 710, was used for the analysis. A bootstrap of the sample was used to determine a confidence level for the sample mean representation of the population.

It is important to point out that models derived as part of this research are not intended to be used for forecasting ridership, but to have an idea of the average values that could be expected from a group of organizations having similar characteristics.

1.3 State of the Data

There is a vast set of organizational capacity characteristics already being gathered. For example, the National Transit Database (NTD) comprises a diverse set of variables, such as amount of revenue vehicles, employee hours, and capital investment, among others. However, the characteristics of the organization's environment are not that vastly explored. The NTD posts information about three of the variables that may be used as organization environment indicators: institution type, organization/agency type and amount of strikes.

The International Association of Public Transport (UITP, by its initials in French) collected some information related to policies in their "Mobility in Cities" document. Such information is available for the years 1995 and 2001.

1.4 State of the Literature in the Subject

Recent studies have incorporated the organization in transportation research.

Currently, the University of South Florida is developing a research on the structure/performance relationships of public transit agencies (Hinebaugh & Simmonds, Ongoing). Their objective is to provide a detailed explanation of the relationship between the structures of public transit agencies in the USA and their performance. Their proposed methodology includes a statistical correlation study combined with a regression analysis. They will also design of a survey to obtain empirical data on both structure and performance, which will be used as basis for their analysis. This study will consider only the structural part of the organization.

Leland & Smirnova (2008) studied the effect of government structure on urban bus transit efficiency. They found that transit specific organizations are more effective than general organizations like municipalities, and that privately operated routes tended to be more effective than public operated ones. The methodology used included a regression analysis using National Transit Database for fiscal year 2002 and excluded Puerto Rico & territories. The dependent variable was a vector of different effectiveness and efficiency factors (labor productivity, vehicle utilization, revenue, expense, etc.). Although they included if an organization managed another mode, this didn't really address the issue of integration (fare, schedule, etc.). They also concluded that future research should consider the analysis of variables that specifically relate to the different types of authority systems (such as whether boards are elected or appointed), and measure their influence on a larger set of efficiency and effectiveness indicators.

Marsden & May (2006) studied the effect of institutional arrangements on the development and implementation of transportation policy. They used a set of desktop reviews and interviews to analyze three British cities and developed conclusions based on that. However, no mathematical approach or statistical model was intended to be used or included in their methodology, nor was the level of use of the service by patrons. They concluded that several changes in organization and responsibilities (nature of responsibilities and geographical coverage) affect negatively the ability to deliver policy as new relationships are formed and new powers taken up.

1.5 Contribution

The organizations of transportation have been considered in literature and has been acknowledged as important. However, there is no information regarding level of importance of specific characteristics, or if they could be related to the success in achieving patronage. This is precisely what is analyzed in this work, to find out if there can be specific characteristics that can be identified as influencing ridership and to establish how important they are as compared to other characteristics.

Previous studies have left out the consideration of several characteristics related to the organization while concluding that they should be considered in future studies of effectiveness. This research includes a broad spectrum of organizational characteristics from which the ones impacting ridership are identified.

Also, previous studies have been focused on a single analysis tool: regression. This research utilizes a different tool that has been identified as useful when analyzing tendencies derived from categorical variables: Multiple Classification Analysis (MCA). The MCA allows observing how the average ridership values vary among different classifications of an indicator.

In addition, this research will help to identify the specific organization internal environment indicators that may be useful to describe the performance of the institution specifically related to achieving a desired patronage. Therefore, data collecting entities such as the NTD can consider including them as part of the collection requisites.

1.6 Objectives

This research has the following main objectives:

1. To propose a new framework unifying both Manheim and Horton, et. al.'s theories.
2. To determine if the transit organization has influence on transit ridership.
3. To identify which are the organizational characteristics from the transportation institutions that influences their transit ridership and their relative contribution.
4. To determine if such characteristics can feasibly be measured and used as part of the set of ridership estimators.
5. To validate proposed transportation framework.

In addition, there are the following secondary objectives:

1. Evaluate the effectiveness of the process used to gather data (e.g. survey contents and distribution)
2. Obtain a profile of respondent transit organizations to identify possible trends that might be useful in designing future surveys (i.e. identify if responding the survey appealed to a particular type of agency or diverse companies sharing a common characteristic)
3. Develop recommendations for future related (i.e. transportation organization) research (i.e. survey contents or its distribution)

1.7 Background

The search for alternatives to improve mobility and quality of life is one of the major tasks facing transportation professionals. Mass transportation has been identified as a mean to support movement of people in a sustainable way. This is mainly as a result of using transit as an alternative to private auto. Substituting auto trips with by transit trips could help to reduce traffic congestion, consumption of petroleum-based fuels, emissions of greenhouse gases, and improve human health and limit infrastructure deterioration, among other benefits (Victoria Transportation Policy Institute, 2012). Such benefits could represent millions of dollars in annual savings (CMA Architects & Engineers LLP, Porticus and EFGB, 2011).

Congestion results from poor policy choices and a failure to separate solutions that are effective from those that are not (citation of Norman Mineta, former U.S. Secretary of Transportation, in American Association of State Highway and Transportation Officials, 2007). In general, several engineering and financial aspects of mass transit have been studied and according policies and programs have been applied in order to enhance transportation systems as feasible alternatives to private auto. However, policies and programs can be successful only to the extent that the organizations responsible for their implementation have the capability of carrying out their responsibility (Meyer & Miller, 1984).

Having worked at agencies managing several transit modes for more than twelve years, direct observations and information from informal conversations have led me to hypothesize whether organizational characteristics such as culture and stability of policies, among others, may currently influence the outcome of agencies related to achieving ridership goals. For example, in an organization not used to maintain well informed their employees about policy changes, such employees were unable to properly educate transit users. Other observed example was within an organization that was not used to consider their operation and technical employees' input on the decision making process, resulting in policies and service changes that does not necessarily met the users' needs and/or expectations. A third example was observed in an organization that temporarily offered transit passes to their employees. While the passes were offered, many employees used transit; however, they went back to the private auto when the pass benefit ceased.

Classic theories such as the Transportation Relationships (Manheim, 1979) put organizational components within the transportation system, hence, having an indirect repercussion in the flows that result from the transportation systems and activities. This research intends to find out if such organizational repercussion still exists within current framework related to transit and if there is a feasible way to directly measure it.

Table 1-2 shows International Association of Public Transit (UITP)¹ data from top six cities that experienced an increase in Public Transit (PT) market share between 1995 and 2001. Note that all cities are from different countries with diverse area, climate, and political, economic and cultural characteristics.

¹ UITP Mobility in Cities Database. August 26, 2008 <www.uitp.org>.

Table 1-2 UITP Public Transit Indicators

Indicator / City	London	Madrid	Vienna	Singapore	Hong Kong	Paris
Mechanized trips by PT (%)	26.8	30.2	46.4	45.7	73.9	27.5
Annual PT trips per inhabitant	390	290	495	485	525	310
Average Annual Investment (%GDP)	0.64	0.81	0.62	0.84	1	0.32
Length of Exclusive ROW (km/million inhabit.)	176	92.5	185	29.5	22.5	151.5
PT Speed (km/hr)	34.6	30.7	27	28.6	26	30.9
PT Vehicle x km per inhabit. (supply)	157	85	106	112	172	84
PT Vehicle x km per hectare (supply)	8,650	4,750	7,100	11,500	49,200	3,400

Table from UITP (2007)

Table 1-3 shows the results for a Pearson correlation analysis performed among National Transit Database (NTD) indicators for the year 2006. The analysis was performed with Minitab (Minitab, Inc., 2004). Pearson correlation coefficient is calculated as indicated in Equation 1-1. For this analysis, all urbanized areas with data inputted were included. Values of individual agencies within the same urbanized area were added. Normalization was performed by urbanized area population, as indicated in the NTD. It can be observed that vehicle-kilometers or miles and vehicle-hours provided of public transport are highly correlated to consumption in USA cities. Note that all correlation coefficients had statistical significance (p-value < $\alpha=0.05$).

Equation 1-1 Pearson Sample Correlation Coefficient

$$r_{xy} = \frac{n \sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n \sum x_i^2 - (\sum x_i)^2} \sqrt{n \sum y_i^2 - (\sum y_i)^2}}$$

Where: r_{xy} is the correlation coefficient, x_i is the independent variable for observation i , y_i is the dependent variable for observation i and n is the sample size. (McClave & Benson, 1991)

Table 1-3 Service Indicators Correlation Table - NTD Indicators

Correlation Table (n=63 UZA; data from NTD 2006)	Vehicles Available for Maximum Service / sq mi	Vehicles Available for Maximum Service / pers	Annual Vehicle Revenue Miles / sq mi	Annual Vehicle Revenue Miles / pers	Annual Vehicle Revenue Hours / pers x1000	Annual Vehicle Revenue Hours / sq mi	Unlinked Passenger Trips/person	Passenger Miles/person	Unlinked Passenger Trips/area	Passenger Miles/area
Vehicles Available for Maximum Service / sq mi	1.000									
Vehicles Available for Maximum Service / pers p-value	0.924 <0.001	1.000								
Annual Vehicle Revenue Miles / sq mi p-value	0.634 <0.001	0.553 <0.001	1.000							
Annual Vehicle Revenue Miles / pers p-value	0.560 <0.001	0.641 <0.001	0.884 <0.001	1.000						
Annual Vehicle Revenue Hours / pers x1000 p-value	0.624 <0.001	0.709 <0.001	0.771 <0.001	0.855 <0.001	1.000					

IMPACT OF TRANSIT ORGANIZATION IN RIDERSHIP

Correlation Table (n=63 UZA; data from NTD 2006)	Vehicles Available for Maximum Service / sq mi	Vehicles Available for Maximum Service / pers	Annual Vehicle Revenue Miles / sq mi	Annual Vehicle Revenue Miles / pers	Annual Vehicle Revenue Hours / pers x1000	Annual Vehicle Revenue Hours / sq mi	Unlinked Passenger Trips/person	Passenger Miles/person	Unlinked Passenger Trips/area	Passenger Miles/area
Annual Vehicle Revenue Hours / sq mi p-value	0.711 <0.001	0.625 <0.001	0.918 <0.001	0.778 <0.001	0.871 <0.001	1.000				
Unlinked Passenger Trips/person p-value	0.511 <0.001	0.421 <0.001	0.841 <0.001	0.666 <0.001	0.668 <0.001	0.827 <0.001	1.000			
Passenger Miles/person p-value	0.385 0.002	0.360 0.001	0.853 <0.001	0.835 <0.001	0.547 <0.001	0.650 <0.001	0.749 <0.001	1.000		
Unlinked Passenger Trips/area p-value	0.488 <0.001	0.338 0.004	0.850 <0.001	0.598 <0.001	0.574 <0.001	0.823 <0.001	0.970 <0.001	0.741 <0.001	1.000	
Passenger Miles/area p-value	0.407 0.001	0.288 0.007	0.886 <0.001	0.706 <0.001	0.515 <0.001	0.743 <0.001	0.845 <0.001	0.920 <0.001	0.897 <0.001	1.000

Data from NTD 2006's Table 19: Transit Operating Statistics. Agencies' data was grouped for their corresponding urbanized area. Correlation determined using Minitab, Inc. (2004).

Therefore, it can be inferred that usage is related to the service provided, mostly measured in terms of relative revenue miles or kilometers. That is, more ridership can be expected when more unit service is provided. Of course, this quality of service provided will probably depend on the level of mobility and accessibility that it is able to achieve. It is presumed that if the usage is high, is because it satisfies mobility needs.

Levels of service of public transportation (PT), as previously defined as unit vehicle-kilometers or miles provided, vary greatly among different systems. UITP's Mobility in Cities indicates:

In 2001, the highest levels of service were observed in Hong Kong and Moscow (respectively: 172 and 155 vehicle x km per inhabitant and 49,000 and 25,000 vehicle x km per hectare). Singapore, London, Berlin, Munich, Vienna, Bern, Zurich, Helsinki, Prague and Warsaw recorded figures above 100 vehicle x km per inhabitant and above 5,500 per hectare. Paris, Brussels, Stockholm, Madrid, Rome, Newcastle and Budapest then followed with a supply level higher than 75 vehicle x km per inhabitant and 3,000 per hectare. Chicago, Dubai, Melbourne, Seville and Clermont-Ferrand were the least well-served cities.

The same source also pointed out that:

The majority of cities in the sample saw a marked growth in urban sprawl. At the same time, population levels fell in central and inner-urban areas... (-5% in only six years) ... Over this same period, car ownership rose by around 11% (from 375 to 415 cars per 1000 inhabitants).

Therefore, most cities suffered same tendencies regarding urban sprawl and increase in auto ownership. However, very different cities in terms of area, climate, and political, economic and cultural characteristics achieved high levels of service, like Hong Kong and Moscow. Similarly, other cities that also greatly differ in terms of aforementioned characteristics had in common a provision of low transit levels of service, like Chicago and Dubai. It is also interesting that cities that are more similar in terms of area, climate, and political, economic and cultural characteristics differ greatly on their public transit levels of service, like Madrid and Seville.

Why some providers are still unable to meet their PT level of service and/or usage goals? Is it possible that they are failing in giving adequate importance to other variables? What do

those successful providers have in common? In what they differ from those who are apparently failing?

One aspect that may vary among different providers is their organization. Characteristics describing the organization includes: their vision, goals, objectives, procedures, hierarchical structure, work environment, power structure and relation to other institutions and responsibilities such as planning, and participation concerning multi-modalism, among others. Such characteristics, although executed through highly technical resources, are established through policies and are executed within an environment which is highly influenced by human values. Therefore, is it possible that what Hardin (1968) described as a “non-technical-solution problem” applies, to some extent, also to the provision of PT services? Hardin (1968) described a technical solution as “one that requires a change only in the techniques of the natural sciences, demanding little or nothing in the way of change in human values or ideas of morality”. Therefore, is possible that, in order to have a successful PT service, it is necessary to modify as well human values, specifically those influencing transit organizations.

2 METHODOLOGY

Before describing the methods used to develop this study, it is important to point out that several statistical analyses were performed in the research progression; some of them were applied in multiple instances and stages of the process. Hence, the general objective of such statistical analysis will be defined first, for convenience. Then, the different steps of the research process will be disclosed. Each step will be described, including the name of applicable statistical analysis and their specific objective within the step.

Statistical analyses included are:

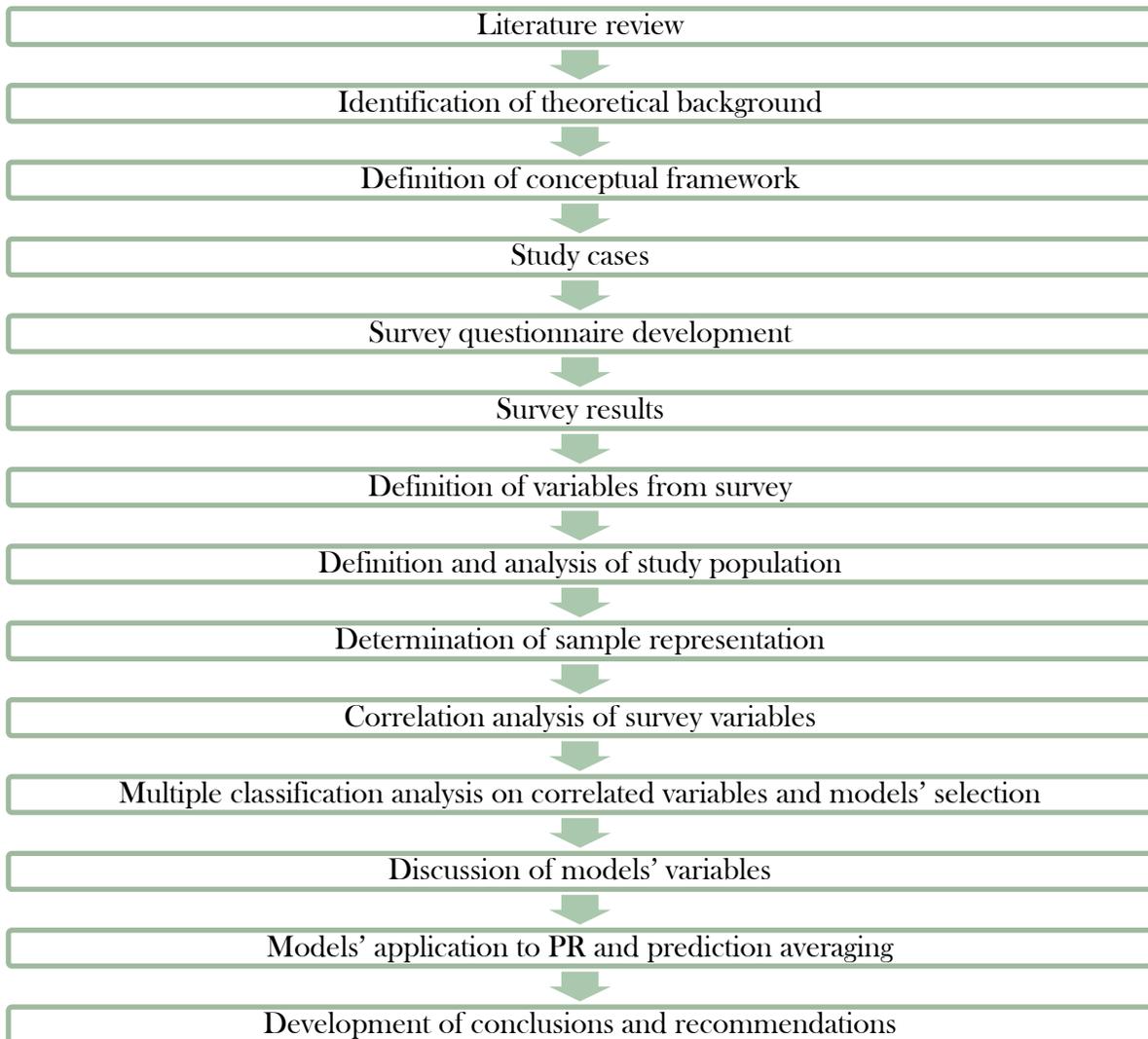
1. **Normality Test** - This test allow determining if the population or sample follows a normal or almost normal distribution. This is important for the selection of further statistical methods, as some of them require normality.
2. **Pearson Correlation Coefficient** - This coefficient allows determining if two interval or ratio variables are linearly related.
3. **Eta Correlation Ratio** - This correlation ratio allows determining if a continuous and a categorical variable are related.
4. **Spearman Correlation Coefficient** - This coefficient allows to determine if two ordinal variables are related.
5. **Cluster Analysis** - This analysis allows dividing a sample into groups. The objective is to have groups where the members of a group would have similar magnitudes, while the magnitude between groups differs.
6. **Regression Analysis** - This analysis allows defining a model to describe a continuous normal dependent variable as a function of one or several independent numerical variables.
7. **Multiple Classification Analysis** - This analysis allows defining a model to describe a continuous dependent variable as a function of one or several independent categorical or ordinal variables.
8. **Bootstrapping** - This is a method for random re-sampling with substitution from an original sample. The resulting distribution for the means of several re-samples

approaches to normal. A confidence interval for the mean can be determined based on percentiles around the mean of the means' distribution.

A general description of each statistical analysis is provided at its first appearance on this document. However, those analysis applied to the survey sample (Eta Correlation Ratio, Multiple Classification Analysis and Bootstrapping) will be further described at the segment exposing its application to the survey.

The methodology of this research includes the steps presented in Figure 2-1:

Figure 2-1: Methodology



Each step is described in the following subsections.

2.1 Literature Review

The first step of the process was the literature review. Literature review was used to gather background information related to organization and transportation paradigm evolution. Also, current research and approaches combining those two subjects were inspected. Literature reviewed is grouped on the following sections:

- Organization - To study basic information regarding organization theory and how its paradigm has evolved.
- Transportation - To review the transportation relationship theory and study the evolution of transportation paradigms.
- Recent organizational research on the transportation industry - To study current investigations in transportation where organizational aspects have being considered.

This review was used to:

- Identify applicable theoretical backgrounds
- Define a conceptual framework for the relation among transit organizations and their ridership
- Identify variables of interest for further inspection through the survey developed later

A discussion on the literature review is presented in Chapter3.

2.2 Theoretical Background

Through literature review was identified the theoretical background for this research. This background is mostly based on:

- The theories of Transportation Relations developed by Manheim (1979), which proposed an inter-relation among the following main characters: activity system, transportation system, and flow patterns.

- The Framework of Organizational Assessment described by Horton, et al. (2003) which describes the relation between two components of the organization (e.g. capacity and internal environment), its performance and the environment external to the organization but in which it exists.

The theoretical background was used to:

- Define a conceptual framework for the research hypothesis
- Identify variables of interest based on indicators representing the components of the conceptual framework

The theoretical background is described in Chapter 4.

2.3 Development of Conceptual Framework

Based on the identified theoretical background, a conceptual framework was developed to describe the proposed hypothesis of this research. The proposed conceptual framework combines Manheim's transportation relations (1979) with the Organizational Assessment framework (Horton, et al., 2003) to describe how the transit organization is related to its ridership. The description of this conceptual framework is provided in Section 4.4.

2.4 Study Cases

Several study cases were selected in order to identify organizational characteristics that may have had some influence in their performance related to patronage. The study cases were divided in two main groups: systems within the United States of America which reports to the U.S. National Transit Database (study population of this research) and successful systems from other countries (cities having top transit shares). The main objective was to identify possible organization indicators that might influence ridership in order to include them in the survey developed later.

2.4.1 NTD Cluster Representatives

The first group consisted in four institutions reporting to the U.S. National Transit Database (NTD). This group will constitute the study population for this research. This population represents transit systems in the United States of America, including Puerto Rico. Each selected institution represented a group with a different level of ridership per service population. Such groups were identified through a Cluster Analysis of the entire database for a single year. The representative was selected in such way that it was the centroid or close to the centroid of the cluster and included a heavy rail system. The heavy rail criteria was selected in order to minimize differences related to the transportation system. The main objective was to discover possible variations in several organizational characteristics between the groups. Literature and data published by such representatives on their websites was reviewed and analyzed.

2.4.2 Other Countries

A second group consisted in one European (Viennese) and one Asian (Singaporean) institution. They were selected for their high transit ridership and because they described them as successful and/or obtained institutional distinctions by their peers. Vienna and Singapore hold the 2nd and 3rd highest public transit ridership as per Mobility in Cities database, respectively (UITP, 2007). The first place, Hong Kong, was not included as a case study because it was considered an outlier. Hong Kong provides 49,200 vehicle-kilometers of transit service per hectare while the next top five provides between 3,400 and 11,500 vehicle kilometers of transit per hectare.

The main objective of studying these cases was to identify common characteristics that might have led them to be successful in achieving high transit patronage. Such characteristics would then be included in the survey. Literature and data published by such institutions on their websites and from other sources was reviewed and analyzed.

2.4.3 Puerto Rico

An additional study case was a Puerto Rican institution, which was compared within the analysis of both study cases' groups. Such institution also reports to the NTD and later would be used to validate models derived from the other survey responses.

Study cases are shown in Chapter 5.

2.5 Survey Questionnaire Development

Currently, there is no database containing diverse and detailed transit organization data. Therefore, a survey was identified as the instrument to gather such information. Using the literature review and the study cases as basis, a questionnaire was developed for an on-line survey. The survey asked about the following indicators:

- Capacity (such as budget, amount of employees, and others)
- Internal environment (such as leadership style, sense of belonging, and others)
- Performance (such as ridership and mode share)
- General indicators that are external to the transportation system (such as service area and population)

The survey was used to identify variables available to inspect the applicability of the proposed scheme describing transportation system's interactions related to transit. Survey development and content details are presented in Chapter 6.

2.6 Survey Results

Although the study focuses on NTD reporting sites, the survey was distributed to several worldwide organizations as an opportunity to gather more information. Descriptive analyses of survey results were performed. They were used to identify a profile of respondents, which were mostly part of the NTD population. The profile was used to define a study population for the rest of the research. The profile will also be helpful in designing future surveys related to the subject of this research, as the characteristics of respondents were identified. Details of these descriptive analyses are shown in Section 6.4.

2.7 Definition of Variables from Survey

Based on survey questions' responsiveness, variables were defined. They were defined in such a way that indicators of capacity, internal environment and ridership performance are represented. The variables were "normalized" by service population.

Also, categories for each variable were defined. The categories were defined in such way that their differentiation has a meaning while maintaining a reasonable amount of membership within each category, given the total amount of data points. These definitions provide the basis for further statistical analysis in this research. The definitions of the variables are presented in Section 6.5

2.8 Definition and Analysis of Study Population

The study population for subsequent analysis was defined as the institutions that report to the NTD. This study population was defined mostly due the following reasons:

- This population represents transit systems in the United States of America.
- Most Puerto Rico's transit systems are included in the NTD reporting sites.
- The population is known, so its parameters can be calculated and compared to the sample.
- Most survey respondents belong to this known population.
- The NTD is an official, established and systematic data collection process that gathers and publishes important information for transportation planners, engineers and policy makers. The NTD could consider the results of this study for future data collection, so its users could benefit from such information.

The analysis performed includes the following:

- Test for normality
- Calculation of parameters such as mean and standard deviation of the ridership per service population

- Re-definition of NTD organization-related variables for further statistical analysis
- Calculation of correlation for NTD re-defined variables, using Eta and Spearman as applicable.

The details on the study population are presented in Chapter 7.

2.9 Sample Representation of Population

Descriptive statistics (such as average, standard deviation and percentage of the population) were calculated for the sample's variable of ridership per service population. A Normality test was also performed for the sample. Finally, a confidence interval for the sample mean was determined using Bootstrapping. This step is presented in Section 7.3.

2.10 Correlation Analysis of Survey Variables

A correlation analysis for the sample was performed in order to identify tendencies between ridership per service population and defined variables from the survey. This analysis was performed through the use of the Eta Correlation Ratio. The variables that resulted most highly correlated from this analysis were the ones selected for further research. This correlation analysis is shown in Chapter 8.

2.11 Multiple Classification Analysis

A multiple classification analysis (MCA) using variables highly correlated to ridership per service population was performed for the sample. The MCA allowed for a comparison of prospective variables in several models, their potential interaction and the relative impact between the independent variables and ridership per service population. The best models were identified based on their statistical significance and sample representation. These analyses are presented in Section 8.2.

2.12 Discussion of Model Variables

The resulting variables included in MCA significant models were inspected. General tendencies of Mean Ridership per Service Population's variations with variations of each individual independent variable are discussed in Section 8.3.

2.13 MCA Models Application

The best resulting models from the MCA were applied to the study case of San Juan, Puerto Rico. This case, which is part of the study population, was excluded from the sample used to derive the models. The objective of this step is to test if the models can be validated for this case. As multiple models resulted, an iterative process of models' adjustment was used. The process included the following criteria:

- The confidence interval width of the empirical mean distribution was compared to the distance between predicted means for each of the categories of the individual variable models. If the distance between categories' predicted means was smaller than the bootstrap confidence interval, the variables' categories were revised. If reasonable, the categories were modified and the model was re-run with the modified categories.
- If the significance (Sig. or p value) for any of the variables in a single model was greater than 0.10, the model was discarded.
- The process was repeated until all of the following met:
 - The confidence interval width is smaller than the distance between any (consecutive if applicable) categories' predicted means for the single variable models
 - The absolute value of the difference between consecutive calculated confidence intervals (means and each of the boundaries) is 5% or less for all three values (boundaries and mean).

This analysis is exposed in Chapter 9.

2.14 Development of Conclusions and Recommendations

Based on the observations through the previous steps, conclusions and recommendations were derived regarding the following:

- Data availability
- Data collection process
- Survey contents
- Analysis application
- Obtained results
- Conceptual framework
- Future related studies

These are presented in Chapter 10.

2.15 Documentation

The final part of the research is to provide appropriate documentation. This includes the preparation of this document including: bibliography, glossary, and appendices, which are presented respectively from Chapter 11 to Chapter 13.

3 LITERATURE REVIEW

The first step of the process was the literature review. This helped to gather background information related to organization and transportation paradigm evolution. Also, current research and approaches combining those two subjects were inspected. This review was used to identify theoretical backgrounds and possible variables of interest.

Literature reviewed is grouped on the following sections:

- Organization - To study basic information regarding organization theory and how its paradigm has evolved.
- Transportation - To review the transportation relationship theory and study the evolution of transportation paradigms.
- Recent organizational research on the transportation industry - To study current investigations in transportation where organizational aspects have being considered.

3.1 Organization

This research utilizes the Transportation Relations (Manheim, 1979) through the Framework of Organizational Assessment (Horton, et al., 2003) to evaluate the possible impact of internal environment characteristics of transportation organizations in their transit system's ridership. Therefore, it is also important to analyze how the organization theory have evolved and why. This information also provided guidance for identifying variables that may serve as indicators, therefore, worthy to be included in the survey that was developed later.

3.1.1 *Paradigm Evolution*

There has been a paradigm² evolution on organizational theory as the industry, its products and people, evolved. This evolution was revised so it could be considered in the variable selection for the survey, according to most recent practices while understanding the historical transition. It is interesting that some of the most recognized theories emerged from experts with engineering background, like Taylor, Mooney and Senge. Similarly, it is interesting that many of these theories came up looking for solutions to increase production related to the railroad industry.

The classic paradigm seems to be a response to industries of simple-manufacturing products. There, workers appeared to perform physical and/or artisanship tasks, being skilled only in that particular task which was performed basically by tradition. Therefore, they found that the military organization type was the appropriate response to increase production. However, F. Taylor, an American mechanical engineer, introduced the concept of a systematic management (Taylor, 1911). As the knowledge apparently was reserved to management, managers had the responsibility to use their knowledge to support production. This was done basically by using their scientific knowledge to determine who and how the work was going to be performed. The measure of effectiveness used was mainly economical for both the enterprise and workers.

J. Mooney, an American engineer and corporate executive, and C. Reiley emphasized division of labor, succession or transfer of skill and thought, and marginal economy or cost decrease as production increase (Mooney & Reiley, 1931). They also described management subsidiaries and types of organizations. Besides line or military organization, they described the concept of a mixed line and staff and/or function organization. In line and

² Philosophical and theoretical framework of a scientific school or discipline within which theories, laws, and generalizations and the experiments performed in support of them are formulated. (Merriam-Webster Dictionary. March 14, 2009 < www.merriam-webster.com/dictionary/paradigm>.)

staff, a specialist (the one with the knowledge) would serve as an advisor to the management, but didn't have authority. In the functional organization, the specialists are placed as managers (with authority).

The paradigm changed towards the consideration of people affairs related to production. G. Mayo, an Australian psychologist, considered elements like fatigue and monotony (Mayo, 1933). Fatigue is considered a physical condition that results in variations in quantity and quality of work done. Monotony is boredom as result of repetitive work. As physiologists have found that work can continue to be performed only in a "steady state", he is recommending using a change from the main occupation rather than rests on complete cessation from work. He also commented that the Hawthorn experiment, where some changes in working conditions were tested with no apparent proportional or direct influence on the performance.

It has been evident that human considerations are very important, as real people are the ones performing the works. Perhaps the non-expected results of the Hawthorn have to do with the fact that people, when knowing that they are being monitored, tend to react different that how they normally and routinely would.

M. Weber, a German lawyer, politician, scholar, political economist and sociologist, emphasized the line of authority, based on rational, legal grounds (Weber, 1947). Here, bureaucracy was born: specification of functions bounded by rules, principle of hierarchy, norms of conduct, absence of appropriation of official position by incumbent, acts/rules/decisions all recorded in writing, etc. This emphasized the fact that only the management had the knowledge. Bureaucracy established a logical establishment of a line of authority and uniform personnel management based on ground written rules.

As can be noticed, on the classical paradigms, the worker-manager relation was more like a slave-master one. It was also based on the premise that all workers were men, as the literature didn't even say workers, but men. Even as the paradigm was evolving, it presumed that the workers were not knowledgeable. Therefore, only managers were allowed to think, and workers were supposed to simply obey. The establishment of written rules and norms,

although do have a noble purpose of uniformity and justice, they can also be used as a mean to oppress the worker as may be convenient.

P. Druker, an Austrian specialized on public and international law, emphasized that the organization is a mean to satisfy business performance (Druker, 1954). He tied efficiency of the organization to its simplicity, short chain of command and manager's training. He proposed the concept of federal decentralization, where activities are organized in autonomous units, each one with its own product, profit and loss responsibility. Druker's concept of federal decentralization seems to be a good way for large enterprises to maintain motivation among employees as they have direct responsibility for their unit. It also appears to simplify the chain of command and be easier to evolve.

V. Thompson (Thompson, 1961) explained that the unspecialized primitive man was organized in kinship groups or family groups which served all of his needs, however, that type of organization is inadequate for specialized man. He also indicated that in the highly specialized industrial society, the predominant form of organization is a highly rationalized and impersonal integration of a large number of specialists cooperating to achieve some announced specific objective; consequently, there is a growing gap between the right to decide, which is authority, and the power to do, which is specialized ability. He also expresses that this gap is growing because technological change, which leads to increasing specialization, and that this increase in specialization occurs at a faster rate than the change in cultural definitions of hierarchical roles.

A more contemporary approach is presented by American business administration professionals J. Rosenzweig & F. Kast (Rosenzweig & Kast, 1972). They pointed out that organizations need to function with a holistic point of view. That is, it is needed to consider all aspects of the business, not only each unit's competence, as they are all part of and could influence the entire system. In order to determine the organization effectiveness, they proposed three levels of analysis: environment, social organization as a system, and subsystems (human participants) within the organization. They also proposed a contingency view of organizations and their management. It is given that organizations are influenced by multiple variables. Also, as per some of their studies, most decisions are general and could

be classified into categories. Therefore, contingency uses probability to define possible outcomes and suggests a set of general actions or suggestions on who might be taking the decision given a particular outcome. The system or holistic approach should be considered as an important paradigm, as all elements and decisions that affect a part of the organization, in fact affects it and ultimately affects all organization. The contingency view could help the decision making process at some extent. However, it looks too simplistic as it doesn't seem to account for a dynamic complex organization.

P. Nystrom (Nystrom & Starbuck, 1981) called the attention to the role of scientists as organizational members. He indicates that the bureaucratic concept of administration assumes the hierarchical authority of those above over those below. However, as he indicates, this type of authority is less effective where staffs are highly specialized or professionalized. That is, as he explains, scientists have authority based on knowledge and their work requires that they be granted autonomy to make decisions based on their specialized knowledge.

P. Senge, an American engineer with an M.S. in social systems modeling and a Ph.D. in management, and other authors (Senge, Kleiner, Roberts, Ross, & Smith, 1994) describe five organization learning disciplines, emphasizing on the fifth: systems thinking. This, as described by him, is a way of thinking about, and a language for describing and understanding, the forces and interrelationships that shape the behavior of systems. He points out that this discipline helps us see how to change systems more effectively, and to act more in tune with the larger processes of the natural and economic world. In other words, it uses the system approach while tries to address what contingency lacks.

A summary of this evolution, as presented by D. Walonik (Walonick), a professor in the Graduate School of Management at the University of St. Thomas in St. Paul, Minnesota and author and software developer in the areas of surveys, statistics, and forecasting, is given below:

Classical organization theory evolved during the first half of this century. It represents the merger of scientific management, bureaucratic theory, and administrative theory. Classical management theory was rigid and mechanistic...Its major deficiency was that

it attempted to explain peoples' motivation to work strictly as a function of economic reward. The human relations movement evolved as a reaction to the tough, authoritarian structure of classical theory. Classical and neoclassical theorists viewed conflict as something to be avoided because it interfered with equilibrium. Contingency theorists view conflict as inescapable, but manageable. The foundation of systems theory is that all the components of an organization are interrelated, and that changing one variable might impact many others. Organizations are viewed as open systems, continually interacting with their environment. They are in a state of dynamic equilibrium as they adapt to environmental changes... The increased complexity of multinational organizations created the necessity of a new structure..., federal decentralization, where a company is organized so that there are a number of independent units operating simultaneously...Systems theory views organizational structure as the "established pattern of relationships among the parts of the organization"... Organizations are open systems and depend on their environment for support. Learning enhances ones capacity to take action.

3.1.2 Organizational Performance

Organizational performance is defined as (Horton, et al., 2003): *the ability of an organization to meet its goals and achieve its overall mission.*

Horton also express that an organization's performance can be expressed in terms of four key indicators: effectiveness, efficiency, relevance, and financial sustainability. It also provides the definition for performance indicators as follows:

- Effectiveness: the degree to which the organization achieves its objectives
- Efficiency: the degree to which it generates its products using a minimum of inputs
- Relevance: the degree to which the organization's objectives and activities reflect the necessities and priorities of key stakeholders
- Financial sustainability: the conditions to make an organization financially viable

An organizational assessment framework (Horton, et al., 2003) is presented on Figure 3-1. From Figure 3-1 can be observed that the components influencing organizational performance (or its ability to meet its goals) includes external environment in which the organization carries out its activities, internal environment that influences the direction of the organization and the energy displayed in its activities, and organizational capacity or its ability to apply its skills and resources to accomplish its goals.

Organizational capacity is defined as organization's potential to perform, or its ability to successfully apply its skills and resources to accomplish its goals and satisfy its stakeholders' expectations... It refers to the resources, knowledge, and processes employed by the organization (Horton, et al., 2003). Some examples of organizational capacity elements presented by Horton are:

- Staffing
- Infrastructure, technology, and financial resources
- Strategic leadership
- Program and process management
- Networks and linkages with other organizations and groups

Figure 3-1 Framework of Organizational Assessment

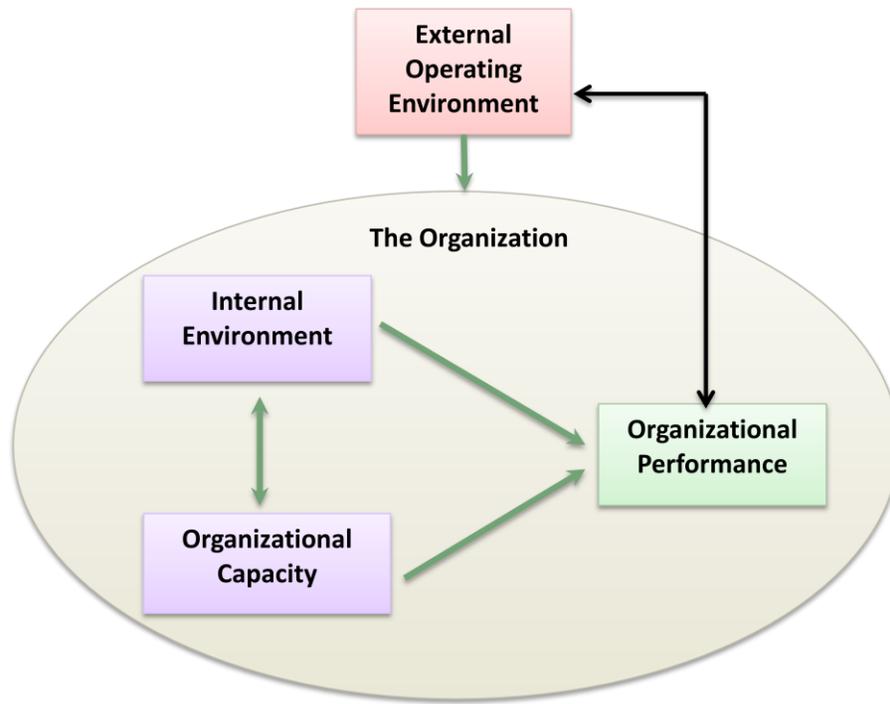


Figure re-drawn from Horton, et al. (2003)

The other organization's internal influencing element is its internal environment, or the internal factors that influence the direction of the organization and the energy displayed in its activities. Some examples of organization's internal environment elements are (Horton, et al., 2003):

- Incentive and rewards systems
- Organizational 'climate' or 'culture'
- History and traditions of the organization
- Leadership and management style
- Clarity and acceptance of the organization's mission
- Extent of shared norms and values promoting teamwork and pursuit of organizational goals
- Organizational structure

The third influencing element is the external operating environment or the external environment in which the organization carries out its activities. Some examples of external operating environment elements are (Horton, et al., 2003):

- Administrative and legal systems in which the organization operates
- Policies and political environment that influences the organization
- Social and cultural setting
- Technology available
- Economic trends

3.2 Transportation

This research utilizes the Transportation Relations (Manheim, 1979) through the Framework of Organizational Assessment (Horton, et al., 2003) to evaluate the possible impact of internal environment characteristics of transit institutions in their transit system's ridership. Therefore, it is important to review Manheim's Transportation Relations theory as well as the evolution of transportation paradigm. This information also provided guidance for identifying variables that may serve as indicators, therefore, worthy to be included in the survey.

3.2.1 *Transportation Relationships*

The proposed research is oriented toward identifying common grounds between the ability to meet transit service-related goals and organization characteristics. Therefore, it is important to find where this relationship between transportation and organization is situated within current theories and practice.

Transportation is the movement of people and goods. The system of interest is an interrelationship that can be defined by three variables (Manheim, 1979):

- **The transportation system** - It includes technologies, networks, vehicles, operation policies or decisions on how the transportation will be operated, and organizational

policies or management, organizational and institutional decisions such as number of institutions, types of institutions, functions, domains of responsibility, communication channels, coordination, and control.

- **The activity system** - It includes the pattern of social, economic, political, and other transactions taking place over space and time in a particular region.
- **The pattern of flows in the transportation system** - It includes the origins, destinations, routes and volumes of goods, and people moving through the system.

The relations among these variables are shown on Figure 3-2.

Figure 3-2 Transportation Related Systems Correlation

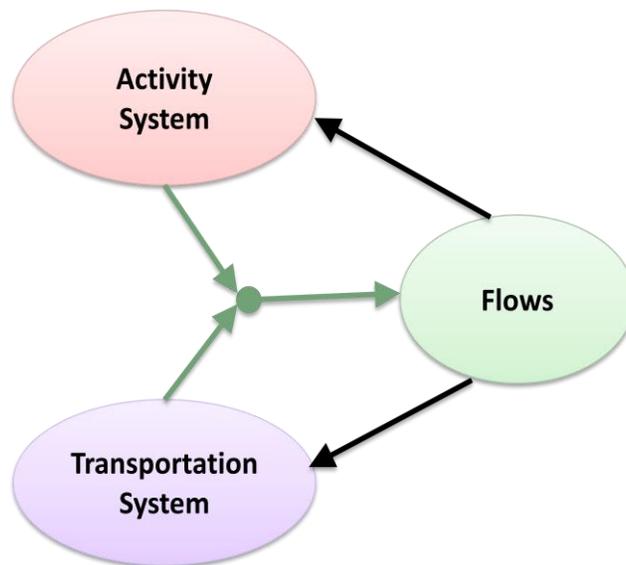


Figure re-drawn from Manheim (1979)

M. Manheim (Manheim, 1979) also indicated that there are individuals, groups and institutions whose decisions interact to affect the transportation system, the activity system, and the pattern of flows. They are: users, operators and government.

S. González (unpublished notes 1980's) proposes a third system called the socioeconomic system, representing groups / organizations, social and economic activities not included on transportation and activities systems. Part of González's proposed system network is shown on Figure 3-3. Note that the relations are subdivided into physical and operational components.

Figure 3-3 Relations among Transportation Subsystems and Components

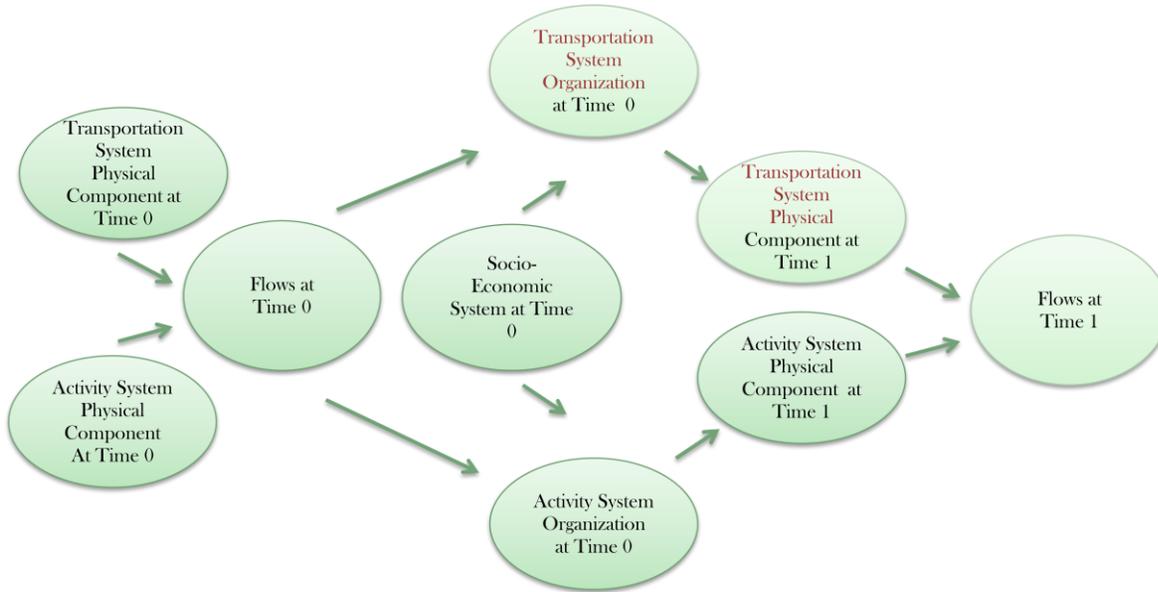
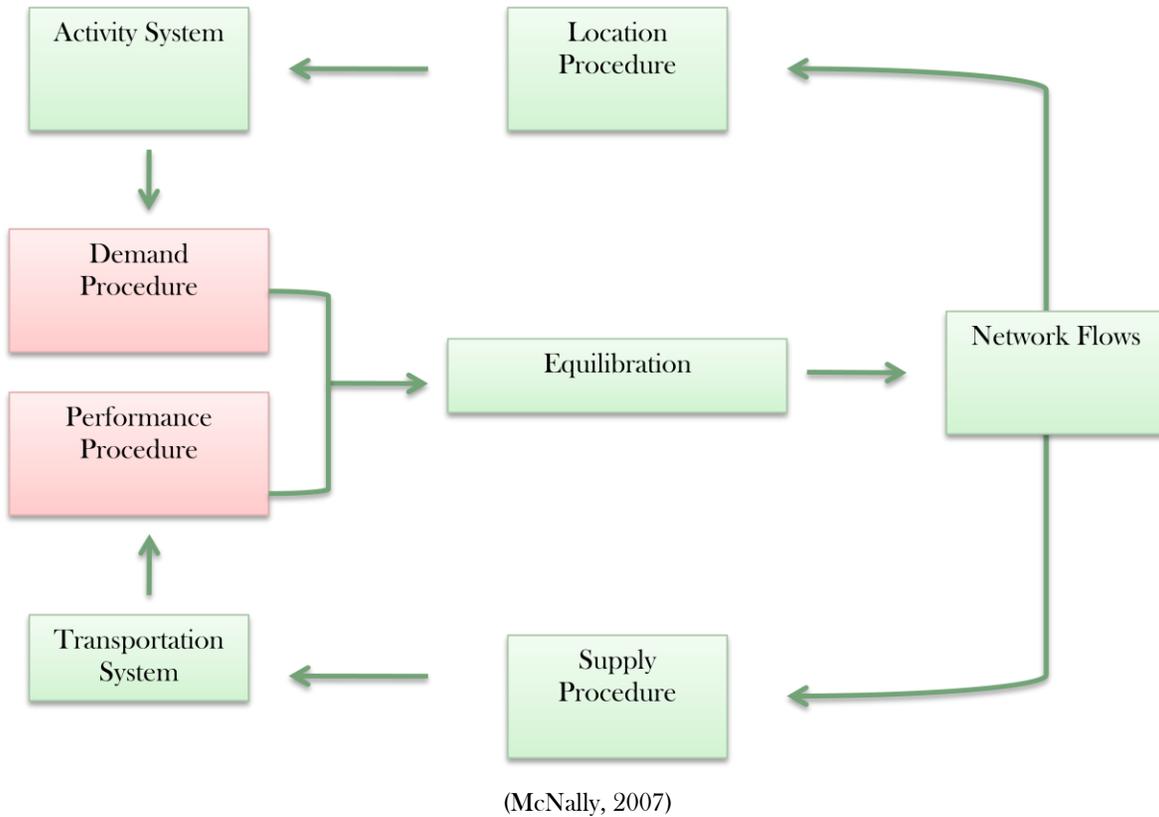


Figure re-drawn from part of figure from González

Michael A. Florian et al, as cited on McNally (The Four Step Model, 2007), incorporates performance and demand procedures, derived from the transportation (T) and activity (A) systems respectively, to the transition of T and A relation to the flows, as can be observed from Figure 3-4.

Figure 3-4 Manheim/Florian Transportation Systems Analysis Framework



3.2.2 Transportation Productivity Paradigms

Traditional measures of effectiveness consider technical and capacity performance. Most recent paradigms related to public transportation include the consideration of service effectiveness.

Our traditional measures of performance are narrowly focused:

- *Simple outputs (miles of highway constructed or hours of transit service provided);*
- *Economic efficiency (how cheaply we produce that output); and*

- *Engineering standards (lane width, pavement deficiencies, and miles between bus and rail-car repairs).*

But, our perspectives have broadened. We now demand to know how our transportation investments and services affect the quality of the travel experience and the overall quality of life and the character of our communities. (Cambridge Systematics, Coogan, Multisystems, Robert F. Wagner Graduate School of Public Service, & TransManagement, 2000).

Typical traditional measures include measuring mean distance between failures of a particular fleet, or measuring on time performance of a particular line, for example. New paradigm calls for accounting for the entire mobility service needed by the user, not only a segment of it. For example, if the user needs to walk, use the bus and transfer to a train in order to reach her/his destination, all stages of the trip must be considered together. It implies coordination and service integration practices, so user can have smooth transfers. Taking the service offered in consideration implies coordination and service integration practices, as the main aspect is to meet the transportation need of the public from their origin to their destination, rather than be interested only in the portion of the trip made by a particular mode or line (Miller, 2004); hence, it is related to customer convenience (San Francisco Municipal Transportation Agency, 2008).

Traditional transit organizations regularly evaluate service and internal operating performance, both to justify budget and to identify opportunities to improve current services. *These self-assessments, however, usually stop short of questioning or examining whether existing institutional arrangements, missions, or business processes are aligned with or are effective in addressing the full range of changes taking place outside the organization. Today, it is these external forces and factors that are more likely to provide the impetus for fundamental change.* (Cambridge Systematics, Coogan, Multisystems, Robert F. Wagner Graduate School of Public Service, & TransManagement, 2000)

The TCRP Report 58 (Cambridge Systematics, Coogan, Multisystems, Robert F. Wagner Graduate School of Public Service, & TransManagement, 2000) also points out several steps

in recognizing the need for change in paradigm. Some of them are inherent of the organization, such as:

- *Conduct an environmental scan.*

Transit organizations exist for a purpose. A scan is a useful start since it involves describing the organization and its relationships in terms of purpose. In doing a scan, it is essential to think in a service-focused, systematic way. What is the organization's mission and philosophy? What services are produced? For who are they produced? What are the chief characteristics of the production system? In general terms, how effectively does the organization's social system function in producing the transit service? What are the key inputs to the organization and on whom do they depend? What is the relationship between the transit organization and local political bodies? Does it receive the support it needs and why or why not?

- *Assess organizational performance in the core mission.*

The core mission of a transit organization has historically been to produce transit services. The core mission may be changing, however, toward the management of services and travel options that improve personal mobility and access. How well the organization performs and balances these tasks is the single most critical factor to its overall wellbeing and long-term viability. What is the quantity and quality of performance? Is performance data captured and used in ways that feedback relevant and timely information to the production side as well as to the strategic level?

- *Assess organizational responses to changing needs and expectations.*

When the press of change (whether from customers or other influential) hits your organization, what is the typical organizational response? What is the pattern of responsiveness to demands for change or opportunities? If response is weak, what information is the organization failing to receive or consider?

- *Assess the organization's response to new ideas and innovation.*

Identify the most important innovations in your organization during the past 5 years. Is there a pattern of exploring new ideas and seeking innovations throughout the organization? What happens when new ideas and suggestions are made? Does management positively promote an innovative or learning culture?

- *Assess employees' sense of the need for change.*

Even when there is an organizational resistance to change or innovation, many employees have a clear sense that change is inevitable and even makes sense. Do employees in your organization have an appreciation of the conditions in the market and in the political context?

TCRP 97 (Stanley, Coogan, Bolton, Campbell, & Sparrow, 2003) indicates that at the center of the new paradigm is a shift in the mission of the organization away from simply maximizing the use of the assets it owns to provide capacity to a broader responsibility for managing mobility regardless of whose assets are used. It resulted from fundamental changes along six dimensions:

- *Mission Shift - Core mission shift from simply providing a form of capacity with assets you own to a broader responsibility for managing mobility, managing a wide range of assets...*
- *“Obsession” for the Customer - Measures of success and performance are increasingly focused on the quality of the customer experience...*
- *Collaboration - Collaboration across modes, organizations, and jurisdictions has become a fundamental strategy...*
- *Integration - Integration of assets, services, and business functions is a common feature of emerging business models...*
- *Information Technology - Effective links to customers and partners are dependent on deployment of state-of-the-art information technologies like universal fare systems; real-time, on-street customer information; and unified scheduling and dispatching systems...*
- *Organizational Structure Change - New business units, functions, skills, and business processes are inevitable with change in these other dimensions... This sixth critical dimension of fundamental change involves the inevitable changes that will need to occur in organizational structure and capacity as a result of embracing a new mission, heightened customer focus, new partnerships, and the requirements of new technologies. Invariably, new business units will need to be formed, traditional functions redesigned or relocated, new professional skills and competencies recruited, and traditional business processes reengineered.*

Bruno Marzloff, French sociologist and keynote speaker at the opening of the 58th UITP World Congress in June 2009, pointed out:

We are in the process of moving away from transport management - performed by operators under regional authority - towards regulation of mobility behavior by the users themselves, using the tools of the new mobility operators... We are shifting from the era of the object (car, bus, train, etc.) to the service age (how to access urban resources)... Reduced growth is no longer necessarily a taboo subject, at least where mobility is concerned...

Therefore, emphasize on providing mobility needed seems to be the current tendency in transportation providers.

(The provision of) new alternatives in public transportation are a general need rather than a (single) sector's need. This is mainly due increase in traffic congestion, pollution, road accidents and energy costs (Ceder, 2004), which are issues carrying consequences worldwide and not only to a specific community. That is, the transportation issue needs to be seen as a whole set of possible alternatives including different modes, land use management and other life quality considerations. This asseveration accepts that exclusively looking to try to improve individually each mode will not be enough to serve effectively the population's transportation mobility needs. At Madrid, for example, defining their own sole transportation authority was their solution to address mobility (De Matías, 2008).

Common obstacles towards meeting the transportation needs of the public can be summarized as:

- The ability to integrate different modes or lines so the user can make smooth transfers
- Financing and allocating public transportation funds where needed
- Random or market-dictated development (without necessary considering transportation, services or special mobility groups' needs such as elderly and handicapped)

- Unstable or non-cohesive public policies within or among organizations

V. Vuchic indicated that:

There is a tendency to develop integrated public agencies adopting some forms and practices of private companies for greater operational efficiency since 1980's. Control by public agencies is retained to ensure public interest over short-term economic efficiency. (Vuchic, 2005)

This emphasizes the purpose of transportation, which is to provide a service to satisfy public social needs, rather than maximize income as it occurs on business.

An organizational process approach is considered appropriate, as policies and programs can be successful only to the extent that the organizations responsible for their implementation have the capability of carrying out their responsibility (Meyer & Miller, 1984). Therefore, the powers and understanding of each party's responsibilities and committing to them is important to achieve or implement any possible solution.

The San Francisco Municipal Transportation Agency (SFMTA), which manages transportation in San Francisco, California, in collaboration with the City's Controller's Office, developed the Transit Effectiveness Project (TEP). The TEP represents the first top-to-bottom review of San Francisco's public transit system in over a generation. It resulted on several recommendations designed to make the transit service more reliable, quicker, and more frequent. As can be seen in the extraction below, they attach effectiveness to customer convenience:

The TEP's Staff Recommendations focus on service factors aimed at increasing customer convenience: improved reliability, reduced travel time, more frequent service and updated Muni bus routes and rail lines that track with current travel patterns. The recommendations focus on providing resources where they are most needed. (San Francisco Municipal Transportation Agency, 2008)

In 2007, eight national organizations, representing both public and private sector, joined in an effort to create a new national “vision” for transportation to maintain America’s place in the world economy and way of life. Those organizations are:

- American Association of State Highway and Transportation Officials
- AAA Auto Club
- American Council of Engineering Companies
- American Public Transportation Association
- American Road and Transportation Builders Association
- American Trucking Associations
- Associated General Contractors
- Association of American Railroads

The resulting draft vision and strategy was compiled on the document entitled Transportation Vision and Strategy for the 21st Century Summit by John Horsley, Executive Director of the American Association of State Highway and Transportation Officials (AASHTO) in 2007. The following is extract from the document is a forecast of what America’s transportation system could become, as per resulting vision:

The system of highways, transit, and rail built during the past century has been preserved. Reliability has increased and congestion reduced. The special needs of the elderly were being met. Capacity has increased in the booming areas of the South and West. Rural America was better connected. Most importantly, a 21st Century national freight network effectively connecting all parts of America to the world has been built. Bottlenecks have been fixed and the performance of highway, transit and rail systems has been enhanced. The world-class transportation system that was created allowed residents to enjoy expanded opportunities for jobs, places to live, time with family, education, healthcare, recreation, and other services. Businesses realized a competitive advantage and productivity growth... Expanding public transportation has helped accommodate growth and has made the overall transportation network perform better. People have freedom to make transportation choices. This has helped realize the overarching goals of economic vitality and quality of life. To meet the transportation needs of the present and pass on a better world to

our grandchildren, expanding the system's capacity to handle traffic must be accomplished while simultaneously reducing its environmental impacts... (American Association of State Highway and Transportation Officials, 2007)

Norman Mineta, former U.S. Secretary of Transportation indicates:

Congestion is one of the single largest threats to our economic prosperity. Each year, Americans lose 3.7 billion hours and 2.3 billion gallons of fuel sitting in traffic jams. Worse, congestion is affecting the quality of American's lives by robbing them of the time that could be spent with families and friends. Congestion is not a fact of life. It is not a scientific mystery, nor is it an uncontrollable force. Congestion results from poor policy choices and a failure to separate solutions that are effective from those that are not. (American Association of State Highway and Transportation Officials, 2007)

The ability of an institution to address the whole set of considerations in order to address the mobility issue of the new paradigm could depend to some extent on the organization itself. That is, it could be influenced by its relation with other organizations, organizational culture, authority levels, communication lines, succession planning, and definition of vision, goals and objectives, among others.

3.3 Previous Studies on Transportation Organization

This section describes some recent research related to organization and transportation.

Currently, the University of South Florida is developing a research on the structure/performance relationships of public transit agencies (Hinebaugh & Simmonds, Ongoing). Their objective is to provide a detailed explanation of the relationship between the structures of public transit agencies in the USA and their performance. Their proposed methodology includes a statistical correlation study combined with a regression analysis. They will also design of a survey to obtain empirical data on both structure and performance, which will be used as basis for their analysis.

Leland & Smirnova (2008) studied the effect of government structure on urban bus transit efficiency. As previously discussed, they found that transit specific organizations are more effective than general organizations like municipalities, and that privately-operated routes tended to be more effective than public-operated ones. The methodology used included a regression analysis using National Transit Database for fiscal year 2002 and excluded Puerto Rico & territories. The dependent variable was a vector of different effectiveness and efficiency factors (labor productivity, vehicle utilization, revenue, expense, etc.). The model resulted in a function of several variables and dummy variables such as amount of modes operated, fixed guide-way, directly operated, region, if bond interest was paid, ratio of local and federal funding, if agency is special purpose, and area density. They defined very thoroughly their variables of interest and productivity parameters, however, interactions between variables were not considered. However, social characteristics such as relation with other institutions, organizational culture, common knowledge of organization objectives or performance measures related to relevance (how objectives reflects necessities), were not included. Although they included if an organization managed another mode, this didn't really address the issue of integration (fare, schedule, etc.). They also concluded that future research should consider the analysis of variables that specifically relate to the different types of authority systems (such as whether boards are elected or appointed), and measure their influence on a larger set of efficiency and effectiveness indicators.

Marsden & May (2006) studied the effect of institutional arrangements on the development and implementation of transportation policy. They used a set of desktop reviews and interviews to analyze three British cities and developed conclusions based on that. However, no mathematical approach or statistical model was intended to be used or included in their methodology, nor was the level of use of the service by patrons. They concluded that several changes in organization and responsibilities (nature of responsibilities and geographical coverage) affect negatively the ability to deliver policy as new relationships are formed and new powers taken up. They indicated that evidence supports the metropolitan-wide authority and horizontal integration. They also pointed out that the involvement of the private sector in service provision is not in itself a barrier to strategy delivery. They identified two types of barriers: those related to funding and those concerning public acceptability. They concluded

that a combination of the following can achieve significant improvements in a short period of time: right powers and institutional structure, flexible funding, and a strong political support.

The TCRP Report 21 (Murray, Koffman, Chambers, & Webb, 1997) calls in a very assertive fashion for dynamic Transportation organizations (with the ability to constantly adapt to changes in conditions) that encourages employee innovation, communication in all directions and simplifying authorization process:

Traditional hierarchical organizations can inhibit mobility management. Such organizations can stifle leadership that emerges from the middle or lower ranks. Customer service and marketing representatives, for instance, may see the benefit of providing a full range of options to callers and businesses long before top administrators with less daily contact in the community. Unless the agency is one that encourages innovation and communication up and down organizational lines, the new view of service will be thwarted. Similarly, organizations that require many approvals limit independent decision making and inhibit changes to respond quickly to the market.

Similarly, the Committee on Management and Productivity of the Transportation Research Board (Transportation Research Board Standing Committees, 1999) were identified, among others, the following needs for the future:

- **Changing public sector roles:** They indicate that historically, agencies have responded directly to the public by providing technical solutions, and that this response will no longer be sufficient. Agencies need to become comprehensive transportation operators or managers who offer transparent service delivery.
- **New program delivery mechanism:** They indicate that innovative contracting methods, such as incentive-based awards, competitive turnkey contracting, and increased outsourcing of both core and routine functions should be explored.
- **Organizational reconfiguration:** They indicate that rightsizing should continue, and that this will change ways of delivering services and the kind of services that will be provided. However, the efforts should consider organization's needs and

customer priorities. Other effects that should be studied are the ones due centralization and decentralization.

- **Process improvement:** They describe this concept as reengineering and realignment of resources to reflect priorities more clearly.
- **Setting priorities:** They state that agencies, in order to be effective, must have in place well-defined missions, goals, and objectives; sophisticated strategic planning tools; and outcome-oriented processes for prioritizing investment decisions based on customer input.
- **Modal integration:** They indicate that the effects of modal integration and intermodal choices on priorities need to be considered as well.

The TCRP Synthesis 47 (Davis, et al., 2003) shows a study on corporate culture and its relation with leadership development, successful succession and employee retention. Their sample included systems of different size, location and modes of operation. They found that all of them are challenged on retaining high-quality leaders. In terms of organizational culture, interviewed leaders indicated that

...they have the freedom to act strategically. However ... it is better to get permission before taking unconventional actions.

They also indicated that:

...agencies were able to clearly identify the core competencies required of successful leaders in their organizations. This knowledge, however, has not been translated into concrete plans for leadership development. For example, succession planning for the most part is still in the conceptual stage... In most participating agencies, the performance management of the transit leadership team is well defined and implemented. Chief executives work with team members to define and monitor progress toward goals.

Research has demonstrated that the study of transportation organizations deserves serious consideration towards accomplishment of transportation goals.

In addition, current practices on the transportation industry are considering organizational aspects, in order to improve service.

One type of approach was used by British Columbia Public Service (Being the Best 3.0 Human Resources Plan 2008|2009 - 2010|2011, 2008), where they promoted an organizational culture oriented to employee engagement:

Employee engagement is recognized by most leading employers as a key element in improving recruitment and retention as well as boosting overall productivity. ... Engagement is really about ensuring employees are involved in and committed to the future of their employer. ... The primary goal of improving engagement in the BC Public Service is to improve service delivery to citizens. Research shows that the more engaged employees are the higher quality of service they will deliver.

Similarly, Dakota Transit is doing an effort to improve communication within the organization. They started with training. An article at The Dakota Transporter (Hutchinson, 2008) summarizes the key elements mentioned at the training session:

Practical, experiential team-building focuses on bringing out the best in people, and leads teams to discover how well they can work together. ...presentation taught participants to create a corporate culture of effective communication and to increase and maintain morale while appreciating diverse contributions.

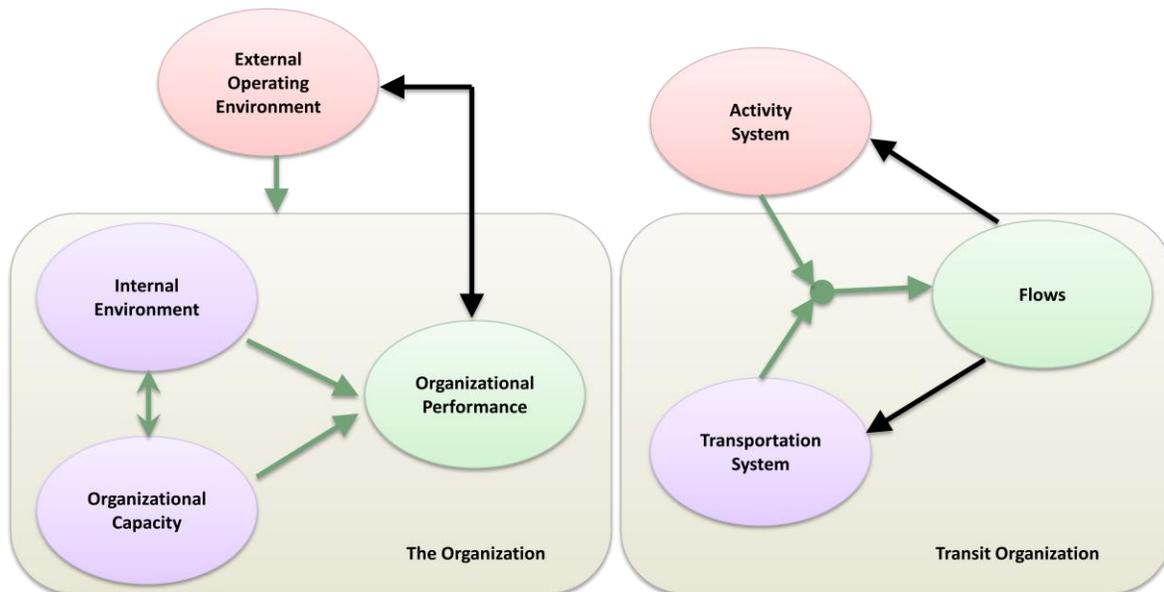
As noted on aforementioned literature, it can be concluded that several transportation related institutions have studied and concluded that organizational aspects, including its human component, are important to the success of the transportation industry. This has led to the application of practical measures like modification of procedures, and to recommendations for further study on the subject which is the goal that proposed research intends to address.

4 THEORETICAL BACKGROUND AND CONCEPTUAL FRAMEWORK

It is proposed that the Transportation System can be visualized and analyzed through an organizational assessment framework. The following theoretical background of Transportation Relations (Manheim, 1979) and the Framework of Organizational Assessment (Horton, et al., 2003) were used to propose a combined scheme to describe the transportation system's interactions.

Organizational Assessment and Transportation Relations were previously presented at Chapter 3 LITERATURE REVIEW, sections 3.1.2 Organizational Performance and 3.2.1 Transportation Relationships, respectively. The Figure 4-1 shows comparable components of the Transportation systems and the organizational framework.

Figure 4-1 Organizational Framework and Transportation Systems Comparison



Adapted from: Horton, et al. (2003)

and

Manheim (1979)

4.1 External Operating Environment and Activity System

Note in Figure 4-1 that both the Organization and the Transportation System are influenced by an external component. In the organizational framework, it is the external environment in which the organization carries out its activities, such as administrative and legal systems, policies and political environment, available technology, and economic trends, among others. (Horton, et al., 2003).

In the case of the Transportation system, this external component is the activity system or the pattern of social, economic, and political transactions, among others, taking place over space and time in a particular region (Manheim, 1979).

Actual and potential transactions determine the demand for transportation, while the levels and spatial patterns of those interactions are affected by the transportation services provided.

In both cases, external components are related to the social, economic and political environments, external from the organization or the transportation system, but in which they exist and operate under.

4.2 Organization and Transportation System

Note also in Figure 4-1 that the Organization has two components namely Organizational Capacity and Internal Environment. The Organization Capacity is defined as organization's potential to perform, or its ability to successfully apply its skills and resources to accomplish its goals and satisfy its stakeholders' expectations... It refers to the resources, knowledge, and processes employed by the organization such as staffing, infrastructure, and leadership, among others (Horton, et al., 2003).

The Internal Environment is composed the organization's internal factors that influence the direction of the organization and the energy displayed in its activities, such as the reward system, organizational culture, and leadership style, among others (Horton, et al., 2003).

Similarly, the Transportation System has several components that are comparable to Organization Capacity; some of them are related to infrastructure and some to the organization itself, just like in the Organizational Framework. As described by Manheim, Transportation System includes:

- Infrastructure (e.g. technologies, networks, vehicles, facilities, maintenance systems)
- System operating policies or decisions on how the transportation will be operated (e.g. routes, schedules, types of services, prices, financing, subsidies, taxing, and regulatory decisions)
- Organizational policies or management, organization and institutional decisions (e.g. private versus public, geographical structure, number of institutions, types of institutions, functions, domains of responsibility, communication channels, coordination and control)

Manheim also mentions as part of the transportation management system some components that are likely to be internal environment characteristics such as (Manheim, 1979):

- Personnel system (e.g. recruiting, training, management, career ladders, incentives)
- Organizational structure (e.g. internal organization structure for accountability and control)
- Planning and analysis system (e.g. corporate planning, short-range planning)

Hence, the Transportation System, as organizations, has an internal environment component.

4.3 Performance and Flows

Organizational performance is defined as the ability of an organization to meet its goals and achieve its overall mission. It can be expressed in terms of four key indicators, previously explained in section 3.1.2 Organizational Performance: effectiveness, efficiency, relevance, and financial sustainability (Horton, et al., 2003).

Traditional measures of transportation performance include measuring the amount of service provided, the economic efficiency, and the fulfillment with engineering standards; while currently it is recognized that it is also important to measure the quality of the travel experience and implications in quality of life (Cambridge Systematics, Coogan, Multisystems, Robert F. Wagner Graduate School of Public Service, & TransManagement, 2000).

Traditionally, the transit industry has relied on production-oriented output measures of performance—efficiency, effectiveness, and productivity—in the use of available resources (Stanley, Coogan, Bolton, Campbell, & Sparrow, 2003). The third tier of the Organization Model proposed in TCRP Report 97 (Stanley, Coogan, Bolton, Campbell, & Sparrow, 2003) propose a systems of performance measurement that bring into balance the quality of the customer's experience (the emerging strategic goal) and the efficiency with which resources are used (the production goal). Therefore, the components of effectiveness and relevance have been incorporated in the new model.

For the Transportation System, Manheim describes a Performance Function (PF). This PF also depends on several indicators that occur in a particular physical, economical and institutional environment in which the system exists (E). (Manheim, 1979) They are:

- The magnitude of resources consumed by a system (**R**) –This could be related to the efficiency and the financial sustainability indicators of organizational performance. The lesser the amount of resources consumed to achieve desired objectives, the more efficient and economically sustainable it results.
- The level of service offered (**S**) – This could be related to the effectiveness indicator of organizational performance. The level of service offered needs to address the transportation necessities and users' expectations.
- The design and operation of the transportation options (**T**) – This is related to the relevance indicator of organizational performance. The provided alternatives needs to be designed and operated in a manner that supports the transportation objectives, mainly to those related to mobility and accessibility.

- The volume of users of the system (V) – This is also related to the effectiveness and relevance. If the volume of users is low, then the provided T and S are not satisfying the users' necessities.

Therefore, a performance function for the particular environment is defined as $\Phi_e(R,S,T,V)$.

Note that performance depends on all basic relations' components: the transportation system, the activity system and the flow on the system. Manheim (1979) also indicates that the PF or Φ can be viewed as composed of a service function Φ_s and a resource function Φ_r , varying as a function of V, in a particular environment E; that is: $S = \Phi_s(V; T,E)$ and $R = \Phi_r(V;T,E)$. Manheim (1979) also indicates that the actual shapes of these relationships will depend significantly on the environment E in which a particular system is being operated, as well as on the characteristics of the system itself.

Manheim (1979) indicates that, from the perspective transportation system performance, V is the independent variable and S the dependent. This way, the level of service represents the proportion of the provided capacity that is being used. However, from the perspective of the activity-system behavior, S is the independent variable and V the dependent variable. $V=D(A,S)$ = demand function depending on the activity-system options and the level of service experienced by the traveler. Hence, demand function characterizes the activity-system A (consumers and their potential activities) and the transportation-system, that is, the level of service S of the alternative travel choices available. That is, the volume of users depends on the activities and the transportation options and level of service provided to be able to perform such activities. This last definition is the one that will allow predicting volumes that will demand particular transportation services (Manheim, 1979).

Manheim (1979) also indicates that the flow pattern F consists of the volume V using the system and the level of service S experienced by those travelers. Level of service is a function of the transportation options T and the volume of flows. Hence, the flow pattern defines how many users are in the available alternatives.

4.4 Conceptual Framework

As previously noted, the volume of users is described by a demand function that depends on the activity and the transportation systems under a particular environment. The interest of this study is to determine if internal environment characteristics of the transit organization are part of those environment and transportation indicators that help to describe the volume (transit ridership) on the demand function.

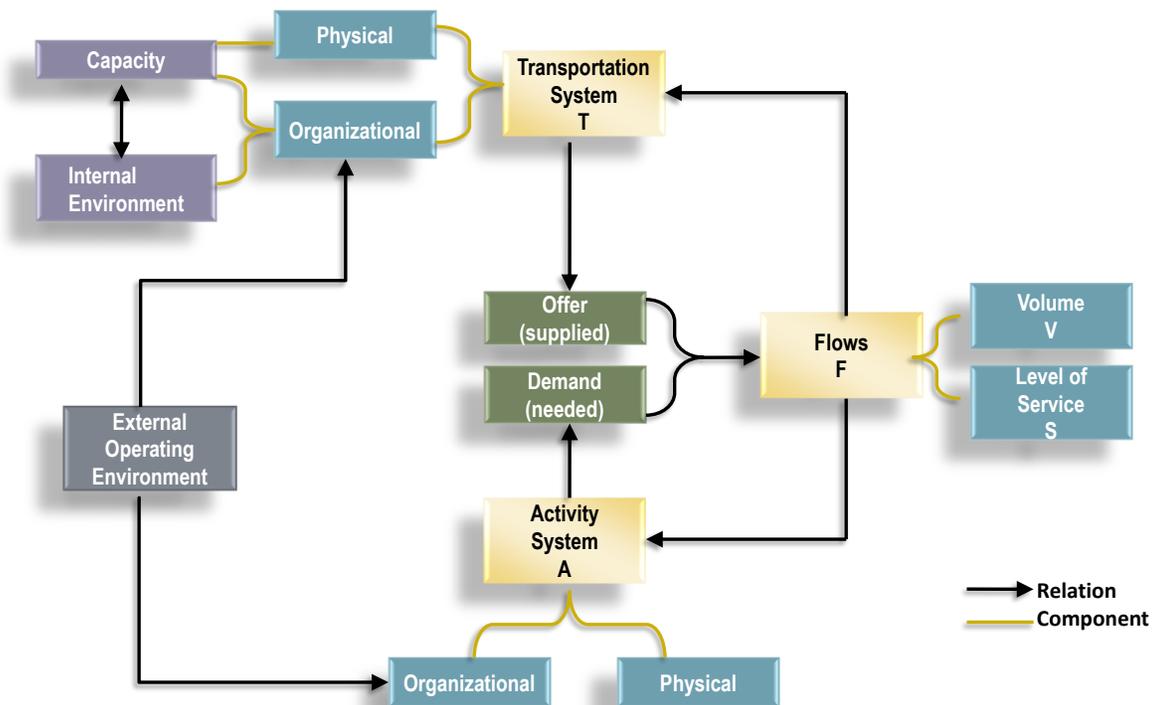
Therefore, let us presume that the system's effectiveness is measured as per recent paradigms, with indicators regarding accomplishment of the following goals: mobility needs are met, congestion is reduced, reliability is increased, environmental impacts are reduced, and there are transportation choices. Then, it could be presumed that one of the main objectives to be measured is the capacity to increase use of modes alternate to private auto, hence, transit ridership or transit flow could be set as an indicator of effectiveness. That this, effectiveness in achieving the goal of increasing the use of alternate modes to private auto is proportional to the usage of modes different to private car, in this case, the use of transit. Hence, transit flow could be considered as a measure of performance, in this case, effectiveness, could be influenced by both organizational capacity and internal organizational environment components that are present in the transportation system.

The proposed framework is shown in Figure 4-2. The main objective of this framework is to describe the relation of organizational components to the basic transportation framework. The F was expanded to show its V and the S components. The proposed framework combines the ones proposed by Manheim (Manheim, 1979), Florian (McNally, 2007), González (González) and Horton (Horton, et al., 2003). The basic Manheim's transportation framework remains, as in Florian's and González's. Florian's offer and supply components, derived from T and A respectively, are incorporated to the transition of T and A relation to F. Also, T and A were expanded to show González's physical and organizational components. Horton's organizational framework was incorporated to show its relation to T. Also, it is shown the External Operating Environment, which is comparable to

González socio-economic system, as an influencing factor to the organizational component of both the Activity and Transportation systems.

In order to estimate transit flow resulting from the equilibrium of the demand and the performance, the indicator of transit ridership over service population will be used as the dependent variable. The survey performed was used to identify possible independent variables related to the organization that might influence the aforementioned indicator. Both Internal Environment and Capacity components were included as they both might influence flow. In addition, it is sought to compare the relative magnitude of the influence of such variables.

Figure 4-2 Proposed Framework



This work is oriented towards showing existence or non-existence of a relation between organizational characteristics and ridership in current transit systems. Intermediate relations and other components as presented on the general framework are not studied in this work. Therefore, the main objective is to identify tendencies related to the influence of organizational components as opposed to predict ridership, where other components would need to be included.

5 STUDY CASES

Study cases were inspected using available literature from the source transportation institution. The information was used to identify organizational characteristics that may have had some influence in their performance, especially in the system effectiveness to achieve high levels of ridership. Such characteristics were identified as possible questions for the survey.

The first case study consisted of four institutions reporting to the U.S. National Transit Database (NTD). These four institutions manage heavy rail transit services, at different levels of ridership per service population. Such levels were determined through a cluster analysis applied to the NTD. The selected study case was the institution carrying heavy rail which was closest to the centroid of each group.

General factors that were derived from literature review were inspected. They are: organization's mission, leadership style, organizational culture, and institutional structure. From such observations, information was gathered to develop possible survey questions.

The second case study consisted of one European (Viennese) and one Asian (Singaporean) institution that proudly present them as being successful in achieving high ridership levels. Common characteristics among them were identified as possible indicators for success, hence, possible survey questions.

The study case of the Puerto Rico Highway and Transportation Authority (HTA) was also included in both approaches as a comparison reference.

The HTA is of special interest to the author of this study, as is the main transit institution in her hometown. It is part of the NTD reporting systems. This case will be used to test the models derived later from this study.

5.1 NTD Sample

NTD data was inspected focusing in systems that included heavy rail transit services. First, the characteristics of heavy rail systems were observed. Secondly, a cluster analysis was performed to NTD ridership per service population data and a representative from each cluster, having heavy rail, was selected. Then, such representatives were asked to fill a survey. However, no responses to the survey were received, so the analysis was performed using published information from those systems.

5.1.1 NTD Heavy Rail Systems

An initial inspection of the transportation institutions managing heavy rail services was performed in order to, identify some general descriptive tendencies. The 15 agencies managing transit systems containing the heavy rail mode that reported information to the NTD for the year 2008 are shown on Table 5-1.

IMPACT OF TRANSIT ORGANIZATION IN RIDERSHIP

Table 5-1: NTD Institutions Managing Heavy Rail Services

Name	Passenger miles/service area	Unlinked passenger trips/Service population	Mode services/area	Employee hours/Service population	Exclusive ROW/Service area	Operating funds/Service population	Capital funds/Service population	Operating cost/Service population	Agency Type	Institution Type
MTA New York City Transit (NYCT)	11,437.18	0.61	0	5.23	0.25	168.14	184.89	331.85	2. Public agency or authority that contracts for some or all transit service (not a State DOT)	3. Subsidiary Operating Unit of Regional Agency
Washington Metropolitan Area Transit Authority (WMATA)	6,184.40	0.36	0	4.94	0.24	145.38	135.69	340.2	2. Public agency or authority that contracts for some or all transit service (not a State DOT)	2. Independent Agency with an appointed Board of Directors
Massachusetts Bay Transportation Authority (MBTA)	3,772.78	0.32	0.01	2.94	0.09	111.72	99.92	259.2	2. Public agency or authority that contracts for some or all transit service (not a State DOT)	2. Independent Agency with an appointed Board of Directors
Southeastern Pennsylvania Transportation Authority (SEPTA)	2,825.76	0.22	0	3.47	0.25	77.21	83.56	189.47	2. Public agency or authority that contracts for some or all transit service	2. Independent Agency with an appointed Board of

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Name	Passenger miles/service area	Unlinked passenger trips/ Service population	Mode services/ area	Employee hours/ Service population	Exclusive ROW/ Service area	Operating funds/ Service population	Capital funds/ Service population	Operating cost/ Service population	Agency Type	Institution Type
									(not a State DOT)	Directors
Chicago Transit Authority (CTA)	3,013.66	0.2	0	2.66	0.12	57.12	116.39	143.46	1. Public agency or authority that directly operates all transit service (not a State DOT)	2. Independent Agency with an appointed Board of Directors
Maryland Transit Administration (MTA)	4,000.67	0.19	0.01	3.55	0.8	60.72	75.67	254.77	3. State Department of Transportation	6. Unit of State Government
Metropolitan Atlanta Rapid Transit Authority (MARTA)	1,336.56	0.14	0	2.76	0.05	29.02	73.57	106.95	1. Public agency or authority that directly operates all transit service (not a State DOT)	2. Independent Agency with an appointed Board of Directors
Los Angeles County Metropolitan Transportation Authority (LACMTA)	3,943.39	0.13	0	1.53	0.16	29.21	38.38	99.6	2. Public agency or authority that contracts for some or all transit service (not a State DOT)	2. Independent Agency with an appointed Board of Directors
San Francisco Bay Area Rapid Transit District (BART)	9,165.42	0.12	0	1.78	0.51	95.75	78.37	148.36	1. Public agency or authority that directly operates all transit service (not a State DOT)	1. Independent Agency with an elected Board of Directors

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

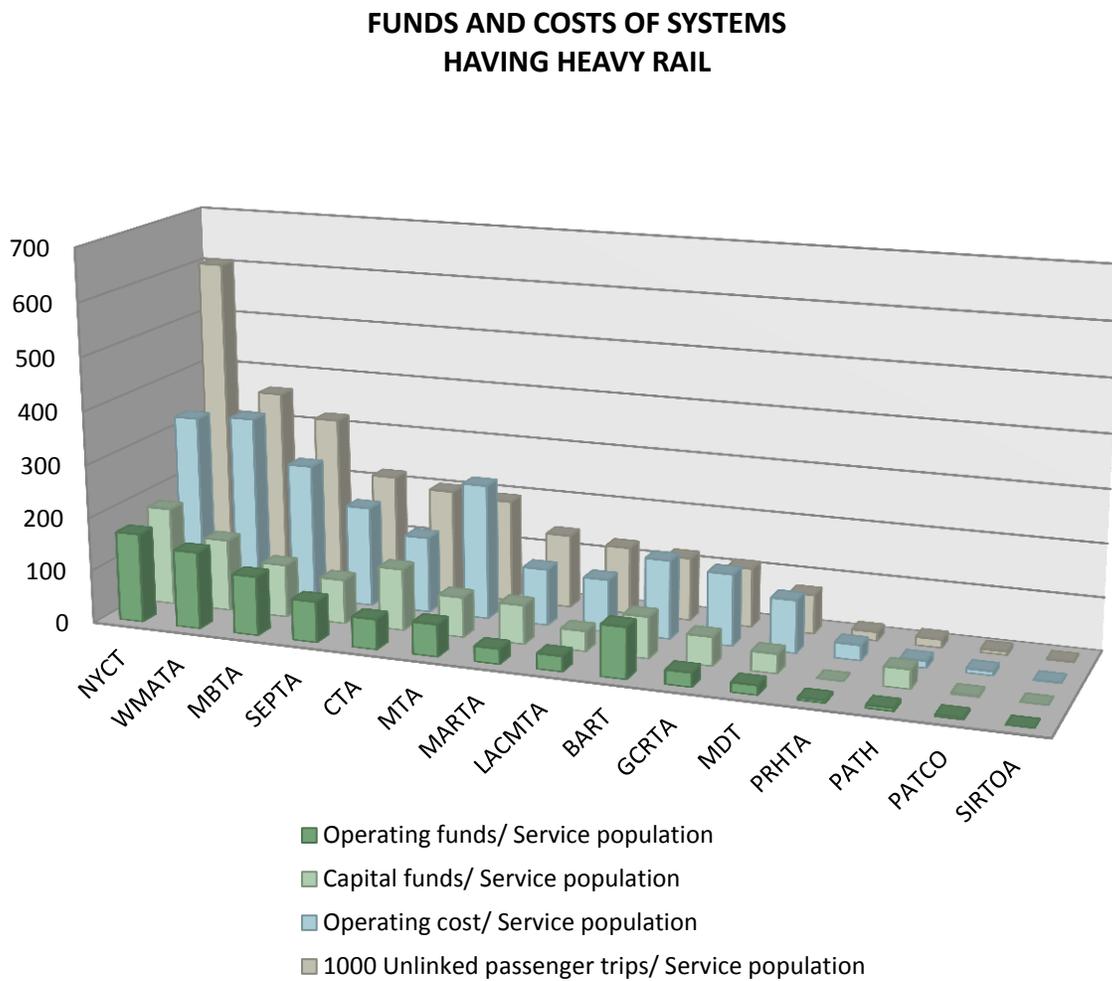
Name	Passenger miles/service area	Unlinked passenger trips/ Service population	Mode services/ area	Employee hours/ Service population	Exclusive ROW/ Service area	Operating funds/ Service population	Capital funds/ Service population	Operating cost/ Service population	Agency Type	Institution Type
The Greater Cleveland Regional Transit Authority (GCRTA)	1,343.28	0.11	0.01	2.57	0.14	26.86	54.44	134.92	2. Public agency or authority that contracts for some or all transit service (not a State DOT)	2. Independent Agency with an appointed Board of Directors
Miami-Dade Transit (MDT)	1,741.42	0.07	0	1.72	0.06	18.23	36.75	99.2	2. Public agency or authority that contracts for some or all transit service (not a State DOT)	5. Unit of County Government
Puerto Rico Highway and Transportation Authority (HTA)	200.47	0.02	0	0.88	0.04	5.22	0	29.05	2. Public agency or authority that contracts for some or all transit service (not a State DOT)	6. Unit of State Government
Port Authority Trans-Hudson Corporation (PATH)	364.4	0.02	0	0.14	0.01	6.47	36.22	13.74	2. Public agency or authority that contracts for some or all transit service (not a State DOT)	2. Independent Agency with an appointed Board of Directors
Port Authority Transit Corporation	181.72	0.01	0	0.11	0.02	4.12	2.8	8.26	1. Public agency or authority that	2. Independent

IMPACT OF TRANSIT ORGANIZATION IN RIDERSHIP

Name	Passenger miles/service area	Unlinked passenger trips/ Service population	Mode services/ area	Employee hours/ Service population	Exclusive ROW/ Service area	Operating funds/ Service population	Capital funds/ Service population	Operating cost/ Service population	Agency Type	Institution Type
(PATCO)									directly operates all transit service (not a State DOT)	Agency with an appointed Board of Directors
Staten Island Rapid Transit Operating Authority, dba: MTA Staten Island Railway (SIRTOA)	48.84	0	0	0.03	0.01	0.33	0.05	1.65	1. Public agency or authority that directly operates all transit service (not a State DOT)	3. Subsidiary Operating Unit of Regional Agency
PR employee-hours available data is from the first revenue year (June 5 to December 31, 2005).										

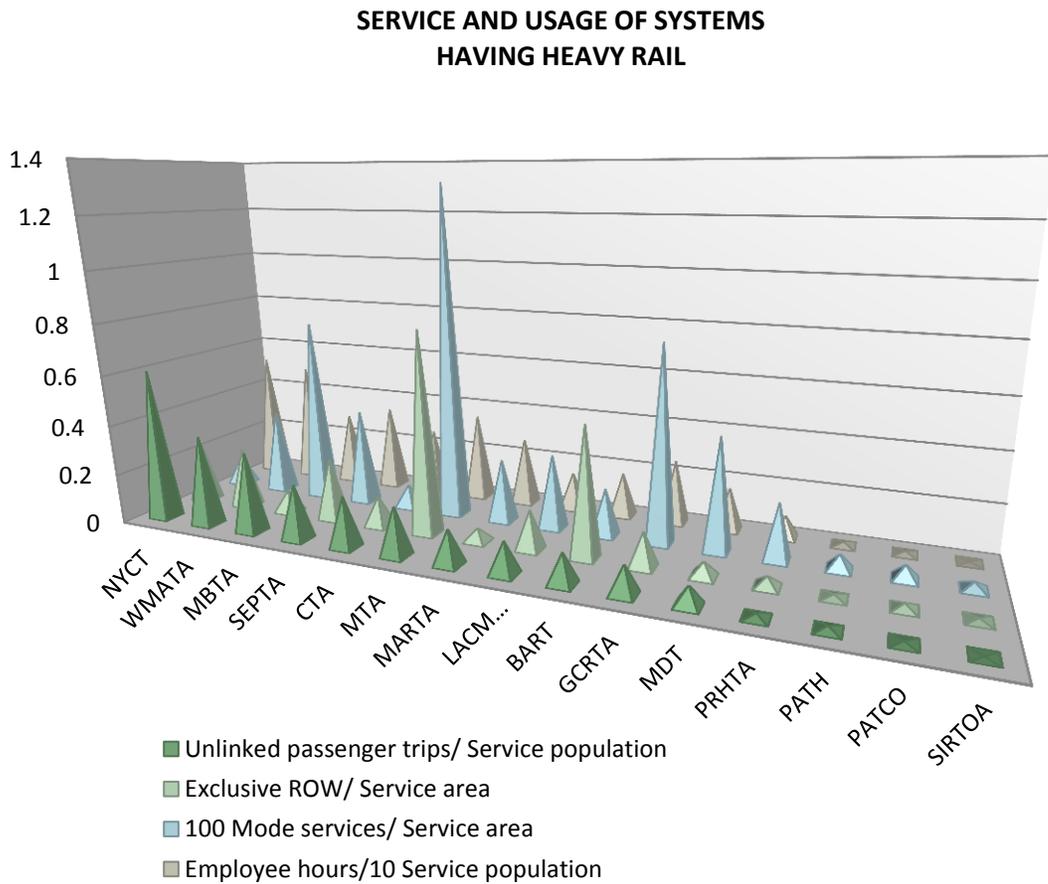
As can be observed from Figure 5-1, operating funds, capital funds and operating costs have a similar tendency, which is also observed with usage. That is, the systems with higher capital and operating costs are the ones having the higher funds and higher ridership per service population. Note that operating costs greatly exceed operating funds in most cases.

Figure 5-1: Funds and Costs of NTD Systems Having Heavy Rail



For most systems, as appears on Figure 5-2, the amount of unlinked passenger trips appears to have some proportional tendency with amount of employee hours, as the systems with higher hours per service population have higher amount of unlinked passenger trips per service population. However, doesn't appear to have it with amount of modes that they use to provide transit services or exclusive right of way. Note that HTA hours' data was available only for the year 2005. This is the year when heavy rail revenue services from HTA started, specifically, on June 5, 2005.

Figure 5-2 Service and Usage of NTD Systems Having Heavy Rail



HTA hours data available and used here was from June 5 to December 31, 2005.

A correlation analysis was performed using Minitab (Minitab, Inc., 2004). The analysis was performed through the Pearson Correlation Coefficient, which is determined as shown in the following equation.

Equation 5-1 Pearson Sample Correlation Coefficient

$$r_{xy} = \frac{n \sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n \sum x_i^2 - (\sum x_i)^2} \sqrt{n \sum y_i^2 - (\sum y_i)^2}}$$

Where:

r_{xy} is the correlation coefficient

x_i is the independent variable for observation i

y_i is the dependent variable for observation i

n is the sample size

(McClave & Benson, 1991)

As can be observed in the following table, it is confirmed that the amount of unlinked passenger trips per service population is positively correlated to capital funds, operating funds, operating costs and employee hours.

Table 5-2: NTD Variables Correlation

Pearson Correlation & P-Value	Unlinked passenger trips/ Service population	Passenger miles/ service area	Mode services/ area	Employee hours/ Service population	Exclusive ROW/ Service area	Operating funds/ Service population	Capital funds/ Service population
Passenger miles/ service area	0.798 <0.001						
Mode services/ area	0.122 0.664	-0.041 0.885					
Employee hours/ Service population	0.896 <0.001	0.688 0.005	0.233 0.404				
Exclusive ROW/ Service area	0.296 0.284	0.544 0.036	0.383 0.159	0.464 0.082			
Operating funds/ Service population	0.930 <0.001	0.877 <0.001	0.104 0.713	0.860 <0.001	0.423 0.116		
Capital funds/ Service population	0.939 <0.001	0.799 <0.001	0.088 0.756	0.905 <0.001	0.357 0.191	0.918 <0.001	
Operating cost/ Service population	0.905 <0.001	0.754 0.001	0.334 0.224	0.954 <0.001	0.541 0.037	0.928 <0.001	0.894 0.037

5.1.2 Cluster Representatives

A Cluster Analysis³ was used to divide NTD institutions in groups based on yearly Unlinked Passenger Trips (UPT) per service population. For the 578 non-blank observations in the 2008 database, the average UPT per day per service population for the entire database was 0.0357 and the standard deviation was 0.0567. The minimum value was 0.000005, while the

³ Statistical classification technique for discovering whether the individuals of a population fall into different groups by making quantitative comparisons of multiple characteristics (Merriam-Webster, Incorporated, 2012). There is no assumption of normality in Cluster Analysis (Kendall, Cluster Analysis and Normality, 2004).

maximum value was 0.6061. The software SPSS (Statistical Package for Social Sciences, Version 10.0) was used in order to perform the analysis, through the K-Means algorithm.

The algorithm is used to classify a given data set through a certain preset “K” number of clusters. The objective is to define k centroids, one for each cluster. The algorithm aims at minimizing an objective function (see Equation 5-2). In this case, the objective function means the error and is an indicator of the distance of the data points from their respective cluster centers. The algorithm is composed of the following steps:

- 1. Place K points into the space represented by the objects that are being clustered. These points represent initial group centroids.*
- 2. Assign each object to the group that has the closest centroid.*
- 3. When all objects have been assigned, recalculate the positions of the K centroids.*
- 4. Repeat Steps 2 and 3 until the centroids no longer move. This produces a separation of the objects into groups from which the metric to be minimized can be calculated.*

(Matteucci, 2008)

Equation 5-2 K-Means Objective Function

$$J = \sum_{j=1}^k \sum_{i=1}^n \|x_i^{(j)} - c_j\|^2$$

Where:

$\|x_i^{(j)} - c_j\|^2$ = Chosen distance measure between a data point $x_i^{(j)}$ and the cluster center c_j

n = Amount of data points

All 578 UPT data points available at the 2008 database (most recent at the time of the analysis) divided by the corresponding service population were used. If grouped in order, New York City Transit will have the greater UPT category, while HTA will be in the fifth cluster. It was observed that there is at least one city operating heavy rail among each cluster.

Cluster results are shown on Table 5-3. Note that the groups with the smaller centroid have more members.

Table 5-3 NTD Cluster Analysis for UPT Results

Centroid (UPT/ Population)	Cluster	Cases in Cluster	Notes
0.606130	2	1	NYCT
0.322865	1	7	MBTA
0.154466	3	35	MARTA
0.063253	5	114	MDT
0.012186	4	421	PATH (HTA category)
Total		578	

The cluster membership for the fifteen heavy rail systems is shown in the following table.

Table 5-4: Heavy Rail Systems' Cluster Membership

HR name	Unlinked passenger trips/ service population	Cluster
MTA New York City Transit(NYCT)	0.606130464	2
Washington Metropolitan Area Transit Authority(WMATA)	0.362566092	1
Massachusetts Bay Transportation Authority(MBTA)	0.32070307	1
Southeastern Pennsylvania Transportation Authority(SEPTA)	0.219267562	3
Chicago Transit Authority(CTA)	0.202110785	3
Maryland Transit Administration(MTA)	0.193730453	3
Metropolitan Atlanta Rapid Transit Authority(MARTA)	0.138905207	3
Los Angeles County Metropolitan Transportation Authority(LACMTA)	0.127146414	3
San Francisco Bay Area Rapid Transit District(BART)	0.119008364	3
The Greater Cleveland Regional Transit Authority(GCRTA)	0.111676789	3
Miami-Dade Transit(MDT)	0.073959003	5
Puerto Rico Highway and Transportation Authority(HTA)	0.016759782	4
Port Authority Trans-Hudson Corporation(PATH)	0.016121924	4
Port Authority Transit Corporation(PATCO)	0.007027276	4
Staten Island Rapid Transit Operating Authority, dba: MTA Staten Island Railway(SIRTOA)	0.001558383	4

The sample was reduced to represent different levels of UPT/per capita of systems. This measure will represent the relative amount of unlinked passenger trips made in transit per person in the service area. Therefore, regardless the system size, its service area or population, they could be compared. A representative from each cluster was selected, reducing the sample to places where there is a heavy rail. The four selected points will be those systems operating heavy rail that are represented by the centroids of the clusters, are close to them or are the only heavy rail systems within that cluster.

For the sample selection, NYCT was discarded, as it is considered an outlier. HTA was also selected as a study case.

The selected transit systems in the sample are:

- Massachusetts Bay Transportation Authority (MBTA)
- Metropolitan Atlanta Rapid Transit Authority (MARTA)
- Miami-Dade Transit (MDT)
- Port Authority Trans-Hudson Corporation (PATH)
- Puerto Rico Highway and Transportation Authority (HTA)

5.1.3 Information of Interest

The following factors of interest were researched for the selected sample:

- Organization's mission
- Leadership style
- Organizational culture
- Institutional structure

These factors were selected based on Chapter 3 LITERATURE REVIEW of this document. As indicated in section 4 THEORETICAL BACKGROUND, the search is emphasized in the components of the Organizational Framework that impact productivity: External Environment, Organizational Capacity and Internal Environment. Selected factors concerns mostly to internal organization environment, which is the main focus of this study.

A summary of related literature review is presented below.

Major factors considered part of the internal environment of an organization includes: organization's mission statement, leadership styles, and its organizational culture (WebFinance, Inc.). Therefore, they will be the main focus of the study. Institutional structure was also specifically considered important by other previous research mentioned in literature review [i.e. (Leland & Smirnova, 2008) and (Marsden & May, 2006)].

Leland & Smirnova (2008) concluded that future research should consider the analysis of variables that specifically relate to the different types of authority systems (such as whether boards are elected or appointed). Therefore, this is one characteristic that will be considered.

Marsden & May (2006) concluded that several changes in organization and responsibilities (nature of responsibilities and geographical coverage) affects negatively the ability to deliver policy as new relationships are formed and new powers taken up, and that evidence supports the metropolitan-wide authority and horizontal integration. They also pointed out that a combination of the following can achieve significant improvements in a short period of time: right powers and institutional structure, flexible funding, and a strong political support. Therefore, authority levels and institutional structure will also be part of the characteristics considered, in order to study if their conclusions made for England systems also apply to US ones.

TCRP Report 21 (Murray, Koffman, Chambers, & Webb, 1997) concludes that unless the agency is one that encourages innovation and communication up and down organizational lines, the new view of service will be thwarted. It also points out that organizations that require many approvals limit independent decision making and inhibit changes to respond quickly to the market. Therefore, communication lines will be another characteristic considered.

The Committee on Management and Productivity of the Transportation Research Board as part of Transportation in the New Millennium (Transportation Research Board Standing Committees, 1999) identified, among others, that for the future it is needed that agencies, in order to be effective, must have in place well-defined

missions, goals, and objectives; sophisticated strategic planning tools; and outcome-oriented processes for prioritizing investment decisions based on customer input.

As literature related to both organization and transportation subjects pointed out the importance of the organizations' mission, which is part of the internal environment and haven't been well recognized in transportation literature, this will be one of the factors that will be studied. With this regard, the particular mission statement will be asked, its relation with other institution's mission statements in the region (if any), and its rate of change (if any). Then, they will be analyzed in terms of level of coverage, items covered, and level of detail.

Other factor that is mentioned in both approaches is the leadership style. As per Business Dictionary, it is defined as formal and informal organizational structure, policies, and procedures through which leadership is exercised. Therefore, it is related to the types of authority mentioned by Leland & Smirnova (2008), communication through organization lines mentioned on TCRP Report 21 (Murray, Koffman, Chambers, & Webb, 1997), and the outcome-oriented processes for prioritizing investment decisions based on customer input mentioned on the Transportation in the New Millennium (Transportation Research Board Standing Committees, 1999). With this regard, different leadership styles will be defined, as per literature, and responders will be asked to identify the style that best describes their organization, with opportunity for comments. This will also allow trying to pair their leadership styles to an organization paradigm as studied on the literature review.

The third factor is related to the organizational culture. As per Business Dictionary (WebFinance, Inc.), it is the total sum of an organization's past and current assumptions, experiences, philosophy, and values that hold it together, and are expressed in its self-image, inner workings, interactions with the outside world, and future expectations; it is based on shared attitudes, beliefs, customs, express or implied contracts, and written and unwritten rules that the organization develops over time and that have worked well enough to be considered valid. Therefore, it is related to what Transportation in the New Millennium (Transportation Research Board Standing Committees, 1999) mentions as strategic planning tools, processes goal and priorities setting. In this case, open questions will be asked regarding:

- How their strategic planning is performed and by whom
- How their priorities and processes are established and by whom

The fourth factor will be directly related to the powers and institutional structure mentioned by Marsden & May (2006). In this case, an institutional organizational chart will be asked for, with the opportunity to be contacted later for questions if considered necessary. This will allow studying the related institutions, offices, and officers. They will be also asked about the institution's age (decade when it was created), service sector (municipality, region, state, country), inherent modes and main funding sources (government assignment, service & products income, private support, taxes, bonds).

It is expected to gather relevant information to get a general description of the organization of institution's studied and to analyze any possible relation to the institution's level of relative ridership.

Ultimately, the fact that the information was available for all cases, so they could be compared, was also considered.

5.1.4 Information Gathered

Table 5-5 shows the information gathered for each institution.

Table 5-5 NTD Information for Case Study

Institution	NYCT	MBTA	MARTA	MDT	PATH (operated by Port Authority of NY and NJ)	HTA
Centroid (UPT/ Population)	0.60613	0.322865	0.154466	0.063253	0.012186	
Modes	Heavy Rail, Paratransit, Bus	Bus, Electric Trolley Buses), Heavy Rail, Light Rail, Streetcars, Commuter Rail, Ferry, Commuter Boat, Paratransit	Bus, Shuttles, Paratransit, Heavy Rail	Bus, Heavy Rail, People Mover, and Paratransit	Heavy Rail (PA operates Port, Airports, Heavy Rail, Tunnels, Terminals)	Express Bus, Heavy Rail
Fare Integration	Fare passes including Rapid Transit and Bus, also with other MTA systems (Long Island Bus and MTA Bus) and with PATH.	Several fare passes with different combinations of the following MBTA modes: Subway, Local Bus, Express Bus and Inner Harbor Ferry, Commuter Boat and Commuter Rail.	Fare integration among MARTA's Bus and Heavy Rail	Fare pass including Bus and Heavy Rail (People mover is free)	Pay-Per-Ride may be discounted from NYCT fare pass.	Fare card can be used among Heavy Rail, Express Bus, and Metropolitan Bus Authority Buses.
Authority Level	MTA master authority and budget to subscribed agencies including NYCT. MTA covers New York City and the counties of Nassau, Suffolk, Westchester, Dutchess, Orange, Rockland, and Putnam.	MBTA covers Boston and 77 other total cities and towns.	MARTA is part of a regional solution to transportation, and is working across the region with transit partners and planning agencies.	Dade County comprises 35 municipalities.	Rail connection between New Jersey and New York, subsidiary organization of the NY NJ Port Authority (interstate agency)	HTA is a public corporation within the Department of Transportation and Public Works umbrella. Its jurisdiction covers the entire "state" (not municipal) transportation system.
Mission	MTA: Providing quality transportation service to support regional mobility and	The MBTA is a dedicated world class transit system built upon customer service	To strengthen communities, advance economic competitiveness, and	Dade County mission: Delivering excellent public services that	PA: To keep the region moving. To identify and meet the critical transportation	DTPW: Drive Puerto Rico towards economic development

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Institution	NYCT	MBTA	MARTA	MDT	PATH (operated by Port Authority of NY and NJ)	HTA
	economic growth.	excellence, accessibility, reliability, state-of-the-art technology, and a diverse workforce that reflects our commitment to the communities we serves.	respect the environment by providing a safe and customer-focused regional transit system.	address our community's needs and enhance our quality of life. Transit Department mission: To meet the needs of the public for the highest-quality transit service: Safe, Reliable, Efficient and Courteous.	infrastructure needs of the bi-state region's businesses, residents, and visitors: providing the highest quality, most efficient transportation and port commerce facilities and services that move people and goods within the region, providing access to the rest of the nation and to the world, while strengthening the economic competitiveness of the New York-New Jersey Metropolitan Region.	through a transportation system that is efficient, safe and in harmony with the environment; procuring a vanguard and excellence service delivery.
Governance	The MTA is governed by a 17-member Board. Members are nominated by the Governor, with four recommended by New York City's mayor and one each by the county executives of Nassau, Suffolk, Westchester, Dutchess, Orange, Rockland, and Putnam counties (the members representing the	Five-member Board of Directors appointed by the Governor with expertise in transportation, finance and engineering to oversee the new Massachusetts Department of Transportation (MassDOT). This Board is the governing body of both MassDOT and the Massachusetts Bay Transportation Authority (MBTA), which will be part of	Board of Directors: MARTA's Board is comprised of 18 members, from City of Atlanta, Fulton, DeKalb, Gwinnett and Clayton counties. They meet regularly to address the latest issues of importance concerning ridership, safety, economics, new technology, government regulations and more.	The Miami-Dade Board of County Commissioners is the governing body of unincorporated Miami-Dade County and has broad, regional powers to establish policies for Miami-Dade County services. The government provides major metropolitan services countywide and city-type services for	Bi-state agency; it reports to the governors of New York and New Jersey, who each appoint six commissioners to the Board. The governor of each state appoints six members of the agency's Board of Commissioners, subject to state senate approval. Commissioners serve as public officials without pay for overlapping six-year terms. The governors retain the right to veto the actions of the Commissioners from his	The Secretary of Transportation and Public Works, appointed by the Governor, is the only member of the PRDTPW and HTA Board of Directors.

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Institution	NYCT	MBTA	MARTA	MDT	PATH (operated by Port Authority of NY and NJ)	HTA
	latter four cast one collective vote).	MassDOT but will retain a separate legal existence. MassDOT is administered by a Secretary of Transportation, appointed by the Governor to serve as Chief Executive Officer.		residents of unincorporated areas.	or her own state. Board meetings are public.	
General Leadership	MTA is headed by a Chairman/Chief Executive Officer. It have a Chief Operating Officer, Chief of Staff, Senior Advisor to Chairman, Deputy Executive Director for Corporate and Community Affairs, Director for Labor Relations, Chief Financial Officer, Auditor General, Chief Diversity Officer, Deputy Executive. Director for General Counsel, Deputy Executive Director for Administration, Deputy Executive Director for Security, Director of Government Affairs, Director for Policy	MassDOT oversees four new divisions: Highway, Mass Transit, Aeronautics and the Registry of Motor Vehicles (RMV), in addition to an Office of Planning and Programming.	N/A	Miami-Dade has a Mayor with the power to veto Commission action items. In January 2007, the Mayor was given additional powers providing for the oversight of the day-to-day operations of Miami-Dade.	An Executive Director, appointed by the Board of Commissioners, is responsible for managing the operation of the Port Authority in a manner consistent with the agency's policies, as established by the Board. There are four main officers under the Executive Director: financial, administrative, operating and capital planning. Under the Chief Operating Officer there are the following divisions/modes: aviation, tunnels/bridges/terminals, rail transit, and port commerce.	There are common divisions of legal affairs, communications & public relations, and strategic planning that are shared among the DTPW and HTA. In general, HTA builds infrastructure and DTPW maintains it. HTA also operates the freeway and heavy rail systems.

IMPACT OF TRANSIT ORGANIZATION IN RIDERSHIP

Institution	NYCT	MBTA	MARTA	MDT	PATH (operated by Port Authority of NY and NJ)	HTA
	and Media Relations, and Director of Special Project Development & Planning .					
Individual Leadership	Each of 7 agencies has its president. Agencies: NYCT, Long Island Rail Road, Long Island Bus, Metro-North Railroad, Bridges and Tunnels, Capital Construction, Bus Company.	A single person occupies the positions of General Manager of the MBTA and the Rail & Transit Administrator of MassDOT to manage the day-to-day operations of the MBTA and MassDOT 's Transit Division.	Executive Management Team: responsible for operations, maintenance, finance and human resources.	Transit Department Director. Other departments (sample): Public Works, Sustainability, Port of Miami, Planning & Zoning, Environmental Resources Management, Aviation, Building Code Compliance, among others.		HTA has an Executive Director, appointed by the Governor and the DTPW Secretary.
Own Transportation Police	MTA Police		Yes	Miami-Dade County Police	Yes, Port Authority Police Force	No. The Transit Order Corp of the DTPW exists to enforce parking regulations.
Agency Enacting Law Date	1968 (1st MTA Board Chair)	1964 (Massachusetts Bay Transportation Authority, having been voted into law in June of that year by the General Court)	1965 (the Metropolitan Atlanta Rapid Transit Authority Act was passed by the state legislature and subsequently approved in four counties and the City of Atlanta, creating	County: 1957 (Metropolitan Dade County Transit: government was officially established in 1960. (The County Commission passed an	Port Authority 1921. PATH 1962	DTPW: 1952. HTA: 1965 (Highway Authority, 1991 amended to Highway and Transportation Authority)

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Institution	NYCT	MBTA	MARTA	MDT	PATH (operated by Port Authority of NY and NJ)	HTA
			MARTA)	ordinance creating the Metropolitan Transit Authority (MTA) to unify the different transit operations into one countywide service. This ordinance provided for the purchase, development, and operation of an adequate mass transit system by the County. These companies included the Miami Transit Company, Miami Beach Railway Company, South Miami Coach Lines, and Keys Transit Company on Key Biscayne and would be managed by National City Management Co.)		
Transportation History at Date of Enacting	On 67, Public Roads Administration, Bureau of Motor Carrier Safety and National Highway Safety Bureau become part of the Federal Highway	On 63, Vietnam war. On 64, Under president Lyndon Johnson, Urban Mass Transportation Act (3-year program).	On 64, Under president Lyndon Johnson, Urban Mass Transportation Act (3-year program).	On 56, Under Dwight David Eisenhower presidency, Federal Aid Highway Act to support National system of Interstate & Highway	On 56, Under Dwight David Eisenhower presidency, Federal Aid Highway Act to support National system of Interstate & Highway Defense, creation of Highway Trust Fund.	On 64, Under president Lyndon Johnson, Urban Mass Transportation Act (3-year program). On 91, Under president

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Institution	NYCT	MBTA	MARTA	MDT	PATH (operated by Port Authority of NY and NJ)	HTA
	Administration; under the Department of Transportation. On 68, Federal Aid Highway Act amended to include a section of Civil Rights within the Office of the Secretary of Transportation. Office of Civil Rights turned into a departmental office on 69.			Defense, creation of Highway Trust Fund.		Bush Sr., Intermodal Surface Transportation Efficiency Act, creation of Federal Transit Administration, and Inter-modalism office at the Bureau of Transportation Statistics.
Main Organization Paradigm as per Literature at Date of Enacting	Recognition of specialization and that its rate of increase is faster than rate of change of organizational culture.	Recognition of specialization and that its rate of increase is faster than rate of change of organizational culture.	Recognition of specialization and that its rate of increase is faster than rate of change of organizational culture.	Organization is a mean to satisfy performance. Its efficiency is tied to its simplicity, short chain of command and manager's training.	Recognition of specialization and that its rate of increase is faster than rate of change of organizational culture.	Recognition of specialization and that its rate of increase is faster than rate of change of organizational culture.

Main observations from information gathered are presented as follows:

- Modes - All institutions from the different cluster representatives manage several modes.
- Fare Integration - All institutions have some level of fare integration.
- The cluster with the major usage have a single fare pass integrating other modes managed by the institution and also another heavy rail managed by other institution (this one is in the smaller usage cluster).
- Authority Level - The three representatives of the clusters with more usage have a master institution that manages several modes at a regional level, covering several counties or several cities.
- The representative of the clusters with mid-level usage has a smaller coverage area in terms of amount of jurisdictions (one county).
- The representative of the clusters with less usage have state or bi state jurisdiction.
- Own Police - The following have their own police force: MTA, MARTA, Miami-Dade County, Port Authority NY/NJ, and DTPW have an order corps to emit parking violation tickets.

5.1.4.1 Institution Age

Table 5-6 presents the enacting year of the institutions and relates it to an historical event related to transportation and the main transportation paradigm as per literature of that time.

As can be noticed, most institutions were created around the 60's. At that time, federal agencies were re-arranging and laws were created to emphasize mass transit. Organization literature of the time emphasized the fact of specialization.

Table 5-6 Institution Age

	Agency Enacting Law Date	Transportation History at Date of Enacting	Organization Paradigm in Literature
MTA	1968 (1st MTA Board Chair)	1967 - Public Roads Administration, Bureau of Motor Carrier Safety and National Highway Safety Bureau become part of the Federal Highway Administration; under the Department of Transportation. 19 68 - Federal Aid Highway Act amended to include a section of Civil Rights within the Office of the Secretary of Transportation. The Office of Civil Rights turned into a departmental office on 1969.	Recognition of specialization and that its rate of increase is faster than rate of change of organizational culture.
MBTA	1964 (Massachusetts Bay Transportation Authority, having been voted into law in June of that year by the General Court)	1963 - Vietnam war 1964 - Enactment of Urban Mass Transportation Act (3-year program) under President Lyndon Johnson,	Recognition of specialization and that its rate of increase is faster than rate of change of organizational culture.
MARTA	1965 (the Metropolitan Atlanta Rapid Transit Authority Act was passed by the state legislature and subsequently approved in four counties and the City of Atlanta, creating MARTA)	1964 - Enactment of Urban Mass Transportation Act (3-year program) under President Lyndon Johnson,	Recognition of specialization and that its rate of increase is faster than rate of change of organizational culture.
Dade	County: 1957 (Metropolitan Dade County Transit: government was officially established in 1960 (The County Commission passed an ordinance creating the Metropolitan Transit Authority (MTA) to unify the different transit operations into one countywide service. This ordinance provided for the purchase, development, and operation of an adequate mass transit system by the County. These companies included the Miami Transit Company, Miami Beach Railway Company, South	1956 - Enactment of Federal Aid Highway Act, under Dwight David Eisenhower presidency, to support the National System of Interstate & Highway Defense, creation of Highway Trust Fund.	Organization is a mean to satisfy performance. Its efficiency is tied to its simplicity, short chain of command and manager's training.

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

	Agency Enacting Law Date	Transportation History at Date of Enacting	Organization Paradigm in Literature
	Miami Coach Lines, and Keys Transit Company on Key Biscayne and would be managed by National City Management Co.)		
PANYNJ	Port Authority 1921. PATH 1962	1956 - Enactment of Federal Aid Highway Act, under Dwight David Eisenhower presidency, to support the National System of Interstate & Highway Defense, creation of Highway Trust Fund.	Recognition of specialization and that its rate of increase is faster than rate of change of organizational culture.
HTA	DTPW: 1952. HTA: 1965 (Highway Authority, 1991 amended to Highway and Transportation Authority)	1964 - Under president Lyndon Johnson, Urban Mass Transportation Act (3-year program). 19 91 - Under president Bush Sr., Intermodal Surface Transportation Efficiency Act, re-purpose of Urban Mass Transportation Administration into the, and Inter-modalism office at the Bureau of Transportation Statistics.	Recognition of specialization and that its rate of increase is faster than rate of change of organizational culture.

5.1.4.2 Mission Statement

Table 5-7 presents 11 key words that are repeated in the mission statement of the institutions.

The most repeated word is “service”, which is found at all mission statements.

The institution with most of those words in their statement is MARTA, which have 8.

The system with more usage, MTA, emphasizes the following: service, economy, quality, region and excellence.

The system centroid of the lesser usage, PANYNJ, emphasizes: service, economy, quality and region. These are the same as MTA, except for “excellence”.

Table 5-7 Mission Statement Key Words

	Mission Key Word	MTA	MBTA	MARTA	Dade	PANYNJ	HTA	Count
1	service	x	x	x	x	x	x	6
2	economic	x		x		x	x	4
3	quality	x			x	x		3
4	regional	x		x		x		3
5	excellence	x		x			x	3
6	community		x	x	x			3
7	safe			x	x		x	3
8	efficient				x		x	2
9	customer		x	x				2
10	reliable		x		x			2
11	environment			x			x	2
	Count	5	4	8	6	4	6	33

5.1.4.3 Governance

Table 5-8 presents the type of governance and its principal members. As can be noticed, all systems, but HTA, are governed by a Board composed of several members.

Not all boards have uneven amount of members. The institutions with more users (MTA, MBTA) have multiple and uneven amount of members in its governing Board. The systems with lesser amount (MARTA, PANYNJ, and HTA) have either even amount of members or a single one.

HTA used to be governed by a board, but since 1971 it is governed by a single person, the Secretary of Transportation, who is appointed by the Governor.

Boards are generally appointed by the Governor.

Table 5-8 Governance

	Board	Board Members	Appointed By	Notes
MTA	Y	17	Governor	Positions recommended by mayor or county executives of service region.
MBTA	Y	5	Governor	MassDOT board governs it and MBTA. MBTA will be part of MassDOT but will retain a separate legal existence.
MARTA	Y	18	---	Members represent service cities and counties.
Dade	Y		---	County governed by board of commissioners.
PANYNJ	Y	12	Governor	Each governor appoints 6 commissioners, subject to state senate approval. Commissioners are public officials without pay for overlapping 6 years. Governor retains veto for acts of his state commissioners.
HTA	N	1	Governor	HTA Board suppressed in 1971, powers given to the Secretary of Transportation who administers DTPW.

5.1.4.4 Leadership Structure

Table 5-9 presents a general idea of leadership and organizational structure of each institution. General observations per institution are pointed out below.

- MTA - Single institution a composed of 7 operational agencies. Agencies comprises different modes covering different areas, and different objectives (operation, construction)
 - New York City Transit
 - Long Island Rail Road
 - Long Island Bus
 - Metro-North Railroad
 - Bridges and Tunnels
 - Capital Construction
 - Bus Company

MTA Organization is composed of the following officers:

- Chairman/Chief Executive Officer, Senior Advisor to Chairman
 - Chief Operating Officer, Chief of Staff, Chief Financial Officer, Chief Diversity Officer
 - Deputy Executive Director for Corporate and Community Affairs, Deputy Executive Director for General Counsel, Deputy Executive Director for Administration, Deputy Executive Director for Security
 - Director for Labor Relations, Director of Government Affairs, Director for Policy and Media Relations, Director of Special Project Development & Planning
 - Auditor General
- MassDOT - Administered by a Secretary of Transportation, appointed by the Governor to serve as Chief Executive Officer. MassDOT Organization is distributed by modes and objectives (e.g. registry, planning):
 - Modes
 - Highway
 - Mass Transit
 - Aeronautics
 - Objectives
 - Registry of Motor Vehicles (RMV)
 - Planning and Programming

The Administrator of MassDOT Mass Transit Division is the General Manager of the MBTA.

- MARTA - It is administered by an Executive Management Team. The organization is distributed by objectives:
 - Operations
 - Maintenance
 - Finance
 - Human Resources

- Miami-Dade County - The Mayor has the power to veto Commission action items. In January 2007, the Mayor was given additional powers providing for the oversight of the day-to-day operations of Miami-Dade. The County organization is mostly by objectives. Some examples of Departments are:
 - Transit
 - Public Works
 - Sustainability
 - Port of Miami
 - Planning & Zoning
 - Environmental Resources Management
 - Aviation
 - Building Code Compliance
 - Others

Each Department has a Director.

- Port Authority of NY and NJ - An Executive Director, appointed by the Board of Commissioners, is responsible for managing the operation of the Port Authority. It has four main Officers under the Executive Director (by objectives):
 - Financial
 - Administrative
 - Operating
 - Capital Planning

Under the Chief Operating Officer there are the following divisions/modes:

- Aviation
 - Tunnels/Bridges/Terminals
 - Rail Transit (PATH)
 - Port Commerce
- HTA - HTA has an Executive Director, appointed by the Governor and the DTPW Secretary. HTA is a public corporation, financed by fares, taxes, loans

and bonds. HTA Board was suppressed in 1971; when those powers were given to the Secretary of Transportation who administers DTPW (a central government agency funded by the general government budget). The HTA organization includes common divisions of legal affairs, communications & public relations, and strategic planning that are shared among the DTPW and HTA. Employees of those divisions are HTA employees. In general, HTA builds infrastructure and DTPW maintains it. HTA also operates the freeway and heavy rail systems. HTA main divisions are:

- Infrastructure
- Traffic and Freeways
- Transportation (transit)
- Finance
- Human Resources

Table 5-9 Leadership

Institution	Principal Leader	Main Divisions	Other Leadership
MTA	Chairman/ Chief Executive Officer	Chief Operating Officer, Chief of Staff, Senior Advisor to Chairman, Deputy Executive Director for Corporate and Community Affairs, Director for Labor Relations, Chief Financial Officer, Auditor General, Chief Diversity Officer, Deputy Executive Director for General Counsel, Deputy Executive Director for Administration, Deputy Executive Director for Security, Director of Government Affairs, Director for Policy and Media Relations, and Director of Special Project Development & Planning	Each of the 7 MTA agencies has its president. Agencies: NYCT, Long Island Rail Road, Long Island Bus, Metro-North Railroad, Bridges and Tunnels, Capital Construction, Bus Company.
MBTA	MassDOT is administered by a Secretary of Transportation, appointed by the Governor to serve as Chief Executive Officer.	MassDOT oversees four new divisions: Highway, Mass Transit, Aeronautics and the Registry of Motor Vehicles (RMV), in addition to an Office of Planning and Programming.	A single person occupies the positions of General Manager of the MBTA and the Rail & Transit Administrator of MassDOT to manage the day-to-day operations of the

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Institution	Principal Leader	Main Divisions	Other Leadership
			MBTA and MassDOT's Transit Division.
MARTA		Operations, Maintenance, Finance, Human Resources	Executive Management Team
Dade	Miami-Dade has a Mayor with the power to veto Commission action items. In January 2007, the Mayor was given additional powers providing for the oversight of the day-to-day operations of Miami-Dade.	Departments (sample): Transit, Public Works, Sustainability, Port of Miami, Planning & Zoning, Environmental Resources Management, Aviation, Building Code Compliance, among others.	Department Directors
PANYNJ	An Executive Director, appointed by the Board of Commissioners, is responsible for managing the operation of the Port Authority in a manner consistent with the agency's policies, as established by the Board.	There are four main officers under the Executive Director: financial, administrative, operating and capital planning.	Under the Chief Operating Officer there are the following divisions/modes: aviation, tunnels/bridges/terminals, rail transit, and port commerce.
HTA	HTA has an Executive Director, appointed by the Governor and the DTPW Secretary.	There are common divisions of legal affairs, communications & public relations, and strategic planning that are shared among the DTPW and HTA. In general, HTA builds infrastructure and DTPW maintains it. HTA also operates the freeway and heavy rail systems. HTA main divisions: Infrastructure, Traffic and Freeways, Transportation, Finance, Human Resources.	Each HTA main division has a Deputy Executive Director.

5.1.5 General Conclusions

It was observed that the cluster with the major usage have a single fare pass integrating other modes managed by the institution and also another heavy rail managed by other institution (this one is in the smaller usage cluster). Hence, the greater usage was found on the institution that integrated its fare, not only with all its modes but with some modes managed by other institution. The study of mode integration deserves further study. It may appear that if an institution finds out that users need other existing services managed by other institutions, the service quality and its usage may be improved with some kind of coordination, fare and/or other integration measures.

The three institutions with the greater usage level are the ones that serve at a regional level (i.e. covering several counties or several cities), while the lesser usage is observed at institutions that serve at state or greater level. Therefore, it can be said that to study the service area level may be worthwhile. While a regional level appear to be beneficial in considering several stages of the user's trips, this ability seems to diminish in greater areas of service.

Other aspect that seems to deserve be further studied is the configuration of the boards governing and taking decisions in the institutions. That is, as it was found that the institutions representing the higher levels of usage have multiple and uneven amount of members in their governing boards. On the other hand, the ones with less usage have either even amount of members or a single one, situation that could make the decision making process a time consuming one (in the case of even members) or bias it (in the case of a single member).

The organizational configuration is the other factor that is recommended to be further investigated. The institutions with the greater levels of usage have operational divisions per modes, however, the rest of the administration is considered as a whole or as a system.

It is also considered important to investigate the mission statement of the institutions. The system with the highest level of usage emphasizes the following key words in their mission statement: service, economy, quality, region and excellence.

Therefore, for the formal survey, questions about the following characteristics will be included: mode integration (how is it considered), jurisdiction of service area (coverage and how it is considered), and configuration of the decision making process related to leadership style, and mission statement.

5.2 Study Cases from other Countries

This second group consisted in one European (Viennese) and one Asian (Singaporean) transportation system. They were selected for their high transit ridership and because they described them as successful and/or obtained institutional distinctions by their peers. Vienna and Singapore hold the 2nd and 3rd highest public transit ridership as per Mobility in Cities database, respectively (UITP, 2007). The first place, Hong Kong, was not included as a case study because it was considered an outlier. Hong Kong provides 49,200 vehicle-kilometers of transit service per hectare while the next top five provides between 3,400 and 11,500 vehicle kilometers of transit per hectare.

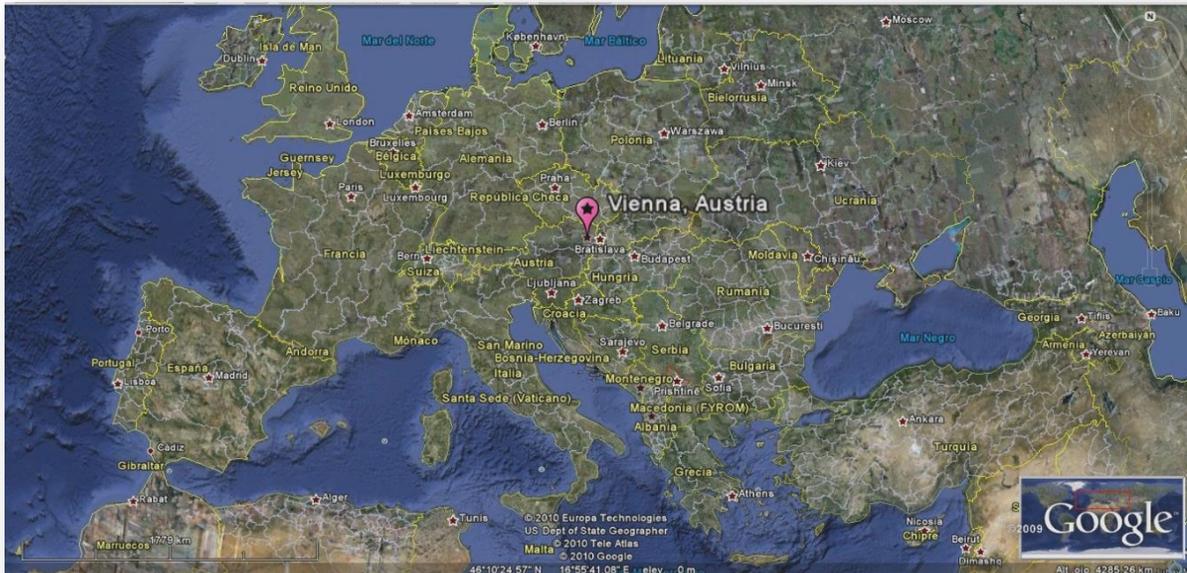
They will also be compared to HTA. A brief description of each site is described below:

- **Vienna** - This system was reviewed as an example of a place where modal split is almost equally divided among non-motorized, transit and auto.
- **Singapore** - This system was reviewed as an example of a place having a transportation institution that sells themselves as a great employer that recruits only the best and do what it takes to retain them.
- **Puerto Rico** - Transportation system of my home island is reviewed to take into consideration a general background on the historical transition of the Puerto Rican transportation system and its related institutions. It will help to understand those transitional changes, under what general conditions they emerged, and the current status of the system which is also described in this segment of the review.

5.2.1 Vienna

Vienna is the capital city and a province of Austria. Its location is shown on Figure 5-3.

Figure 5-3 Location of Vienna

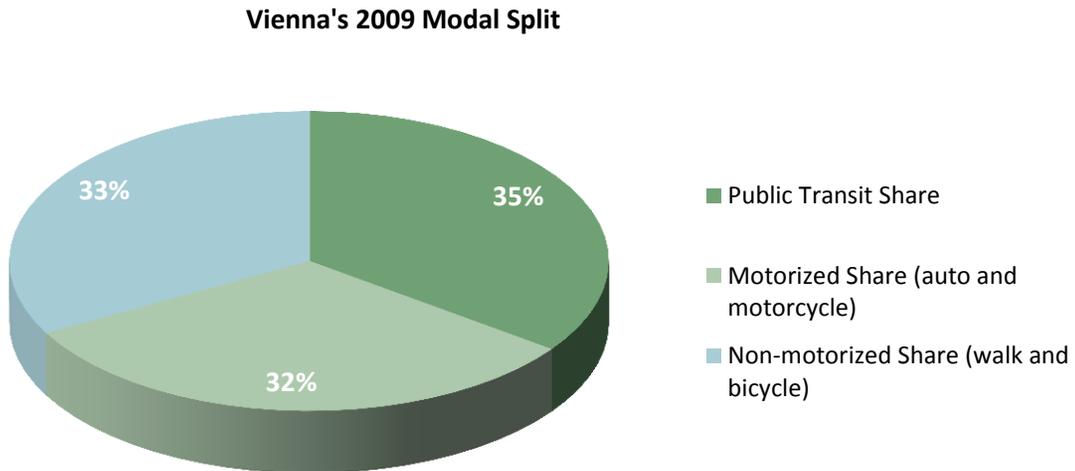


View from Google Earth on 09 Sep. 2010.

Forty eighth percent (48%) of their mechanized trips (non-pedestrian) on an average day are made by public transportation (UITP, 2007). Vienna is also the city with the highest quality of life among the European Union (Wiener Stadtwerke Holding AG, 2008). Their transportation system includes buses, rail and trams, and fare payment is honor-based.

As indicated on the evidence [i.e. (Kossina, 2009), (Vienna City Administration, 2010)], 35% of all types of trips were made using public transit, while only a 33% of them were made by private car and a 32% of them were made through non-motorized modes. These percentages are more noticeable on Figure 5-4.

Figure 5-4 Vienna's Modal Split



Modal share, as well as transit passenger trips and population of Vienna from 2006 to 2009 are exposed on Table 5-10. Interestingly, public transit share remained constant since 2006, while the motorized share lowered and non-motorized share increased. Decrease and increase in the last two mode shares was greater in proportion than the proportion of population growth. Therefore, it can be inferred that transit usage is growing parallel to population while some users appear to be changing from motorized to non-motorized modes.

Table 5-10: Vienna’s Modal Share, Trips and Population History

	2006	2007	2008	2009	2009-2006 Change
Public Transit Share	35%	35%	35%	35%	0.00%
Motorized Share (auto and motorcycle)	34%	32%	33%	32%	-5.88%
Non-motorized Share (walk and bicycle)	31%	33%	32%	33%	6.45%
Transit Passenger Trips	772,100,000	793,000,000	803,600,000	811,800,000	5.14%
Population	1,661,206	1,674,909	1,687,271	1,698,957	2.27%

5.2.1.1 Political System

The first thing observed was the political system in which institutions are set. An overview of Austrian modern political history is presented on Figure 5-5, since its establishment as a Republic in 1918 to its inclusion into the European Union in 1995.

Austria’s constitution is republican-democratic (Stadt Wien, 2010). Therefore, the administration is open to all citizens and the supreme power is vested on the people. But Austria is a representative democracy; therefore, citizens delegate authority in elected representatives. Since 2008, the minimum age to vote is 16 (Compress VerlagsgesmbH & Co KG).

Figure 5-5 Austria's Brief Modern History Highlights



Information from Compress VerlagsgesmbH & Co KG

The Republic of Austria is a federal state consisting of nine federal provinces organized in a federalist structure. This means that the authority is divided among a national (state or federal) and other sub-national (provinces and municipalities) governments. A map of Austria indicating the provinces are shown on Figure 5-6.

Figure 5-6 Map of Austria and Its Provinces



Map from PlanetWare, Inc.

Austria's state administrative organization is one form of decentralization and provision of direct administration. Hence, delegation of tasks, decision-making rights and responsibilities to lower levels in accordance with the relevant legal provisions applies. Therefore, independent administrative bodies perform their designated duties, in compliance with statutory regulations, without being bound to directions from other authorities. Their exclusive competences are protected by constitutional or other legal provisions, however, they are still under federal supervision (may be obliged to report to super-ordinate authorities and to follow directions from these authorities). A scheme of Austria's administrative structure is presented in Figure 5-7. (Stadt Wien, 2010)

Figure 5-7 Austria's Administrative Structure



Figure adapted from Stadt Wien (2010).

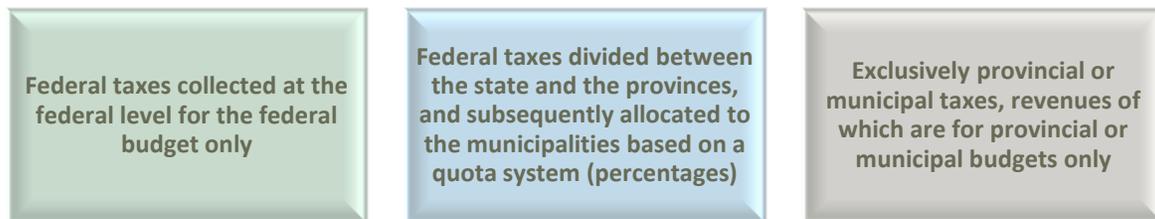
5.2.1.2 Administration

Austria's state administration is based upon monocratic and collegial organization principles. Monocracy (where one person carries out the tasks, takes the decisions and assumes full responsibility) is used in state administration and in some other socio-economic bodies such as enterprises and business. Collegial organizations, where a group of persons is jointly responsible for carrying out tasks and making decisions, are generally found at the level of provincial governments, as well as in some court instances ("senates of judges"). Boards of companies owned by the federal state, the provinces or municipalities are frequently found to be collegial bodies. (Stadt Wien, 2010)

5.2.1.3 Finances

The financial distribution among the federal state, the provinces and the municipalities is stated in The Act Governing Constitutional Rules on Public Finance, issued on the basis of Article 13 of the Federal Constitutional Act. Taxes are classified according to which regional authority (federal state, provinces, and municipalities) is entitled to dispose of tax revenues in its budget. Also, both the federal state and the provinces have the authority to introduce new taxes. Municipalities have the authority to charge certain dues or taxes by decree; as part of the "right to independent resolutions" granted to municipalities by federal or provincial law. The types of financing allocations are summarized on Figure 5-8. (Stadt Wien, 2010)

Figure 5-8: Austria's Financial Allocations



Information from Stadt Wien (2010)

Other important element of Austria's financing structure is their financial equalization. This scheme is used to distributed taxation rights and tax revenues between the federal state, the federal provinces and the municipalities of Austria. Also, the Federal Act on Financial Equalization⁴ has a limited term (four to six years) and is renegotiated between representatives of the federal, provincial and municipal levels. (Stadt Wien, 2010)

⁴ As indicated on Financial Equalization from Statistics Austria 2010: Financial Equalization Act (FAG) – current version: FAG 2008 for the FAG period 2008 to 2013 – regulates authority over the revenue generated by each type of taxes. The Act stipulates specific amounts that are deducted from the total revenue yielded by joined federal taxes before the revenue is disbursed among the individual “financial equalization partners” in accordance with a defined code. Amounts specified in detail in the Act are in turn deducted from the resulting shares for specific purposes. After this procedure the ultimate sums available for disbursement to Federal Government, Länder and Local Governments can finally be determined. A further 12.7% is deducted from Local Governments' shares and is transferred to Länder for granting payments for special requirements to Local Governments and Local Authorities. With its special status as Land and Local Government the federal capital Vienna is shown separately in all tables. In addition to the disbursement of revenue generated by taxes, the Financial Equalization Act deals with transfers (non-reimbursed cash benefits) that are made in accordance with legal stipulations at federal or land level and that serve to enable the receiving authority to fulfill its obligations. These transfers include:

- Compensation of the salaries and wages of teachers employed by Land (current benefits and pensions including care allowances)
- Subsidies and grants for specific purposes from Federal Government to Länder and Local Governments
- Subsidies and grants for specific purposes from Länder to Local Governments and Local Authorities
- Special fees (“Landesumlage“, special fees of social assistance and educational Local Authorities)

In general terms, financial equalization seeks to “equalize” citizen’s fiscal residuum (taxes minus benefits) among its equals (i.e. similar employment type or level of income) regardless its location within the federal state.

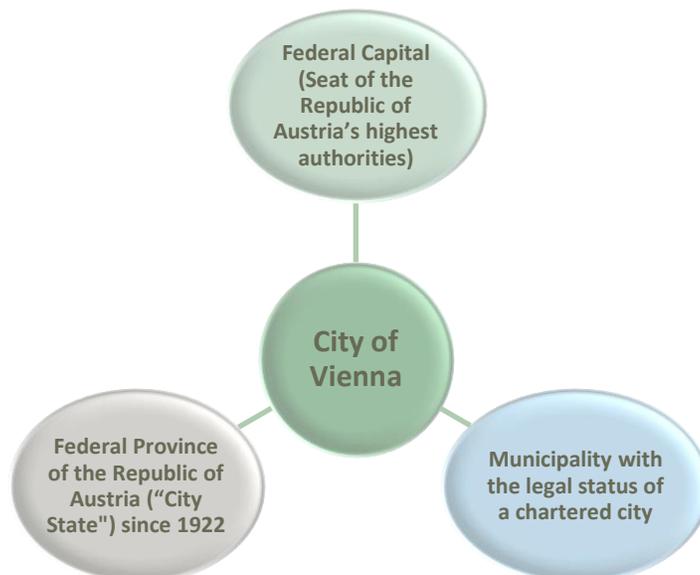
In order to ensure the uniform structure and classification of the budget and final balance in all regional authorities, the federal state also decreed a Budget and Final Balance Ordinance applicable to all provinces and municipalities. (Stadt Wien, 2010)

5.2.1.4 City of Vienna

Vienna has a special position within Austria. As can be appreciated in Figure 5-9, it is the federal capital, a province and charter city municipality. As the federal capital of Austria, Vienna is the seat of its highest authorities, and the economic and political center of Austria.

Vienna is also one of the nine autonomous federal provinces of Austria, since 1922. Therefore, it has its own legislation and provincial executive body (the 100-member Vienna Provincial Parliament) and can designate 11 representatives for the Federal Assembly.

Figure 5-9 Roles of Vienna



5.2.1.5 Transportation in Austria

The Austrian federal constitution does not include a list of public services, transportation included, to be granted or provided. The constitution, however, allows the Federal State to enact regulations pertaining to road and rail passenger transport. (Loser, 2009)

The laws ruling transportation in Austria are shown in Figure 5-10.

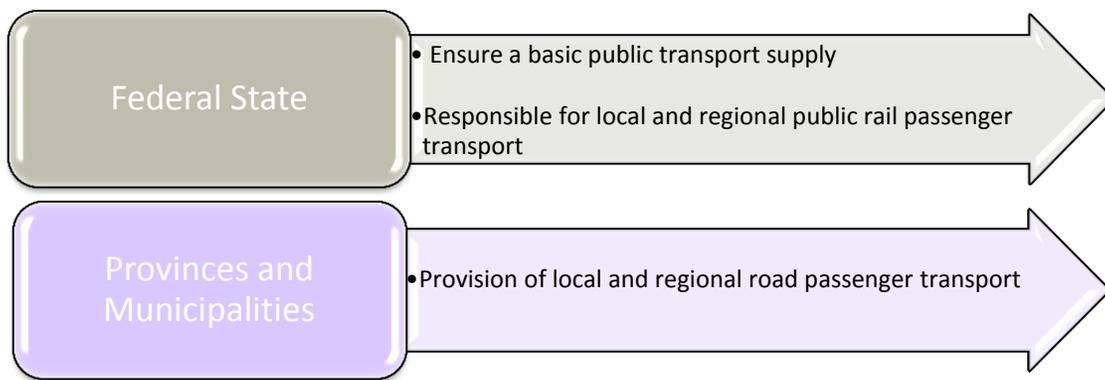
Figure 5-10 Laws Ruling Transportation in Austria



Information from Loser (2009)

Basic responsibilities regarding transportation for corporate bodies, as indicated in the federal Local and Regional Transport Act, are shown on Figure 5-11.

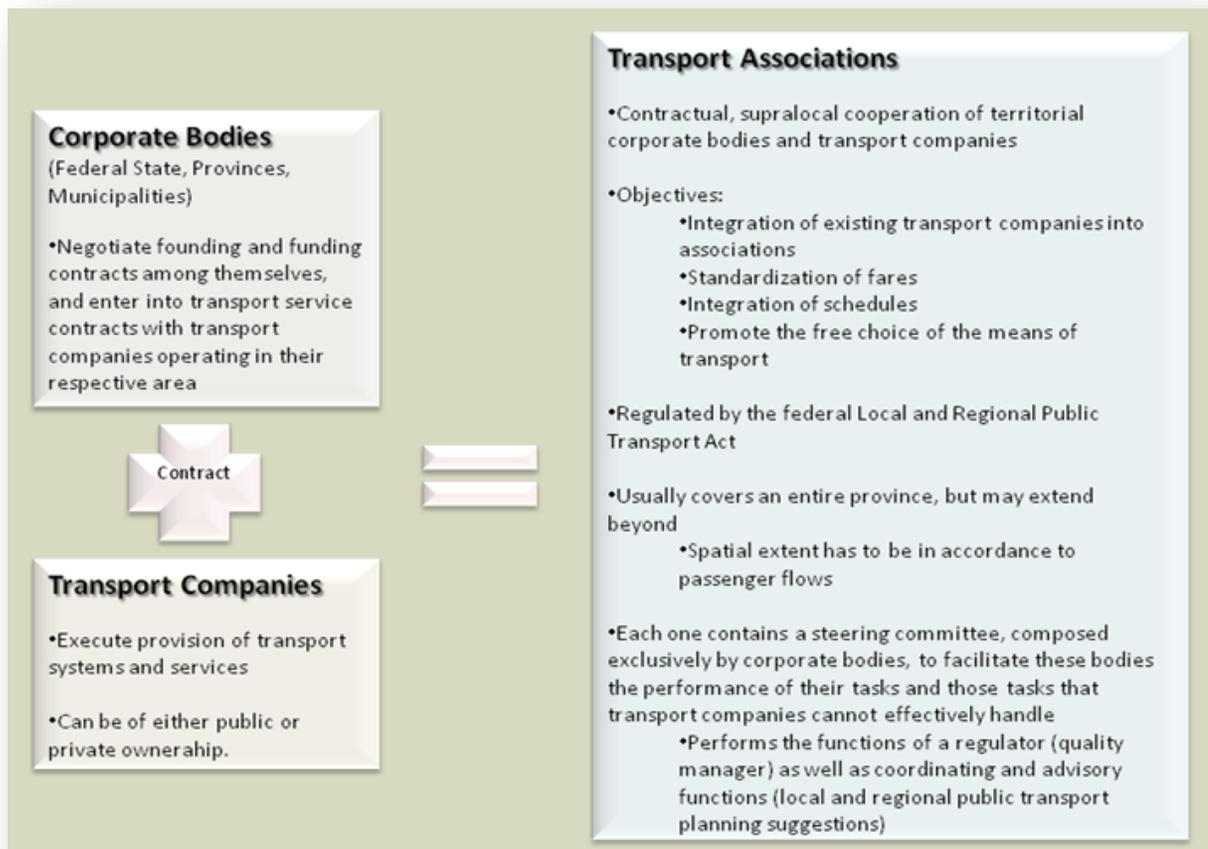
Figure 5-11 Austria’s Transportation Responsibilities by Corporate Body



Information from Loser (2009)

Loser (2009) indicates that the Austrian local and regional public transport is organized along the German model of the Hamburger Verkehrsverbund founded in 1965 (which was advertised by the slogan “Only one single ticket and timetable for the whole of Hamburg!”) To do so, local and regional public transport in Austria is organized nationwide into transport associations and that the federal Local and Regional Public Transport Act envisions cooperation between the transport companies within a particular transport association. The scheme of transport associations is presented in Figure 5-12.

Figure 5-12 Austria’s Transport Associations Scheme



Information from Loser (2009)

5.2.1.5.1 Transportation Financing

Loser (2009) indicates that local and regional public transport services are financed by fare revenues. A steering committee is usually responsible for the calculation of the income and its allocation to the transport companies within the respective transport association. However, fare revenues cover only 33% of total costs of local and regional public transport. The rest of the cost is covered by the territorial corporate bodies.

Loser (2009) indicates that the Federal State apportions a grant amount plus a percentage of the net yield of certain taxes to Municipalities for the promotion of local and regional public transport through capital investment. Around half of this grant is allocated to the Municipality of Vienna. The rest is distributed among Vienna and other Municipalities operating bus, trolley or tram, based on the ratio between the length of the lines and the number of passengers carried. The grant only is around 16 million euro yearly.

Loser (2009) also indicates that it is specified the portion to be used for stationary facilities located at the intersection of public transport routes (bus terminals). The rest is allocated to the provincial capitals with more than 100,000 inhabitants for the promotion of investments in trolley bus and tram lines. Also, the Federal State may make additional money available for public transportation expansion. This assignment could cover up to 50% of costs, with the condition that the local government will cover the rest. This amount is around 11 million euro yearly.

5.2.1.6 Vienna's Transportation

The Vienna Public Utilities encompasses the public services of energy, transportation and funeral services. It was founded in 1949 and was operated by the City Administration until June 1999, when it was privatized. Since then, it is a holding company with the following subsidiaries:

- Holding company: BMG WIENER STADTWERKE Beteiligungs GmbH (Vienna Public Utilities Participation Management Ltd.)

- Energy: WIEN ENERGIE GmbH
- Transportation: WIENER LINIEN GmbH & Co KG (Vienna Public Transport Ltd. and Co.)
- Funerary: BESTATTUNG WIEN GmbH (Vienna Funeral Services Ltd.)

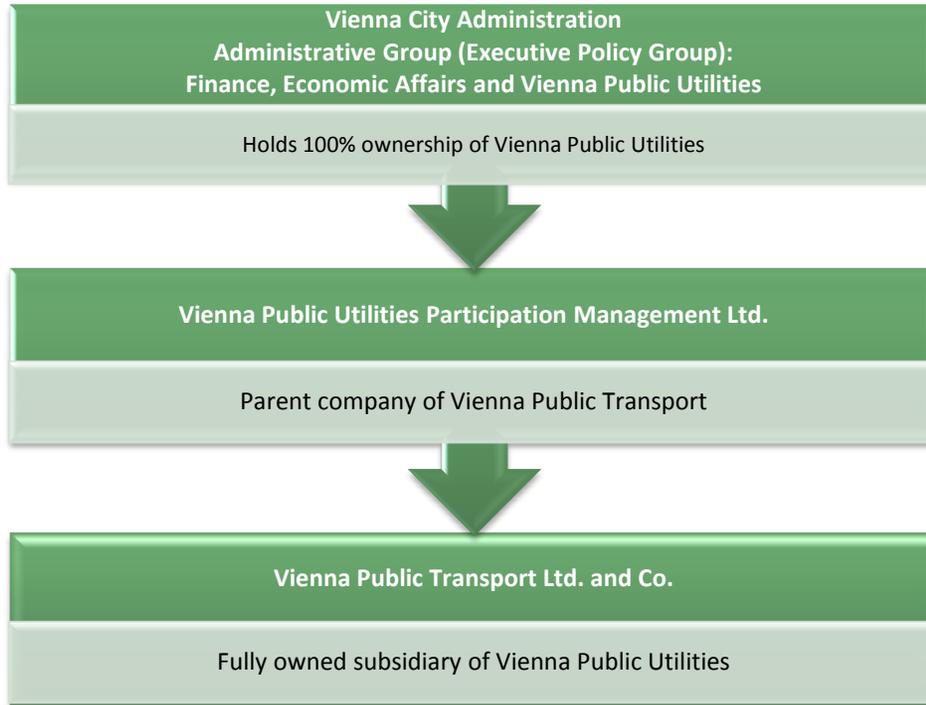
The City of Vienna holds 100 percent ownership of the Vienna Public Utilities via the Wiener Stadtwerke Holding PLC.

As indicated on the WIENER STADTWERKE 2008 Annual Report, they are one of the largest employers in the region and a key motor for regional economy. They also describe themselves as that they ensure the reliable provision of essential services in the Vienna Metropolitan Area. They also point out that:

- Their role is to ensure the collective well-being of the city and that in doing so, they see themselves as a partner to Vienna's population and economy in every area of daily life.
- They emphasize their interest in sustainability, focusing attention not just on commercial targets but also on ecological and social ones.

As per Kossiona (2009), WIENER STADTWERKE operates under direct commission contract with the owner, the City of Vienna. Related to transportation, the contract encompasses an integrated system including metro, tram and bus. Productivity parameters are established, including volume, quantity and quality of service. Their contract was for a period of ten years with a renewal option for eight additional years.

Figure 5-13 Vienna’s Institutional Hierarchy Related to Transportation



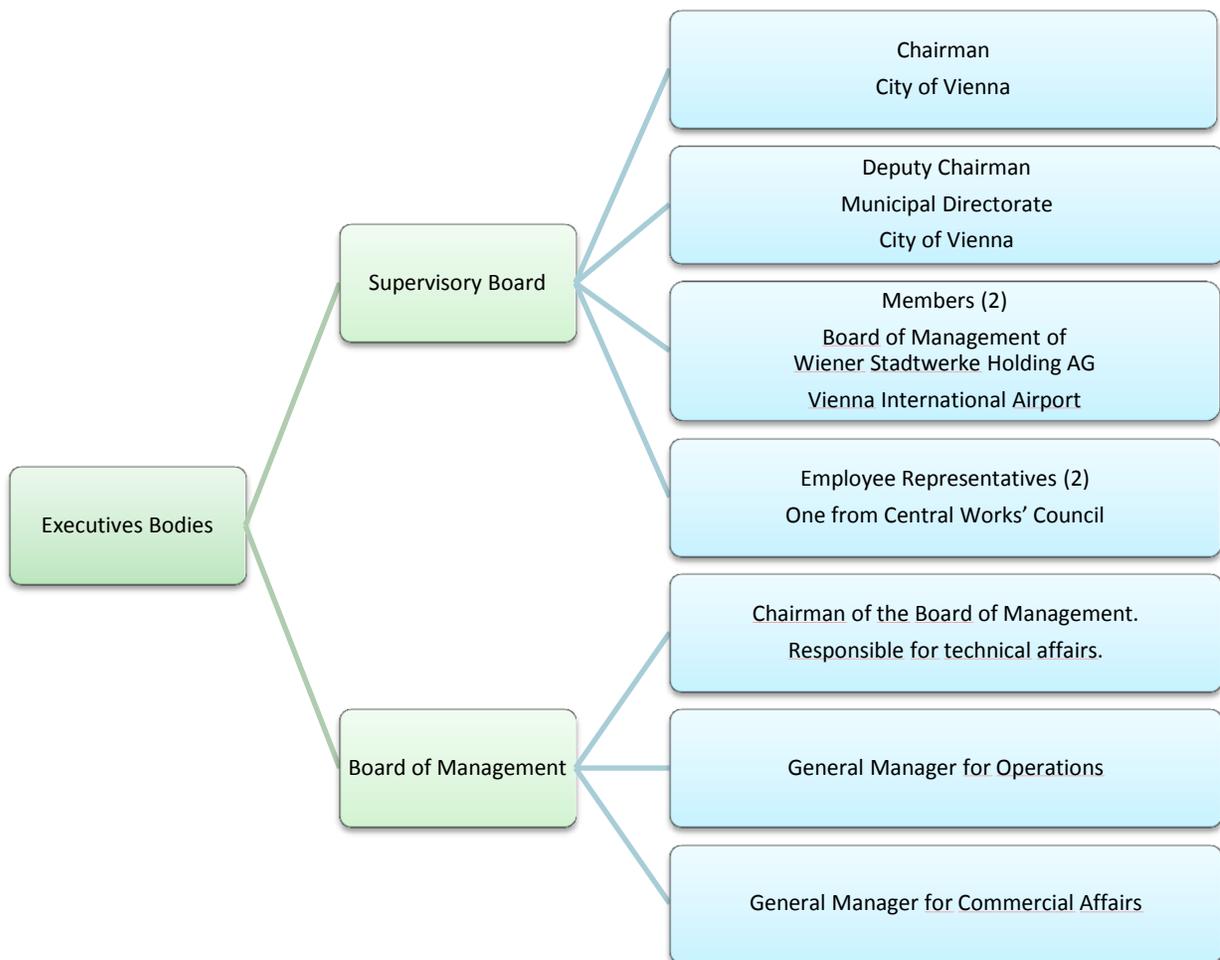
The Wiener Linien Annual Report 2009 (Wiener Linien, 2010) indicates that “the European Union Directive 1370/2007 on public rail and road transport services prescribes the mandatory conclusion of public sector service agreements in as far as these entail the receipt of compensatory payments from a competent public authority or exclusive rights for the performance of communal obligations. Such public sector service agreements may be awarded directly to an internal operator, such as Wiener Linien GmbH & Co KG (Vienna Public Transport) as is for the City of Vienna, subject to certain preconditions. In the period after the directive came into effect, Wiener Linien GmbH & Co KG continued as an internal provider, guarantying the high level of quality of public transport services in Vienna in accordance with the above directive.”

As indicated on Research Results Digest 71 (Transit Cooperative Research Program, 2005), “Wiener Linien is 60% subsidized by the city, the Eastern Austrian regional government, and

Austria’s federal government, being the city who provides half of that subsidy.” In addition, the revenue from a monthly tax of 1 euro per month per employee that is collected from Viennese employers is assigned to Wiener Linien.

As indicating by Payr (2010), “the Local Public Transportation and Financing Agreement (ÖPNV-Vertrag) between the City of Vienna and Wiener Linien has a provision for a public transportation subsidy of around 295 million euro per year. This is supplemented by annual revenues from ticket sales of approx. 420 million euro. In addition, an amount of 125.5 million euro is made available by the City of Vienna for the purposes of financing investments in existing infrastructure.”

Figure 5-14 Wiener Linien Executive Bodies



5.2.1.6.1 Policies

The Wiener Linien Annual Report 2009 reflects several interesting policies. As can be noticed on the following quotes, some of those policies are compatible with the new transportation paradigm mentioned on the literature review. Please note the emphasized italic text.

“Wiener Linien is a service provider, meaning that we have to offer our customers the best possible service, just like any other service company. Without this, long-term success is quite impossible. We never forget why we are here: to serve the people of Vienna.”

“Constant dialogue with passengers is a key aspect. Wiener Linien carries out customer surveys on a continual basis, to find out how satisfied passengers are with public transport and to identify potential room for improvement. In addition to this, so-called mystery shoppers test the service quality of the customer service centers, information points and booking offices using a comprehensive catalogue of assessment criteria.”

“Furthermore, in order to bring it even closer to its customers, Wiener Linien set up the Passenger Advisory Board in 2004. This is considered to be the unofficial representative for passengers. The 16 board members press their ears to the ground in the city and pass on any wishes or requests made by the people of Vienna to the company.”

“Austria’s capital city is leading the way on the international stage with its efforts to introduce a comprehensive mobility concept. Firstly, this is due to the fact that Wiener Linien endeavors to optimize the way in which different transport systems interact with each other. Secondly, the principle of mobility for everyone is taken seriously and consistently implemented.”

“*Mobility for everyone*’ is a key principle at Wiener Linien. Mobility must not be allowed to become a discussion on social equality. Tariffs are devised in such a way as to remain affordable for everyone in society – even for those with a lower income.”

“For Wiener Linien, mobility means taking the people of Vienna to their destination in a quick, comfortable and environmentally friendly way. Ensuring that every mode of transport is optimally lined plays an important role in achieving this target.”

“The idea is to link different transport systems with each other as efficiently as possible as part of a long-term master plan.”

In addition, as indicated by Research Results Digest 71 (Transit Cooperative Research Program, 2005), Transport Master Plan 2003/2008 and the Urban Development Plan have the goal is to meet the following defined transport targets (among others) on all days in Vienna by 2020:

- Increasing the proportion of public transport use to 40 percent
- Reducing the proportion of individual motorized traffic to 25 percent
- Increasing the use of bicycles to eight percent

They also have interesting policies regarding employees. Some of the quotes are presented below, with employee related information marked on italic:

“Wiener Linien is well aware of its responsibilities – to the environment and, above all, to people. *This is especially true for its own employees.*”

“Wiener Linien is also one of the largest employers in the Greater Vienna metropolitan area, with more than 8,000 employees. They are the ones who are on the front line. They are the ones who have contact with passengers on a daily basis and have to implement the service philosophy of Wiener Linien. *This can only be achieved if the team is well motivated and highly trained.*”

“Wiener Linien has been an *avid believer in the concept of systematic personal development* for many years. A whole host of measures targeted at groups and individuals alike are in place to promote the personal development of employees, ensuring that their skills continue to be enhanced and developed. The *company considers such activities as being critical to safeguarding its competitiveness, meaning that it is one of the most important investments the company can make in its own future.*”

In addition to courses for operational managers, which have been running successfully for a number of years now, the focus has also been on developing employees’ skills and awareness in the areas of customer orientation, employee protection and healthcare. Finally, the company’s training and further education department also offers a wide range of specialized courses and seminars to improve and develop employees’ social skills.”

“*Fresh faces mean fresh ideas*, which is why Wiener Linien once again took on ten *clerical trainees* and 50 *technical apprentices* (10 of whom were female) in September 2009... A total of 207 *trainees and apprentices* were trained by Wiener Linien in the previous year, with 26 of these being female.”

Similarly, the Research Results Digest 71 (Transit Cooperative Research Program, 2005) indicates: “*Wiener Linien recruits from the pool of skilled workers who have obtained basic technical educations from vocational high schools and trains them in specialized courses. Also, it sends employees to train with the private companies that provide vehicles and equipment to the transit system. It is also making a push to train employees in multiple job assignments.*”

In addition, keeping the service competitive seems to be another successful effort made by Wiener Linien. The following quotes from their Annual Report 2009 are from employees who are also transit users.

“I am usually *quicker on public transport than I am in a car*, particularly when I think about how much time I save not being stuck in traffic jam or hunting for parking spaces.

“*Wiener Linien services are also very well coordinated*. This means that connections between the individual lines are so well timed that there is enough time to connect without any stress, even with a buggy. You just can’t go wrong with public transport.”

“A key service which is performed is the *maintenance of ticketing machines* located in underground stations. Carrying out *regular inspections and servicing work* on ticket machines plays a key role in ensuring that no problems are encountered when buying a ticket – keeping customers happy.”

“I am often asked about what Wiener Linien is doing on this issue. It is a difficult situation as places inevitably get dirty when many people pass through them. This is why we set up the so-called *mobile cleaning service*.”

“By building Park & Ride facilities in step with the expansion of the underground, the situation has considerably improved for commuters, particularly those living in the outer districts of the city.”

“Vienna is the only city in Europe where people make more journeys on public transport than by car.”

“Where the underground or tram lines cannot go, this is where Wiener Linien buses come into play.”

Highlights from Vienna are presented on Table 5-11.

Table 5-11 Vienna Transportation Highlights

Country	Austria
Institution Name	Wiener Linien
Table Data Source	Wiener Linien - Annual Report 2009. StaDt Wien ((2010) Vienna in Figures 2009.
Data Date	2007-2008
Legislative Environment	On 3.12.2007, EU Directive 1370/2007 on public rail and road transport services was published. Following a transitional period of two years, this directive came into effect on 3.12.2009. This directive prescribes the mandatory conclusion of public sector service agreements in as far as these entail the receipt of compensatory payments from a competent public authority or exclusive rights for the performance of communal obligations. Such public sector service agreements may be awarded directly to an internal operator, such as Wiener Linien GmbH & Co KG is for the City of Vienna, subject to certain preconditions. Wiener Linien GmbH & Co KG had already introduced the measures necessary to the handle the changed situation once the directive came into effect. Consequently, in the period after 3.12.2009, Wiener Linien GmbH & Co KG has continued, as an internal provider, to guarantee the high level of quality of public transport services in Vienna, and do so in accordance with the above directive.
Institution Type	<p>Wiener Linien GmbH & Co KG is a wholly owned subsidiary of Wiener Stadtwerke, itself owned by the City of Vienna, and is responsible for the provision of public transportation services within the city.</p> <p>Following a decision of the Vienna City Council in June 1999, the Vienna Public Utilities, which up until then had been operated by the City Administration, were converted into corporations independent of the City Administration. The Vienna Public Utilities are now run as a holding company with the following subsidiaries in particular: WIEN ENERGIE GmbH WIENER LINIEN GmbH & Co KG (Vienna Public Transport Ltd. and Co.) BESTATTUNG WIEN GmbH (Vienna Funeral Services Ltd.) BMG WIENER STADTWERKE Beteiligungs GmbH (Vienna Public Utilities Participation Management Ltd.)</p> <p>The City of Vienna continues to hold 100 percent ownership of the Vienna Public Utilities via the Wiener Stadtwerke Holding PLC.</p>

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Country	Austria																				
Board Members	<p>Supervisory Board*) Supervisory Board of Wiener Linien GmbH Chairman - Josef Kramhöller, City of Vienna Deputy Chairman - Peter Pollak, Municipal Directorate, City of Vienna Members - Gabriele Domschitz, Member of the Board of Management of Wiener Stadtwerke Holding AG Gerhard Schmid, Vienna International Airport Employee representatives - Johann Thier Michael Bauer, Central Works' Council</p> <p>General Management General Manager - Günter Steinbauer, Chairman General Manager - Michael Lichtenegger General Manager - Walter Andrie</p> <p>Vienna, 18 February 2010</p>																				
Responsibilities	<p>Wiener Linien is the leading universal provider of local public transportation in and for Vienna, and acts as a direct point of contact for the City of Vienna in all local public transportation (ÖPNV) matters. In addition to the operation of underground, tram and bus lines, Wiener Linien undertakes all tasks associated with traffic management such as the planning of operating times and intervals, route and stop planning for all transport carriers as well as marketing, sales and public transport controlling. Furthermore, Wiener Linien is also responsible for the operation of the necessary infrastructure and the vehicle fleet in addition to the maintenance of the same.</p>																				
Subsidiaries	<p>WIEN ENERGIE GmbH WIENER LINIEN GmbH & Co KG (Vienna Public Transport Ltd. and Co.) BESTATTUNG WIEN GmbH (Vienna Funeral Services Ltd.) BMG WIENER STADTWERKE Beteiligungs GmbH (Vienna Public Utilities Participation Management Ltd.) The City of Vienna continues to hold 100 percent ownership of the Vienna Public Utilities via the Wiener Stadtwerke Holding PLC.</p>																				
Region	<p>City of Vienna Total area 41,489 ha</p> <table border="1"> <thead> <tr> <th colspan="4">Population - Status, development</th> </tr> <tr> <th></th> <th>2007</th> <th>2008^p</th> <th>2007/08 in %</th> </tr> </thead> <tbody> <tr> <td>Residents</td> <td>1,677,867</td> <td>1,680,266</td> <td>+0.1</td> </tr> <tr> <td>Female</td> <td>876,091</td> <td>877,146</td> <td>+0.1</td> </tr> <tr> <td>Male</td> <td>801,776</td> <td>803,120</td> <td>+0.2</td> </tr> </tbody> </table>	Population - Status, development					2007	2008 ^p	2007/08 in %	Residents	1,677,867	1,680,266	+0.1	Female	876,091	877,146	+0.1	Male	801,776	803,120	+0.2
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Goals	<p>Wiener Linien ensures that the population of Vienna is able to arrive at their destinations reliably, safely, comfortably and affordably. Optimum mobility means optimum quality of life.</p> <p>It is the responsibility of Wiener Linien to meet the mobility needs of the city of Vienna to the best of its ability. The key here is providing an efficient and attractive public transport service for higher quality of life in Vienna. However, this is too abstract for Tamara: “That goes without saying. Why do we have public transport if not for the people of Vienna?” she says with conviction. “In reality, we only have one goal – to ensure the satisfaction of our passengers.” A lot is being done to achieve this. “Wiener Linien carries out customer surveys on a regular basis, both on the high street and on the Internet, so that we can find out what our customers want. We have a passenger advisory board which helps us to understand and find out exactly what people expect of us. We then take this information and incorporate it into our range of services.”</p>																																																												
Objectives	<p>The primary objective was and remains to maintain and further expand an integrated public transport system for Vienna which functions excellently. (These responsibilities enable the Company) to provide an integrated network of public transport services in Vienna, with particular attention paid to the achieving the highest possible levels of efficiency and tapping potential synergies. At the same time, the aim is to offer excellent value for money while also maintaining and improving quality for passengers.</p>																																																												
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IMPACT OF TRANSIT ORGANIZATION IN RIDERSHIP

Country	Austria												
Ridership	<p>Passenger growth in millions</p>  <table border="1"> <thead> <tr> <th>Year</th> <th>Passenger Growth (in millions)</th> </tr> </thead> <tbody> <tr> <td>2005</td> <td>747</td> </tr> <tr> <td>2006</td> <td>772</td> </tr> <tr> <td>2007</td> <td>793</td> </tr> <tr> <td>2008</td> <td>804</td> </tr> <tr> <td>2009</td> <td>812</td> </tr> </tbody> </table> <p>Wiener Linien has overtaken private motorized vehicles as the preferred method of transport. 35% of all journeys in the Austrian capital are now made on public transport compared to just 32% by car. In 2009, around 812 million passengers travelled on the 116 underground, tram and bus lines. In this way, not only does Wiener Linien safeguard the flow of traffic in and around Vienna and provide a comprehensive logistical framework for economic activity, but it also helps to protect the environment and improve quality of life in, and the attractiveness of, Vienna considerably.</p>	Year	Passenger Growth (in millions)	2005	747	2006	772	2007	793	2008	804	2009	812
Year	Passenger Growth (in millions)												
2005	747												
2006	772												
2007	793												
2008	804												
2009	812												

5.2.2 Singapore

Singapore is a city-state island. Its location is presented in Figure 5-15.

Figure 5-15 Location of Singapore



Map from © 2011 GMS, MapIT, Tele Atlas, Google

Around 60% of the morning peak trips are made by transit in Singapore (Land Transport Authority, 2009). This makes Singapore an interesting case for examining its success on achieving such great transit share. The following sections describe the background where transportation is placed and then some characteristics of the transit institutions are summarized.

Singapore's historical modal split is presented on Table 5-12. Note that public transit has a higher share than cars.

Table 5-12 Singapore’s Historical Mode Split

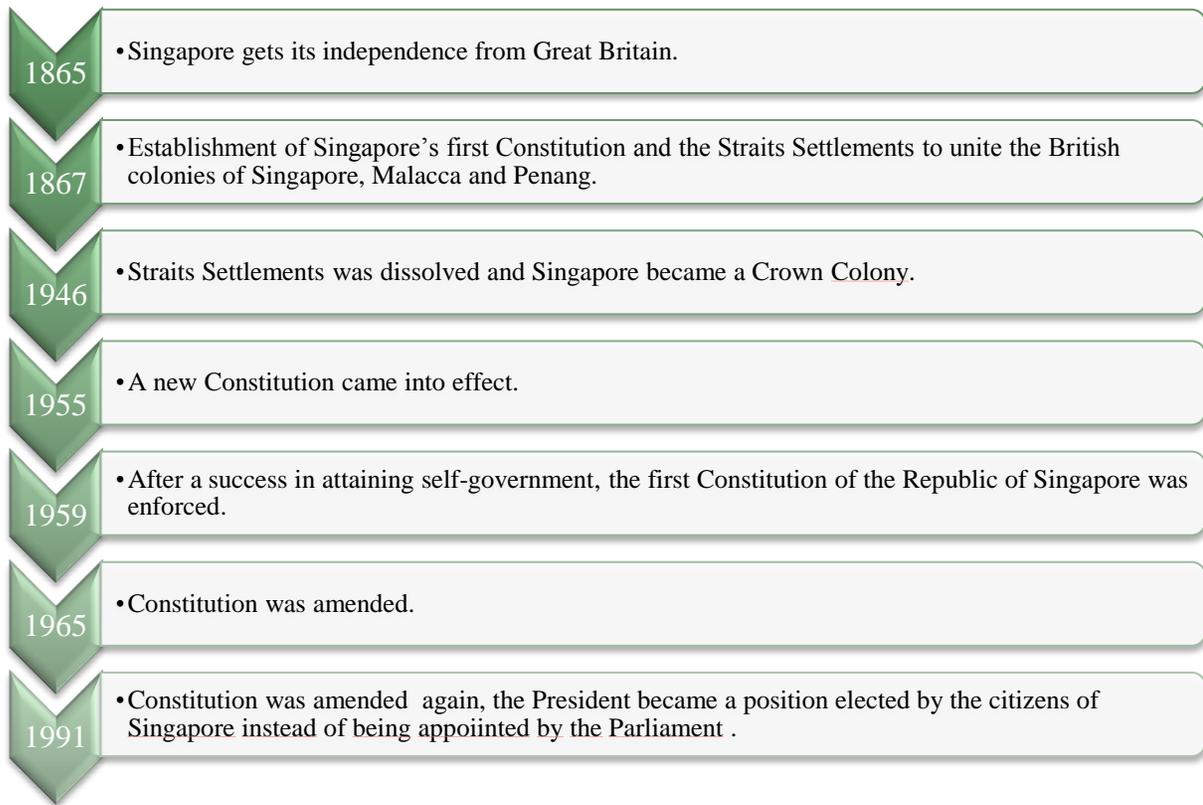
Singapore Modal Split of Journeys to Work (1980-1995)				
	1980 Census	1982 Household Expenditure Survey	1990 Census	1995 General Household Survey
Private Motorized				
Cars	13.7%	16.5%	16.1%	20.2%
Motorcycles	5.4%	5.8%	4.9%	4.9%
Public Motorized				
Bus	56.0%	53.7%	47.5%	38.7%
Mass Rapid Transit	---	---	10.4%	14.5%
Taxi	0.8%	0.8%	0.8%	1.1%
Other Motorized	4.6%	6.8%	7.5%	7.8%
Non-Motorized				
Bicycle	2.1%	1.9%	small and included in Other Motorized	
Walking	17.4%	14.5%	12.8%	12.8%
Total	100.0%	100.0%	100.0%	100.0%

Table from Willoughby (2000)

5.2.2.1 Government

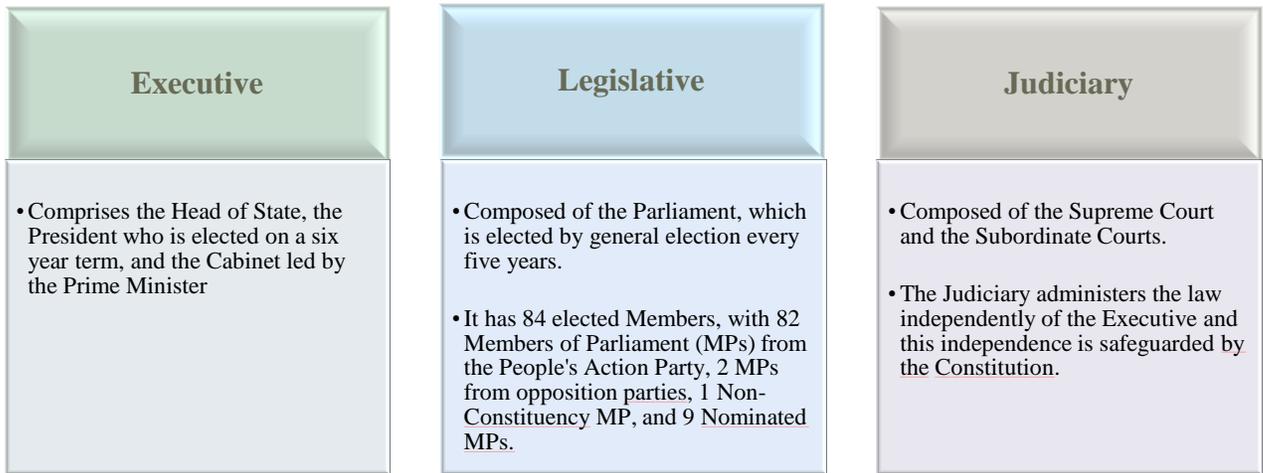
Singapore is a republic with a parliamentary government (Ministry of Information, Communications and the Arts, 2012). The city-state and former British colony adopted the Westminster Model after it gained independence on 9 August 1965. Some key historical facts are shown on Figure 5-16.

Figure 5-16 Singapore's Brief History Highlights



Singapore has only one level of government: national government and local government are the same (Asia-Pacific Economic Cooperation Secretariat, 2003), as per its city-state status. Government's power division is described on Figure 5-17.

Figure 5-17 Singapore Government Powers



Information from Library of Congress - Federal Research Division (2006)

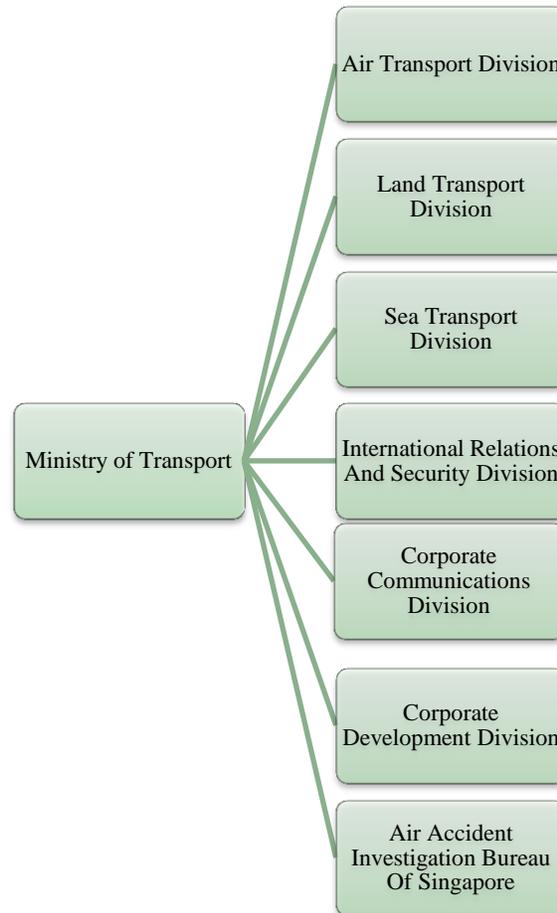
5.2.2.2 Transportation

There are three main institutions related to transit:

- The Ministry of Transport - Part of the executive power, in charge of establishing policies and oversee the related transportation statutory boards.
- Land Transport Authority - Statutory board created by Parliament and supervised by the Ministry of Transport. It is in charge of operating transit systems.
- Public Transport Council - It is an independent body created by Parliament that regulates bus services, bus service operators, ticket payment services, and bus and rapid transit system fares.

The structure division of the Ministry of Transport is presented on Figure 5-18. As can be observed, the divisions include separation by air, land and sea.

Figure 5-18 Singapore Ministry of Transport Division Chart



Information from Ministry of Transport (2010)

The Ministry sets the strategic and policy directions while the operations and regulatory tasks are carried out by the statutory boards under MOT's charge (Ministry of Information, Communications and the Arts , 2010). These are the Civil Aviation Authority of Singapore (CAAS), the Land Transport Authority (LTA), the Maritime and Port Authority of Singapore (MPA), and the Public Transport Council (PTC). The Ministry also oversees the operations of the Air Accident Investigation Bureau of Singapore (AAIB).

LTA is a Statutory Board under the Ministry of Transport (Land Transport Authority, 2011). It plans the long-term transport needs of Singapore, taking care of those who drive as well as those who take public transport. LTA has twelve groups supporting our core functions:

- Corporate Communications
- Corporate Services
- Engineering
- Innovation & Info. Comm. Technology
- Policy & Planning
- Rail
- Road Projects
- Road Operations & Community Partnership
- Safety & Contracts
- Vehicle & Transit Licensing
- Transportation & Ticketing Technology
- Corporate Planning and Research

The Public Transport Council was established in August 1987. As indicated on the Ministry of Transport website, the Council works closely with players in the public transport industry and in partnership with other public agencies including the Land Transport Authority (LTA), to bring about quality basic bus services and an affordable public transport system.

5.2.2.3 Finance

Singapore does not have competition laws (Asia-Pacific Economic Cooperation Secretariat, 2003). However, the Government started to corporatize and privatize some of their services as a mean to provide competition.

As indicated on the Ministry of Transport website (Ministry of Transport, 2010),

...a sound financing framework is necessary to ensure prudent use of government funds (for expanding rail lines) ... guiding principles for the framework are:

- *Financial sustainability* - The operator is able to recover its operating costs and make provision for asset replacement from the services rendered without the need for operating subsidies from the government
- *Affordability* - Fares need to remain affordable to commuters in general. As we expand the rail network, future lines will be more expensive to build, operate and maintain as most of them will be underground.

5.2.2.4 Policies

Singapore's transport policies are also compatible with the new paradigm mentioned on the Literature Review, that is, to provide the service that the public need. Given their land constraints, they understand that future travel demand will need to be met by public transit. In order to achieve that, they indicate that they need to make public transport a choice mode. Their goal is to have a 70 percent transit split by 2020 (it was 59 percent at 2010). The measures they are taking to achieve their goal include improving waiting and trip time, as well as integration. Other goals includes to provide *seamless and convenient transfers***Error! Bookmark not defined.**, *easily accessible services***Error! Bookmark not defined.**, *reliable and comfortable travel journey, competitive journey time relative to cars, affordable fares, having at least 85 percent of commuters to complete their door-to-door journey within 60 minutes during the morning peak hours (at 2010 it was 66 percent), among others.* (Land Transport, Ministry of Transport, 2010)

The Ministry of Transport core values are presented on Figure 5-19.

Figure 5-19 Singapore's Ministry of Transport Core Values

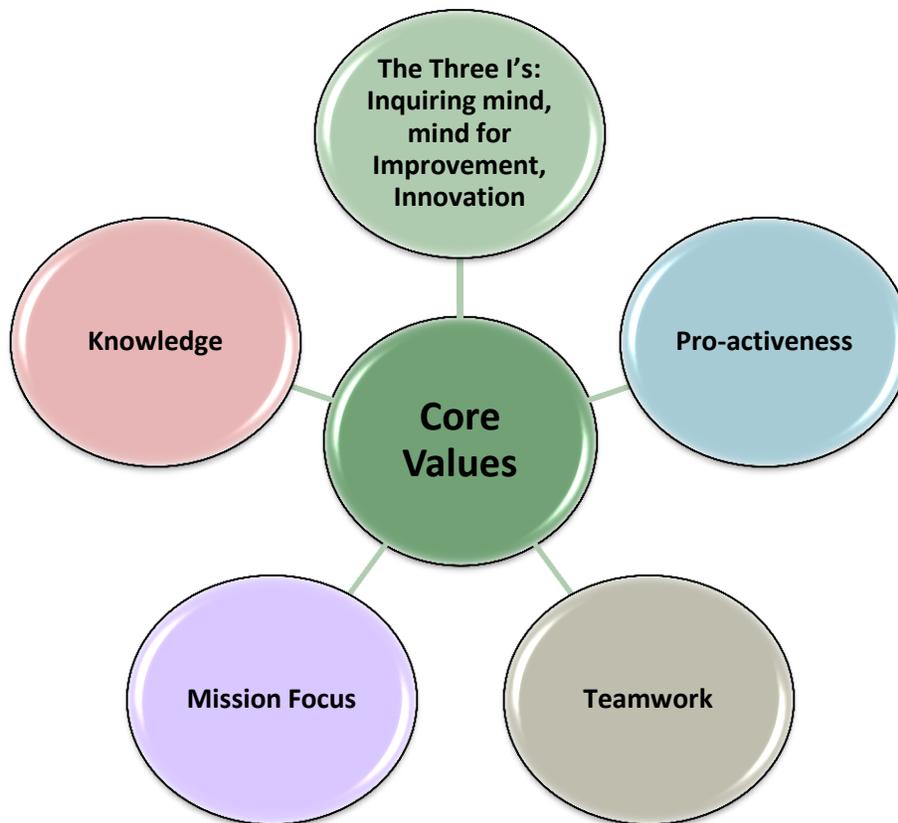


Figure from Ministry of Transport website.

As indicated on the Ministry of Transport website (Ministry of Transport, 2010), for the bus network, LTA aims to benefit as many commuters as possible while ensuring its overall financial viability. The following objectives are adopted:

- To improve journey quality
- To have better integration across public transport modes and services
- To strengthen the current hub-and-spoke model
- To ensure the overall financial viability of the bus network.

In addition, the Public Transport Council established a comprehensive set of bus service standards and specifications to regulate the performance of the basic bus operators. The

standards are regularly updated to better reflect the travel experience of commuters. In addition, a penalty framework was established to enforce quality standards. (Ministry of Transport website)

Similarly, related to the rail network, LTA implemented operating performance standards to safeguard the service levels of the rail network. They include the following objectives: to impose a more stringent limit on the maximum number of passengers each train can carry, and to ensure that the intervals between trains during the morning and evening peak periods as well as during lunchtime do not exceed prescribed standards.

Also, LTA's land transport policies set for over the next 10 to 15 years are: making public transport a choice mode; managing road usage; meeting the diverse needs of the people. (Aisha, 2008)

LTA was awarded the 2008 Innovation Excellence Award (one of Spring Singapore's Business Excellence Awards). One of the things that they emphasize is that, while large organizations are generally seen to be less innovative than small ones due to their limited flexibility, LTA proves to be an exception (Aisha, 2008). Some interesting quotes from Aisha (2008) related to their culture of innovation are mentioned below **Error! Bookmark not defined.:**

- LTA fosters a strong culture of innovation and bottom-up creativity.
- Creative thinking is promoted among staff in their daily work.
- An Innovation Framework was also instituted to spread the culture of innovation throughout the organization.
- Staff is encouraged to submit ideas through an electronic system.
- Every suggestion is evaluated and implemented where possible, preventing premature termination of ideas.
- Staff efforts are recognized at two annual events: the Quest for Excellence Day (awards for best staff suggestions, best work improvement teams and project teams that have won international awards) and the dinner and dance.

A summary of LTA description and characteristics is presented on Table 5-13.

Table 5-13 Summary of Singapore’s Land Transport Authority Highlights

Institution Name	Land Transport Authority
Data Source	Land Transport Authority Website. Last updated: 25/05/2010. Accessed: 26Aug10 < http://www.lta.gov.sg >. Making Travel Even Simpler for You: LTA Annual Report 08/09
Data Date	2008-2009
Institution Type	Statutory board under the Ministry of Transport that spearheads land transport developments in Singapore.
Board Members	15
History	LTA was established on 1 September 1995, formed through the merger of four public sector entities, namely: Registry of Vehicles, Mass Rapid Transit Corporation, Roads & Transportation Division of the Public Works Department, Land Transport Division of the then Ministry of Communications.
Modes	Bus and Rail
Organization	There are ten Groups supporting core functions. They are: Corporate Communications Corporate Services Engineering Innovation & Info. Comm. Technology Policy & Planning Rail, Road Projects Road Operations & Community Partnership Safety & Contracts Vehicle & Transit Licensing
Subsidiaries	<p>EZ-Link Pte Ltd was formed on 8 January 2002. It is responsible for the sale, distribution and management of ez-link Cards for public transport travel, as well as other commercial purposes and non-transit applications. For public transport travel, EZ-Link Pte Ltd has appointed Transit Link Pte Ltd as the agent to manage the sale of ez-link Cards on the MRT, LRT and buses. EZ-Link Pte Ltd has also signed a Memorandum of Understanding (MOU) with Green Dot Payment Services Pte Ltd to work on the terms and framework for Green Dot Payment Services to expand the use of the ez-link card beyond public transport for general micro-payments.</p> <p>MSI Global Pte Ltd was set up on 8 February 1995 as the consultancy arm of the Land Transport Authority. MSI Global provides multi-disciplinary consultancy for transport policies and strategies. It has been a key consultant to issues and problems facing the government and policy makers of various countries. Its key solutions center on land transportation matters including:</p> <ul style="list-style-type: none"> • Transportation Planning • Project Management and Implementation • Rail Systems Engineering • Infrastructure Management • Intelligent Transport Systems

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Institution Name	Land Transport Authority
	<ul style="list-style-type: none"> • Demand Management
Region	As a city state, Singapore is the second most densely populated country in the world. Today, roads take up 12 percent of our total land area and the demands on our land transport system are set to increase by 60 percent, from our current 8.9 million daily journeys to 14.3 million by 2020. Making public transport the centerpiece of our land transport system will be crucial to keep congestion in check and help protect the environment.
Trips	Current (2009) 8.9 million daily journeys to 14.3 million by 2020
Transit Ridership	4.89 million (average daily ridership bus + rail)
Vision	<p>A people-centered land transport system. This is the Vision since 2007/08. In 2006/07 it was: "To build a world-class land transport system". However, They included some Values, where current Vision was part of:</p> <ul style="list-style-type: none"> • Commitment to goals • Teamwork • Competence • People focus • Integrity <p>Care & concern</p>
Mission	To provide an efficient and cost-effective land transport system for different needs. This is the same mission stated in 2006/07 (oldest information available).
Objectives	<ul style="list-style-type: none"> • To deliver a land transport network that is integrated, efficient, cost-effective and sustainable to meet the nation's needs. • To plan, develop and manage Singapore's land transport system to support a quality environment while making optimal use of our transport measures and safeguarding the well-being of the travelling public. • To develop and implement policies to encourage commuters to choose the most appropriate transportation mode.
Strategic Thrusts	<p>Make Public Transport a Choice Mode Optimize Road Network and Enhance its Accessibility Excel in Service Quality Create Value and Instill Pride in Our Work</p> <p>Same in 2006/07 (oldest information available).</p>
Organization Structure	<p>CHAIRMAN - Michael Lim Director-Internal Audit Chief Executive Deputy Chief Executive (Policy, Planning And Corporate) Corporate Secretary Group Director - Policy And Planning Group Director Corporate Communications Group Director - Corporate Services Group Director - Innovation And Info. Comm. Technology Group Director - Vehicle And Transit Licensing Group Director - Special Duties Deputy Chief Executive (Infrastructure And Development) Group Director - Engineering Group Director - Rail (Thomson & Existing Lines) Group Director - Rail (Circle & Downtown Lines)</p>

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Institution Name	Land Transport Authority
	<p>Group Director - Transportation & Ticketing Technology Group Director - Road Projects Group Director - Road Operations And Community Partnership` Group Director - Safety And Contracts</p> <p>Same Chairman in 2006/07 (oldest information available).</p>
Technology Transfer	<p>In September 2006, the LTA Academy was established to share Singapore’s experience and expertise in land transport and to promote the research and exchange of best practices within the global land transport community. To date, the Academy has designed, conducted or hosted more than 200 professional programs for about 6,000 overseas and local senior officials and professionals.</p>
Human Capital	<p>Recruitment:</p> <ul style="list-style-type: none"> • The LTA aims to be an employer of choice. • LTA builds brand awareness by participating actively in recruitment events such as career fairs and networking events at local and overseas tertiary institutions, and also liaises with industry associations such as the Institution of Engineers, the Institution of Civil Engineers and the Institution of Engineering and Technology. • LTA has expanded its candidate outreach programs by enhancing publicity in print and via online job-portals, as well as through collaborations with national agencies such as Contact Singapore and the Workforce Development Agency and other recruiting partners. • Retention: • LTA is committed to retaining and developing recruited talented individuals. • LTA has launched a Staff Development Framework and Advanced Management Development Programs in order to groom staff for greater responsibilities. There are now customized development programs for officers at different career stages. • LTA will be introducing competency profiles so that staff is aware of the knowledge and skills requirements of their jobs. • It will soon be conducting coaching programs so as to build a coaching culture that will further boost staff development and morale. • It has also expanded the participation coverage to include middle-level managers for the 360° leadership program. • In October 2008, the LTA concluded the Collective Agreement with the Amalgamated Union of Statutory Board Employees (AUSBE). Under this agreement, the union and the LTA implemented the new salary ranges for Technical and Junior Officers and a number of enhancements to staff welfare benefits. • The LTA, together with 11 statutory boards, also signed a Memorandum of Understanding with the AUSBE on the re-employment of older workers. This demonstrates that the LTA values the contribution of older and experienced staff. • As part of a culture of continuous improvement, the LTA has begun implementing a Human Resource Integration System (HRIS). The new system will bring about greater work efficiencies and enhance service levels to our employees.
Operating Income	<p>Management Fee from Government: 328 (\$'M) Vehicle Transit Licensing Fees: 24 Composition Fines: 24 New Motor Vehicle Registration Fees: 16</p>

IMPACT OF TRANSIT ORGANIZATION IN RIDERSHIP

Institution Name	Land Transport Authority																								
	Others: 66 Total operating Income: 458																								
Operating Expenditure	Depreciation of Property, Plant & Equipment: 289 (\$'M) Employee Compensation: 158 Bond Interest: 92 Maintenance & Upkeep: 129 Utilities: 44 Information Technology Service Charges: 27 Agency Fees: 23 Others: 134 Total operating Expenditure: 896																								
Ridership	<p>Note in the graph below the growth tendency from 2005 to 2009.</p> <table border="1"> <caption>Public Transport Ridership (Daily Average)</caption> <thead> <tr> <th>Fiscal Year</th> <th>Total: Bus and Rail (million)</th> <th>Bus (million)</th> <th>Rail: MRT and LRT (million)</th> </tr> </thead> <tbody> <tr> <td>FY04/05</td> <td>~4.1</td> <td>~2.8</td> <td>~1.3</td> </tr> <tr> <td>FY05/06</td> <td>~4.2</td> <td>~2.8</td> <td>~1.4</td> </tr> <tr> <td>FY06/07</td> <td>~4.4</td> <td>~2.9</td> <td>~1.5</td> </tr> <tr> <td>FY07/08</td> <td>~4.6</td> <td>~3.0</td> <td>~1.6</td> </tr> <tr> <td>FY08/09</td> <td>4.89</td> <td>3.08</td> <td>1.81</td> </tr> </tbody> </table>	Fiscal Year	Total: Bus and Rail (million)	Bus (million)	Rail: MRT and LRT (million)	FY04/05	~4.1	~2.8	~1.3	FY05/06	~4.2	~2.8	~1.4	FY06/07	~4.4	~2.9	~1.5	FY07/08	~4.6	~3.0	~1.6	FY08/09	4.89	3.08	1.81
Fiscal Year	Total: Bus and Rail (million)	Bus (million)	Rail: MRT and LRT (million)																						
FY04/05	~4.1	~2.8	~1.3																						
FY05/06	~4.2	~2.8	~1.4																						
FY06/07	~4.4	~2.9	~1.5																						
FY07/08	~4.6	~3.0	~1.6																						
FY08/09	4.89	3.08	1.81																						

5.2.3 Puerto Rico

The Commonwealth of Puerto Rico is a Chain of Islands located at the Caribbean Sea (see Figure 5-20). It is composed of 78 municipalities; two of them are smaller surrounding islands.

Figure 5-20 Location of Puerto Rico



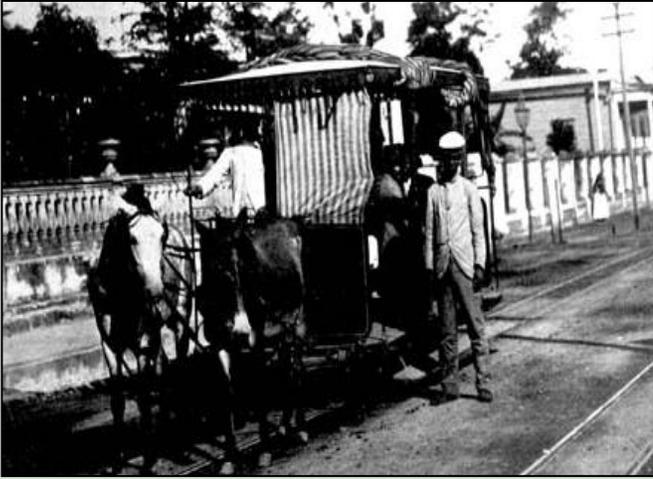
The literature review considers a general background on the historical transition of the Puerto Rican transportation system and its related institutions. This review will help to understand those transitional changes, under what general conditions they emerged, and the current status of the system which is also described in this review.

As per Census Bureau’s 2006-2010 Community Survey estimate, 972,258 workers (88% of them) in the 3,500 square mile Island of Puerto Rico, travel to work by Auto/Van/Truck, 87% of them driving alone. An estimate of 145,126 (13%) of them, have an average travel time to work of an hour or more.

Table 5-14 shows a summary of facts, related laws, modes and operating entities concerning to the history of transportation in PR and in the USA. This will help to visualize the transition of the transportation system in PR within its historical context. As can be observed

from the table, the first public transportation system in PR was a Streetcar. It operated in Mayagüez from 1872. At the table can be appreciated the evolution of the political and transportation system, the modes and the entities that operated them.

Table 5-14 Public Transportation History in Puerto Rico

Happening / Servicing		PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
From	To		
	1492	Indigenous Era: Puerto Rico had 17 Taíno tribes throughout the Island. Each one was governed by a cacique.	
1492	1898	Spanish Colonial Era: Puerto Rico was a Spanish colony, governed by a Spaniard governor appointed from the Spanish Kingdom.	
1510	1512	Import of African slaves after extinction of Taínos.	
1872		Streetcar, Mayagüez 	
1873		Spanish Courts approved the law to abolish slavery in PR.	
1875	1887	El Ferrocarril Urbano de la Villa de Mayagüez [Urban Railway of Mayagüez Village] 	
1878	1901	Don Pablo Ubarri 's San Juan Tramway (steam)	

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Happening / Servicing	PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
1891	1902	Island wide railroad for cargo (sugar cane)
		
1893		Creation of the Office of Road Inquiry
1895	1912	Sociedad Anónima Tranvía de Mayagüez [Mayagüez Tramway Autonomous Society]
1898	1898	Spanish Autonomous Era: Puerto Rico organized its government under an autonomic letter where the powers of PR were enhanced. PR could perform commercial treats with other countries and could fix import and export rights and custom fees.
1898		Hispanic-American War
1898	1900	USA Military Government Era: PR had a military government under United States of America (USA) after their invasion during the Hispanic-American War.
1900	1917	Establishment of Foraker Law. This law allows a civil government in PR where USA government maintains power over PR. The USA President appointed a Governor for PR to lead the local government. Governor would be helped by a Counsel group of eleven members, including an Interior Commissioner also appointed by the President and approved by the Federal Senate for a four-year period.
1901	1946	Porto Rico Railway, Light and Power Company (San Juan Trolley, electric)

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Happening / Servicing		PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
			
1902	1947	American Railroad Company (cargo & passengers) 	
1913	1926	Mayagüez Tramway Company	
1905	1915		Creation of the Office of Public Roads within the Department of Agriculture
1914	1973		American Association of State Highway Officials was founded
1915	1939		Creation of the Bureau of Public Roads within Department of Commerce
1916			Creation of the Federal Aid Highway Program
1917	1918	First World War	
1917		Foraker Law was substituted by Jones Law. At this time, USA was involved in the First World War. Within this Law,	

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Happening / Servicing	PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
	<p>economic and politics relations between PR and USA remained. This Law gave the USA citizenship to Puerto Ricans, which allowed the USA army to recruit Puerto Ricans and build military bases in PR. The Jones Law also establishes the separation of powers: Executive (appointed by the USA President), and Legislative (bi-cameral system of popular election). The Executive power included seven departments: Education Commissioner, General Procurer (Justice), Auditor, Interior Commissioner, Agricultural and Work Commissioner, Health Commissioner and Treasurer. The first three were appointed by the USA President while the others were selected by the Governor and confirmed by the Puerto Rican Senate. The Legislative power had also the faculty to approve the budget. Through the faculty that the Legislative power had to confirm the commissioners and approve the budget, they built a system where the major political party presented three candidates to the Governor and he selected form them. This resulted in public functionaries selected not necessarily by their merits and therefore to an inefficient government.</p>	
1917	<p>1952 Jones Act: Establishes the Department of the Interior] (predecessor of the Departamento de Transportación y Obras Públicas [Department of Transportation and Public Works]),and the Comisión de Servicio Público [Public Service Commission (predecessor of the Comisión de Servicio Público de Puerto Rico [Puerto Rico Public Service Commission])</p>	
1918	<p>San Juan-Santurce Line Inc. (omnibus)</p> 	
1921		<p>Conversion of the Federal Aid Highway Program into the first Federal Aid Highway Act</p>

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Happening / Servicing		PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
1927	1942	White Star Bus Line (owner was a Spaniard resident of PR) 	
1930		USA's Big Depression	
1934		Federal programs Puerto Rico Reconstruction Administration (PRRA) and Puerto Rican Emergency Relief Administration (PRERA) were established to build public infrastructure, and to provide food to people, respectively.	
1935	1967		Interstate Commerce Act, creation of Bureau of Motor Carrier Safety within Department of Commerce
1939	1945	Second World War	
1939	1949		Creation of the Public Roads Administration within Federal Works Agency
1942		Law 213 of August 12, 1942 was created under the government and by the influence of Rexford Guy Tugwell, last American governor appointed in Puerto Rico by the United States of America President. At this time, the legislative and senate members were already elected by Puerto Rican people, being Luis Muñoz Marín the President of the Senate. Tugwell favored the Popular Democratic Party. Then, a Planning Board was created. However, it wasn't attached to any particular power: executive, legislative or judicial. Its status remained undetermined, although Tugwell's scheme defined it as a forth power. After Tugwell, Jesús T. Piñero was appointed as Governor.	

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Happening / Servicing		PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
1942	1959	Autoridad de Transporte (AT), División de Autobuses [Transport Authority, Buses Division] 	
1946		Governor Jesús T. Piñero changed the law to make the position of Governor an elective one, effective for 1948 elections.	
1946	1955	AT División de Puertos y Muelles [Transport Authority, Ports Division]	
1947	1957	Puerto Rico Railroad and Transport Company (passengers until 1953)	
1947	1955	AT División de Aeropuertos [Transport Authority, Airport Division]	
1948		Luis Muñoz Marín was elected Governor. His first project was a re-organization of the Executive branch as he understood that without an efficient Executive body there will be no social development in Puerto Rico. He appointed the Rowe Commission (Rowe was the president of that commission) to propose that re-organization. One of the recommendations from the Commission was to set the Planning Board under the Governor's Office.	
1947			Creation of Transportation position on cabinet level (Secretary of Transportation).
1949			Public Roads Administration lead by the Secretary of Transportation (back at Department of Commerce, Federal Works Agency abolished)
1950	present	The Planning Board was subscribed under the Office of the Governor.	

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Happening / Servicing	PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
1952	The Constitution of the Commonwealth of Puerto Rico was approved, including the definition of the functions of the following executive departments: State, Justice, Public Instruction, Health, Internal Revenue, Work, Agriculture and Commerce, and Public Works.	
1952	1971 Departamento de Obras Públicas (DOP) [Department of Public Works]	
1955	present AT turns into Autoridad de los Puertos (AP) [Ports Authority]	
1956		Under Dwight David Eisenhower presidency, Federal Aid Highway Act to support National system of Interstate & Highway Defense, creation of Highway Trust Fund
1959	present Autoridad Metropolitana de Autobuses (AMA) [Metropolitan Bus Authority]	
		
1962	present Comisión de Servicio Público de PR (CSPPR, regulation of carros públicos, taxis, transportation of goods, excavations, demolitions, pipe safety, and others.) [Public Service Commission of Puerto Rico]	
1963	Vietnam War	
1964		Under president Lyndon Johnson, Urban Mass Transportation Act (3-year program)
1965	1991 Autoridad de Carreteras (AC) [Highway Authority]	

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Happening / Servicing	PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
1966		Under president Lyndon Johnson: creation of the Department of Transportation, National Traffic and Motor Vehicle Safety Act; Highway Safety Act (National Highway Safety Bureau); and the Federal Highway Administration within Department of Transportation
1967		Public Roads Administration, Bureau of Motor Carrier Safety and National Highway Safety Bureau becomes part of the Federal Highway Administration; under the Department of Transportation
1968		Federal Aid Highway Act amended to include a section of Civil Rights within the Office of the Secretary of Transportation
1969		Office of Civil Rights turned into a departmental office.
1970		Under president Nixon: National Environmental Policy Act, amendment to National Highway Safety Act to require passive restraint on motor vehicles and to transform the Bureau into the National Highway Traffic Safety Administration apart from Federal Highway Administration and to respond directly to the Department of Transportation
1971	present	DOP turns into Departamento de Transportación y Obras Públicas (DTOP) [Department of Transportation and Public Works]. AC was then subscribed into DTOP. ACT, AMA, AP and ATM are currently under the supervision of the Secretary of this department)

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

Happening / Servicing		PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
1973	present	AMA was incorporated into DTOP.	Under President Nixon, Federal Aid Highway Act amended to be able to use Highway Trust Funds for Mass Transit projects. AASHO turned into AASHTO (American Association of State Highway and Transportation Officials).
1974			Under President Ford, National Mass Transportation Assistance Act
1976			Under President Ford, Federal Aid Highway Act amended to include the Interstate 3 R Program: resurfacing, restoring, rehabilitation
1978			Under President Carter, Surface Transportation Assistance Act to consolidate highway and transit programs
1982			Under President Reagan, reauthorization of Surface Transportation Assistance Act
1990	present		Under President Bush Sr., Clean Air Act and Americans with Disabilities Act
1991		AC turns into Autoridad de Carreteras y Transportación (ACT) [Highway and Transportation Authority]	Under President Bush Sr., Intermodal Surface Transportation Efficiency Act, creation of Federal Transit Administration, and Inter-modalism office at the Bureau of Transportation Statistics
1998			Under President Clinton, Transportation Equity Act for the 21st Century (6 year)
1999			Transformation to Motor Carrier Safety Bureau to Administration under Department of Transportation

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Happening / Servicing	PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
2004	<p>present</p> <p>Alternativa de Transporte Integrado [Integrated Transport Alternative] (Directorate of the ACT)</p>  <p>Autoridad de Transporte Marítimo (ATM, Acuaexpreso ferry, Vieques & Culebra islands) [Maritime Transport Authority]</p>  <p>Small cargo railroad within Puerto de las Américas</p> 	<p>Under President Bush Jr., Transportation Equity Act: A Legacy for Users</p>

Happening / Servicing		PR Historical Fact/Operating Mode/Company/Agency	USA Historical Fact
2005	Present	The metropolitan heavy rail system Tren Urbano [Urban Railway] starts its operations. It is a 17 kilometer line with 16 stations running through three municipalities. It was first conceived in a 1967 transportation plan. Its construction started in 1991.	

Historic pictures (black and white or tinted black and white) are from the University of Puerto Rico (Tren; Guagua). Other pictures are from the particular agency’s website, accessed within 2006 to 2009. Information included is from several sources such as class notes from Dr. Hermenegildo Ortiz (Public Sector Planning) and Dr. Benjamín Colucci (Traffic Safety), and from Wikimedia Commons (Rail Transport in Puerto Rico; El Parque del Tren,), Torres Rivera (2004), Departamento de Transportación y Obras Públicas de Puerto Rico (Visión, Misión e Historia), Comisión de Servicio Público de Puerto Rico, Autoridad de los Puertos de Puerto Rico, The Associated Press (2003), WebRing, Fortune City, Acosta, PRISA Digital S,L., and United States Department of Transportation (About Us).

Currently, transportation in Puerto Rico is organized decentralized and have various entities having a voice and taking actions related to transportation in their various jurisdictions. There is a high degree of horizontal fragmentation regarding transportation management, as F. Luyanda (2004) indicates: *Responsibility for the transportation system and land use is dispersed among various agencies.*

Transportation management is divided among different agencies with separate budgets, while a directorate (Integrated Transport Alternative) from one of them (Puerto Rico Highway and Transportation Authority) attempts to integrate the services. A simplified organization chart of Puerto Rico government related to transportation is shown in Figure 5-21.

The Planning Board establishes the public policy regarding island wide development; this Board responds directly to the Governor.

In other branch is the Public Service Commission which establishes regulations regarding the traffic of cargo vehicles and used to authorize (responsibility recently transferred to the DTPW and assigned to its DPW’s Center of Services for Drivers -CESCO for its initials in Spanish-) the routes for Público (car or minibus public transportation service by private operators with private vehicles). This Commission also responds directly to the Governor.

The Department of Transportation and Public Works (DTPW) is an umbrella organization that covers several transportation related institutions by having its Secretary (appointed by the Governor) as the President or Member of the board of those institutions. One of these institutions is the Highway and Transportation Authority, which have the Integrated Transportation Alternative (ATI as per its initials in Spanish).

The Directorate of Public Works (DPW) within DTPW is in charge of maintaining state highway infrastructure, except freeways. The DPW budget comes from the General Government Fund. It is proposed and defended by the Secretary of the DTPW and the Executive Director of the DPW, and approved by the Chamber of Representatives (part of the Legislative Branch, together with the Senate). It also authorizes the routes for Públicos, responsibility transferred from PSC to the DTPW in 2008 and assigned to the DPW's Center of Services for Drivers -CESCO for its initials in Spanish- in 2009, and this new authority was effective in January 2010.

The Puerto Rico Highway and Transportation Authority (HTA) is in charge of building transportation infrastructure, and maintaining and operating the freeway and Tren Urbano systems. Its budget comes mainly from bond emissions, toll and fare collection, and federal funds as apportioned by applicable federal laws (i.e. Current Act is entitled Moving Ahead for Progress in the 21st Century and applies the Title 49 of the Code of Federal Regulations).

The Integrated Transport Alternative (ATI by its initials in Spanish) is the entity with the responsibility to integrate all transportation modes in San Juan Metropolitan Area. ATI, a directorate of the HTA, is also in charge of oversight the operation and maintenance of Tren Urbano (TU). ATI also has a responsibility to eventually integrate Island's transportation modes and be ready to directly operate TU. As can be noticed from the chart in Figure 5-21, this entity has a lower hierarchical position than the entities that operate or manage other transportation modes that it is supposed to integrate, which makes difficult its integration duty. One of them is the Metropolitan Bus Authority (MBA).

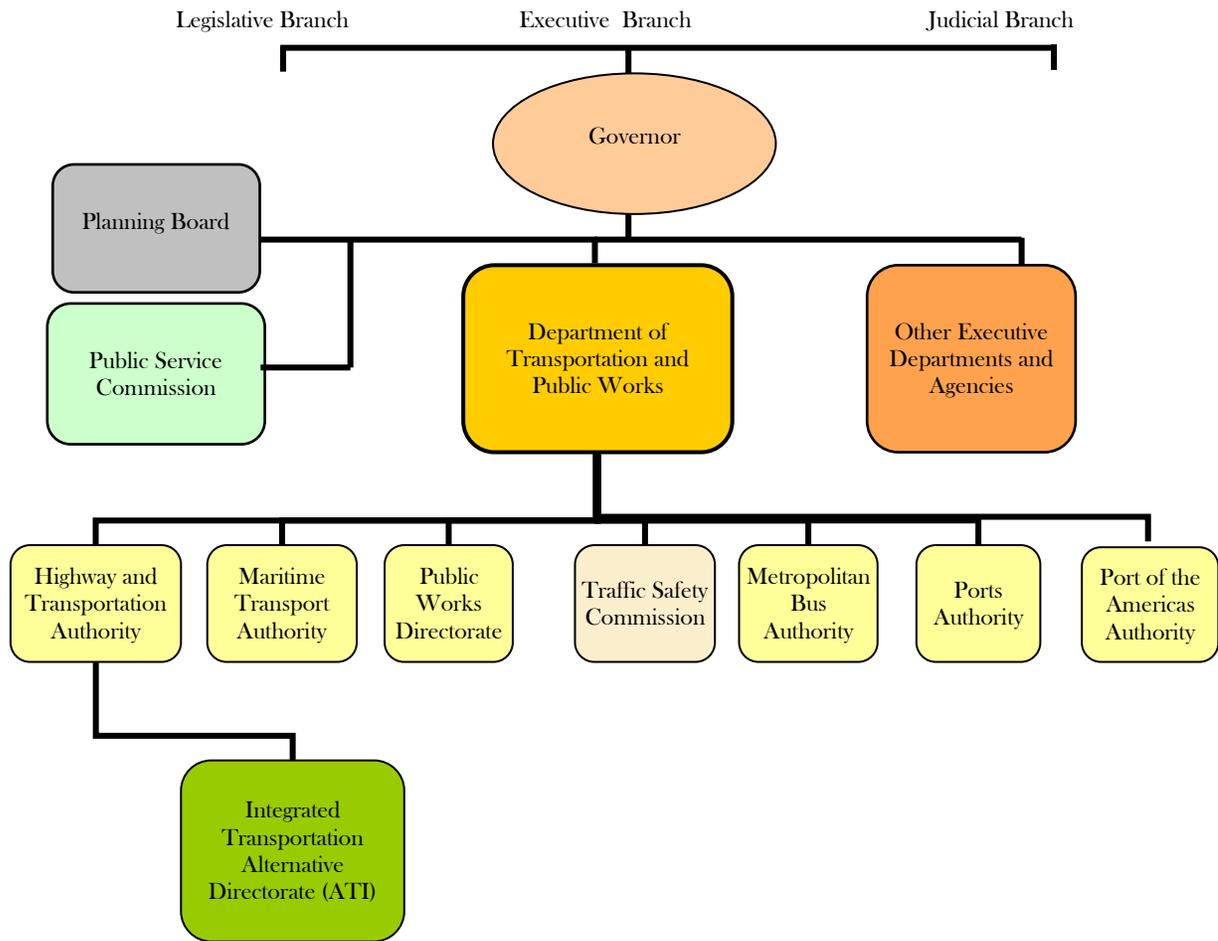
The MBA is in charge of providing bus and paratransit transportation services through several municipalities within SJMA. Its budget comes from the General Government Fund and from federal allocations as per applicable federal laws. Its budget is proposed and defended by the Secretary of the DTPW and the President of the MBA, and approved by the Chamber of Representatives.

The Port Authority is in charge of managing ports and airports, while the Maritime Transport Authority manages ferry systems within the big island.

It is important to point out that agencies have several differences in technology and procedures among them. This was a direct observation while working at DTPW, HTA-ATI and MBA. The integration they have accomplished so far concerns to:

- The use of the same fare card for both TU and MBA
- The use of some TU stations as transfer centers between TU and MBA buses
- The use of MBA buses as bus bridges when TU service is interrupted

Figure 5-21 Puerto Rico Government Simplified Organization Chart Related To Transportation

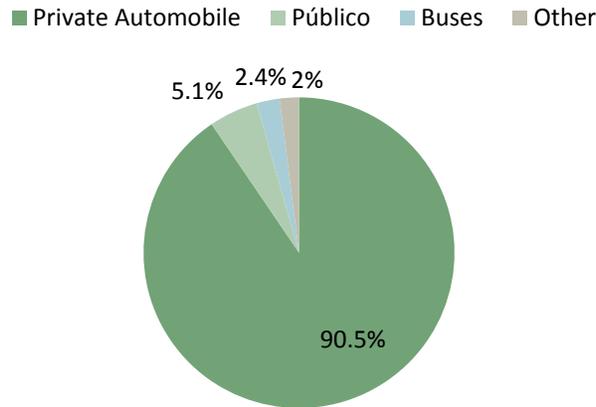


References: Departamento de Transportación y Obras Públicas de Puerto Rico (2006), Junta de Planificación de Puerto Rico (2008), Gobierno de Puerto Rico (2008) and Gobierno de Puerto Rico (2008).

Modal split data for SJMA available at the time this section was developed is as of 1990 census, as presented on Figure 5-22. Note that available modes back then were private auto, public, buses and other.

Figure 5-22 SJMA Mode Split as per 1990 Census

SJMA Mode Split as per 1990 Census



As there is no updated modal split information, it is estimated for 2006 (when TU had 1.5 years of operation) as follows:

- N. Wilson (2006) indicates that estimated passenger trips for SJMA at 2010 are 4.6 million trips per day.
- A simple estimation for 2006 was performed as shown on Table 5-15, resulting on 4.3 million trips per day.
- Information on trips per day for 2006 (most recent available) was gathered from the National Transit Database (NTD). Mode split was estimated as presented in Table 5-16.

Table 5-15 Estimation of SJMA Total Trips per Day in 2006

SJMA 1990	3.2	million trips per day
SJMA 2010	4.6	million trips per day
Difference	1.4	million trips per day
Increase per year presuming constant slope	0.07	million trips per day
Estimation for 2006	4.32	million trips per day

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Estimated mode split can be better appreciated in Figure 5-23, while a comparison of 1990 and estimated 2006 split is shown on Figure 5-24. As can be noticed, despite TU, public transit share lowered while auto increased.

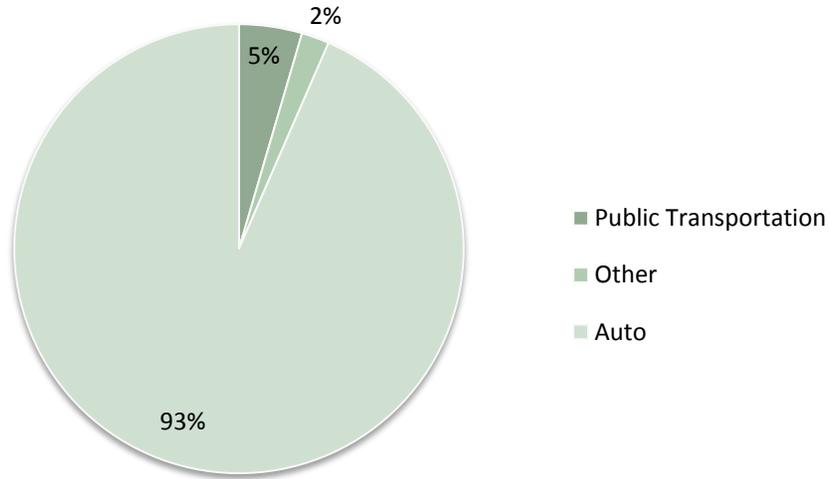
Table 5-16 Estimated SJMA Mode Split for 2006

Mode	Agency	Population Served	Unlinked Passenger Trips	Type of Service	Estimated Trips per Day (Annual/365)	Estimated Mode Split (Trips out of Estimated 4.3 million trips per day in 2006)
Público	Department of Transportation and Public Works (DTPW)	2 216 616	37 957 469	Público ⁵	103 993	2.42%
Llame y Viaje	Metropolitan Bus Authority (MBA)	1 176 968	124 696	Demand Response	342	0.01%
AMA	Metropolitan Bus Authority (MBA)	1 176 968	22 628 112	Bus	61 995	1.44%
TU	Puerto Rico Highway and Transportation Authority (HTA)	1 050 346	6 895 972	Heavy Rail	18 893	0.44%
Metrobús	Puerto Rico Highway and Transportation Authority (HTA)	1 050 346	1 586 909	Bus	4 348	0.10%
Ferries	Puerto Rico Ports Authority (PRPA)	772 332	1 928 526	Ferry Boat	5 284	0.12%
Total					194 854	4.53%
				Other (Presumed to remain constant)	86 000	2.00%
				Auto	4 019 146	93.47%

⁵ Público is a transit mode comprised of passenger vans or small buses operating with fixed routes but no fixed schedules. They are a privately owned and operated..., but regulated through ...government. Públicos are operated under franchise agreements, fares are regulated by route and there are special insurance requirements. Vehicle capacity varies from eight to 24... (NTD / FTA, 2010)

Figure 5-23 SJMA 2006 Estimated Modal Share

SJMA 2006 Estimated Mode Split



SJMA 2006 Estimated Public Transit Share

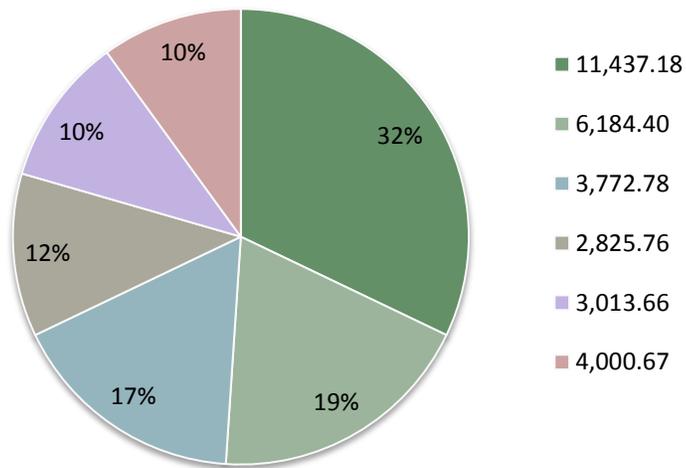
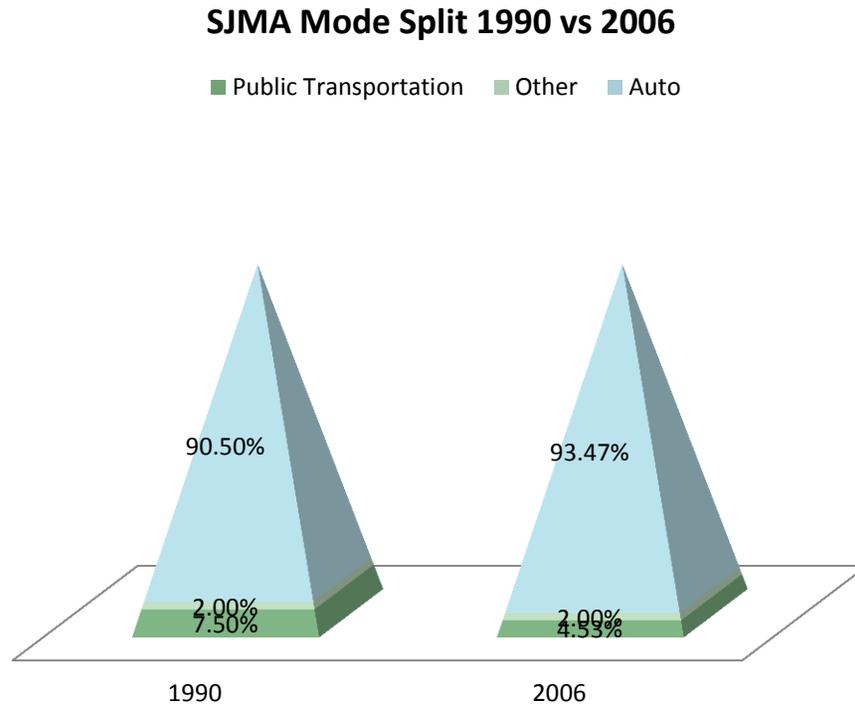


Figure 5-24 SJMA Mode Split Comparison: 1990 vs. Estimated 2006



More recent transportation characteristics at the entire Puerto Rico level are shown in Table 5-17. Note that 76.1% of workers 16 years old and over travel to work by driving alone. Note also that only a 3.3% of them use public transit. Also note that half of them work outside their municipality of residence.

Table 5-17: Puerto Rico’s Transportation Characteristics

Geographic area	Puerto Rico
Percent of People 16 to 64 Years Who Are in the Labor Force	55.6%
Percent of Workers 16 Years and Over Who Traveled to Work by Car, Truck, or Van—Drove Alone	76.1%
Percent of Workers 16 Years and Over Who Traveled to Work by Car, Truck, or Van—Carpooled	11.4%
Percent of Workers 16 Years and Over Who Traveled to Work by Public Transportation (Excluding Taxicab)	3.3%
Percent of Workers 16 Years and Over Who Worked Outside Municipality of Residence	50.2%

Source: United States Census Bureau (2010)

5.2.4 Comparison of Study Cases

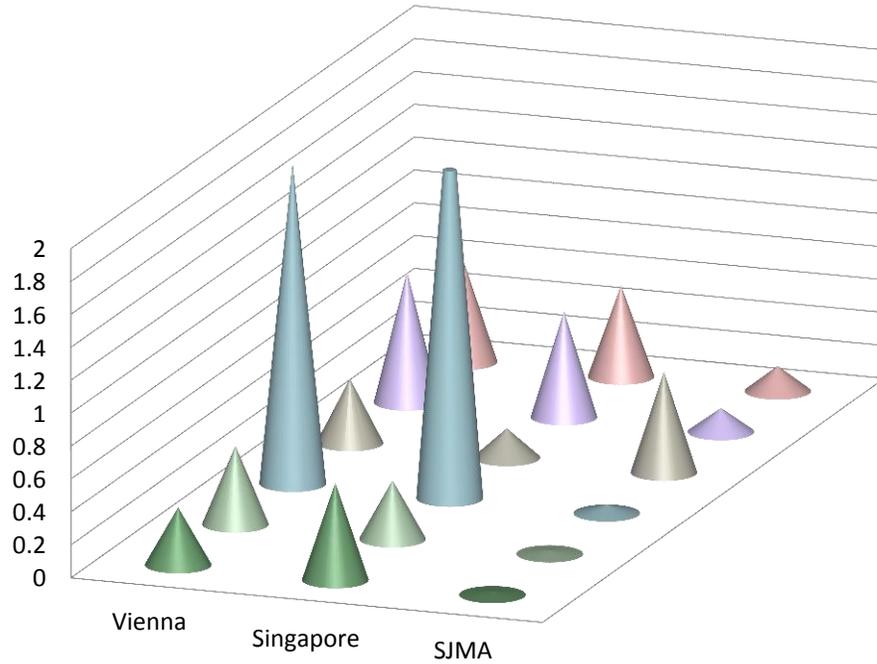
As can be observed from Figure 5-25, Vienna and Singapore show a high usage of transit, while in San Juan Metropolitan Area (SJMA) at Puerto Rico the transit usage is extremely low. It is important to point out that the three places have the modes of rail and bus. It can be observed that the amount of private cars per capita in Puerto Rico is almost twice the amount in Vienna, which is almost twice the amount at Singapore. In addition, the amount of service offered by SJMA is small as compared with Vienna and Singapore. However, the usage relative to the service offered is still low.

A comparison of some qualitative characteristics of the three case studies is presented on Table 5-18.

As observed on Figure 5-25 and Table 5-18, Vienna and Singapore, are both successful in achieving a high modal share of transit with around 30 and 60 percent respectively, among other usage measures. Puerto Rico, on the contrary, shown a very low transit usage (around 2%).

Figure 5-25 Transit Usage Comparison

Transit Share Comparison - 2009



	Vienna	Singapore	SJMA
■ transit split	0.35	0.59	0.02
■ transit trips/1,000 inhabitants	0.48	0.36	0.02
■ million transit trips/sq km	1.96	2.51	0.05
■ private cars/1,000,000 inhabitants	0.39	0.18	0.61
■ vehicle kilometers per inhabitant/100	0.79	0.65	0.14
■ usage of available service [transit trips/1,000 inhabitants] / [vehicle kilometers per inhabitant/100]	0.60	0.55	0.15

Notes: SJMA transit split corresponds to the 2006 projection as explained in section 5.2.3 Puerto Rico. Other data from: Municipal Department 5 - Financial Affairs (2010), Land Transport Authority (2009), National Transit Database (2011), and The World Bank Group (2006-2010).

Table 5-18 Study Cases Comparison

	Vienna	Singapore	Puerto Rico (San Juan Metropolitan Area)
Political Coverage	City-Province	City-State	Self-governing commonwealth in association with the United States
Main Transit Modes	Rail (underground and tram), Bus	Rail, Bus	Rail, Bus
Transit Ridership (million, 2009)	811.78	1,784.85	26.4
Service Area (sq km)	414.87	710	513
Service Population	1,698,957	4,987,600	1,176,968
Government Structure	Representative democracy in federalist structure with republican democratic constitution	Republic with parliamentary government	Republican
Transportation Institution Name	Wiener Linien	Land Transport Authority	Highway and Transportation Authority
Transportation Institution Type	Wholly owned subsidiary of Wiener Stadtwerke, itself owned by the City of Vienna	Statutory board under the Ministry of Transport, it has subsidiaries to support its operation	Public (State Government) Corporation
Vision/Mission/Goals	Goals: Ensures that the population of Vienna is able to arrive at their destinations reliably, safely, comfortably and affordably. Optimum mobility means optimum quality of life. It is the responsibility of Wiener Linien to meet the mobility needs of the city of Vienna to the best of its ability.	Vision: A people-centered land transport system. Mission: To provide an efficient and cost-effective land transport system for different needs.	Vision: Develop and promote an integrated transportation system that, together with the highway infrastructure and the offering of services, will ease the economic development of Puerto Rico in harmony with the environment. Mission: Drive Puerto Rico to the economic development through an efficient transportation system, safe and in harmony with the environment, procuring a vanguard and excellent offering of services.

Information from: Municipal Department 5 - Financial Affairs (2010), Land Transport Authority (2009), National Transit Database (2011), and The World Bank Group (2006-2010).

The following points have been identified as general characteristics that both Vienna and Singapore have in common:

- Having a vision and goals directly related to the service and customer:
- Wiener Linien Goal: Ensure that the population of Vienna is able to arrive at their destinations reliably, safely, comfortably and affordably. Optimum mobility means optimum quality of life.
- LTA Vision: A people-centered land transport system.
- Considering their customers' needs, specially the related to mobility, accessibility and competitiveness of transit. (Refer to sections 5.2.1.6.1 and 5.2.2.4)
- Being proud employers, recognizing the importance of employees in the development of the company and/or having specific policies towards employees' development and recognition (Refer to sections 5.2.1.6.1 and 5.2.2.4)
- Having city-state (or city-province) behavior and managing transport for that coverage area.
- Having a combination of rail and bus modes within the service area.
 - Vienna has rail modes (subway and trams) and buses.
 - Singapore has rail and buses.
- Although part of the services are under contract or privatized, the power to establish policy is kept by the government.
 - Vienna's Vienna Public Transport Ltd. and Co. is the subsidiary of Vienna Public Utilities Participation Management Ltd., which is fully owned by the City of Vienna.
 - Singapore's Land Transport Authority is a Statutory Board of Singapore's Ministry of Transport.

The only characteristics that are repeated in the case of Puerto Rico are the rail-bus mode combination and the fact that policy is established by government. Although Puerto Rico has a service oriented vision related to integration, it is not as customer-oriented as in Vienna or Singapore, but oriented towards economic development.

The developed survey had the objective to look if common characteristics identified in Vienna and Singapore are repeated for other successful organizations and if they could be indicators of such success.

5.3 Conclusions

The first approach of study cases was oriented towards the inspection of a uniform sample (i.e. all NTD reporting entities) including different levels of ridership in order to identify possible tendencies of different factors derived from literature review, as explained on section *5.1.3 Information of Interest*.

From section *5.1.5 General Conclusions* of the NTD study cases was found that some characteristics appear to have some influence in the agency's success in ridership. Such characteristics were:

- Mode integration (how is it considered)
- Jurisdiction of service area (coverage and how it is considered)
- Configuration of the decision making process related to leadership style
- Nature and content of mission statement

The second approach identified two foreign places with high levels of transit ridership and inspected their common characteristics as indicated in literature.

From section *5.2.4 Comparison of Study Cases* of Vienna, Singapore and Puerto Rico it was found that the places with high transit ridership (i.e. Vienna and Singapore) had the following common characteristics:

- Vision and goals directly related to the service and customer:
- Consideration of their customers' needs
- Recognition of the importance of employees in the development of the company and/or having specific policies towards employees' development
- Being a city-state or city-province, hence, managing transport for that level of coverage area.

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- Having a combination of rail and bus modes within the service area.
- The power to establish transportation policy is kept by the government.

The case of Puerto Rico, which has low transit ridership, was included in both approaches as a common basis. Puerto Rico has both similarities and differences with places with high ridership. Some of the similarities include:

- The combination of rail and bus modes
- Some content of the Vision Statement related to integration
- Reporting responsibilities to state and federal entities
- Having the Government as the author of transportation policy

Since the high patronage services have these same characteristics, it could be speculated that they might not be key factors to define ridership levels. However, they will be included in the survey in order to analyze this speculation statistically.

6 SURVEY

This chapter describes the development of the survey, including its content, tools used, deployment, responsiveness, general results, and the definition of variables for further analysis.

The survey was performed with the objectives of obtaining information about organizational variables and analyzing their relation with transit ridership.

It is expected that the results can be related to the schemes presented in Figure 4-1 *Organizational Framework and Transportation Systems Comparison* and explained in section 4 THEORETICAL BACKGROUND.

6.1 Content

The questions included in the survey are based on the study cases inspected. The survey questions included are intended to inquire an insight related to the aforementioned characteristics identified in both study cases. The survey is a discerning one, that is, it is an initial filter of possible influencing characteristics. Therefore, it is broad and included the following information:

- The characteristics that appeared to have some influence in ridership, as per the first study cases
- The characteristics that were common among places with high transit usage, as per the second study cases
- The characteristics that were common to the low-ridership place of Puerto Rico, as per both approaches of study cases

Such characteristics included:

- Mode integration
- Service area jurisdiction and integration with other areas
- Leadership style

- Vision/Mission/Goals/Objectives
- Employees relations and considerations
- Modes and mode integration
- Ownership of transportation system
- Type of institution
- Mode share
- Transit ridership

Other characteristics were included for comparison purposes, for example:

- Service area
- Service population
- Budget
- Amount of employees

6.2 Tools

An on-line survey was used, which link was sent through electronic mail. The main tool used for the development, distribution and data collection related to the survey was Zoomerang Pro (MarketTools Inc., 2010).

The survey was prepared in two languages: Spanish and English, in order to facilitate the completion of the survey to a broader audience. The survey comprehensiveness was tested with two voluntaries from HTA before formally distributing it.

The electronic mail included a brief greeting and explanation of the survey, and indicated that more information and access to the survey was available through the included internet link. It also indicated that they would receive the same invitation for the survey in the alternate language and that they can choose to answer either of them. Copies of the electronic mails are included on Appendix B.

Through the included link, there was access to the informed consent statement and detailed instructions, as well as to the survey questions. A copy of the information that could be accessed through the link is presented on Appendix C.

Additional deployment was made by using the option to publish the survey in my ©Facebook (Facebook, 2011) page. Also, I published a link in several transit ©Facebook pages, on my ©LinkedIn (LinkedIn Corporation, 2011) profile and in several ©LinkedIn transportation groups.

6.3 Deployment

The deployment strategy used was through e-mail distribution inviting to answer the web-based survey. The invitation was directed to the contact person that was on the National Transit Database, systems' websites, professional association websites or personal contacts from the transportation industry. In the case of personal contacts or from professional associations, some responded that they forwarded the survey to other person more related to the information included in the survey. In addition, general invitations were posted in social and professional networks such as ©Facebook and ©LinkedIn. It is important to point out that contact information was very time-consuming to obtain. It was mostly obtained through individual searches for each place. In the case of groups, each member's link and/or website needed to be visited in order to obtain an e-mail address. In the case of internet networking sites, it was necessary to find related to groups and ask to join them so the posting could be made.

Phone approach wasn't used; however, the invitation included a statement indicating that a phone survey can be scheduled if this mean was preferred. Direct phone approach wasn't used due following reasons:

- Extension of the survey - The survey is extensive, so it would have been necessary an extensive period of time available for this approach to be productive. It included 31 questions. It takes about 20 minutes to answer if the information was on hand.

- Nature of the survey - The survey contains questions about information that may not be available on hand; therefore, further time may have been necessary to be scheduled for this task. Examples of that information are: amount of employees, average yearly budget, modal share in the service area, among other information.
- Nature of the respondents - The survey was oriented toward usually busy personnel such as middle management. Also, the survey includes some information that is not usually on hand; hence it was perceived that probably they would ask to receive the survey through e-mail to provide further answers.
- Labor hours - The potential respondents could be reached during labor hours. As indicated before, due to the survey’s extension, it would have been necessary an extensive period of time available for this approach to be productive.

The survey responsiveness is shown in Table 6-1.

Table 6-1 Survey Responsiveness

Email Invites	Visits	Some Response	Partials	All Blank	Completes
494	126	23	3	1	18
Out of Invites	25.51%	4.66%	0.61%	0.20%	3.64%
Out of Visits		18.25%	2.38%	0.79%	14.29%
Out of Responses			13.04%	4.35%	78.26%

As can be observed from Table 6-1, only 25.5% of invites actually visited the survey site. From them, only an 18.2% provided some response to the survey. From respondents, 78.3% were completes while 13% provided partial answers.

From the e-mail deployment, it is interesting to note that received responses were developed at a date very close to the deployment date, hence, maintaining the survey open for a long time didn’t provide significantly more responses. Also, most responses were received after sending an invitation with a style that appealed to some kind of identification of the prospective respondent to the researcher, such as association affiliation or occupation type.

Three of the responses didn't have deployment e-mail address attached, therefore, they probably responded to the social/professional networks posts and/or to a referral. Therefore, the internet networking posting was not a very productive approach for deployment, even after posting was made to specific populated transit groups.

The partial and complete responses were from the places indicated in Table 6-2.

Table 6-2 Origin of Responses (Confidential)

	City	State	Country
1	Bogotá	Bogotá	Colombia
2	San Juan	Puerto Rico	Puerto Rico
3	Barcelona	Barcelona	Spain
4	Unknown	Unknown	Unknown
5	Unknown	Unknown	Unknown
6	Sacramento	California	USA
7	Denver	Colorado	USA
8	Miami	Florida	USA
9	Crown Point	Indiana	USA
10	Port Tobacco	Maryland	USA
11	Howell	Michigan	USA
12	Vestal	New York	USA
13	Cleveland*	Ohio	USA
14	Cleveland*	Ohio	USA
15	Toledo	Ohio	USA
16	Xenia	Ohio	USA
17	Lima	Ohio	USA
18	Canton	Ohio	USA
19	Portland	Oregon	USA
20	Salt Lake City	Utah	USA
21	Roanoke	Virginia	USA
22	Milwaukee	Wisconsin	USA
* May be the same institution.			

As can be observed in Table 6-3, a 77.27% of the respondents were from the United States of America, being 6 of them (27.27% of respondents) from the state of Ohio.

Table 6-3 Summary of Respondents' Origin

Amount	Location	Percentage
1	PR	4.55%
17	USA States	77.27%
1	Spain	4.55%
1	Colombia	4.55%
2	Unknown location	9.09%
22	Total	100.00%
Observations		
6	From the states are OH	
2	From OH may be same place-> one of them was discarded for further analyses	

6.4 Survey Results

This section provides a summary of all survey respondents' profile, regardless of its origin.

Figure 6-1 shows the modes that were represented by survey respondents. As can be observed from the figure, most respondents were responsible for paratransit (68%) and for regular bus system (64%). Note that both express bus and light rail systems were represented by 36% of respondents, which were the next bigger modes represented.

Figure 6-1 Included Modes

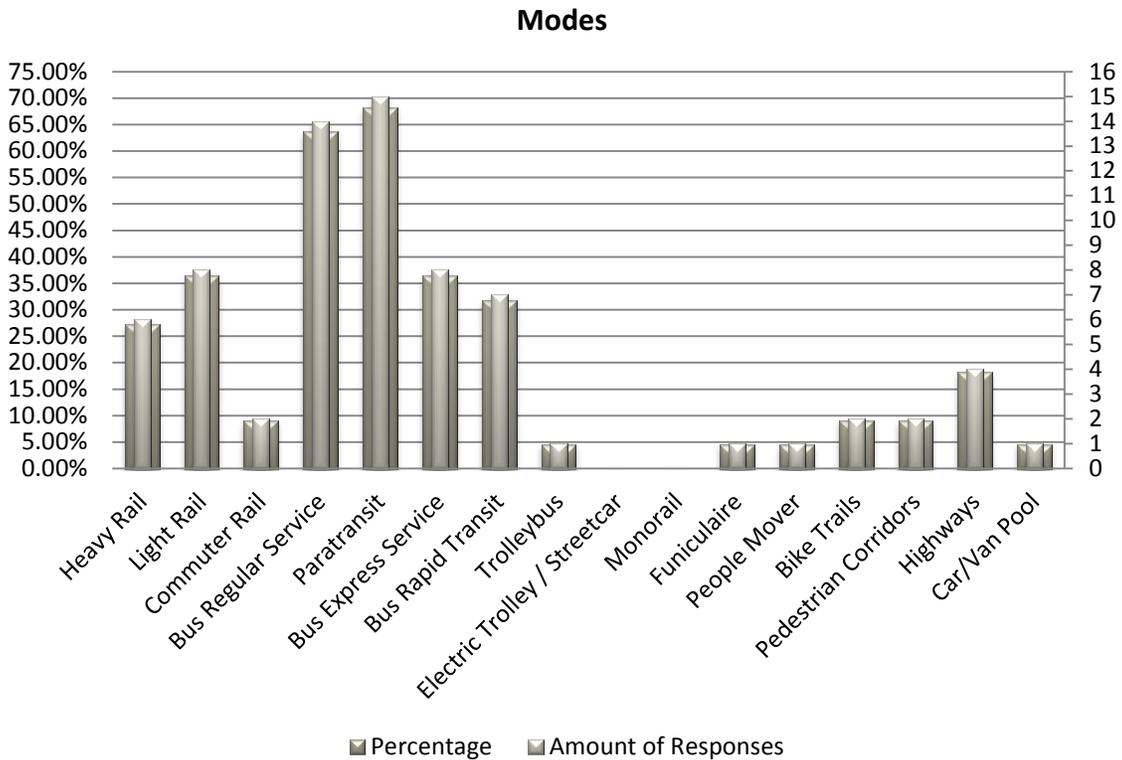
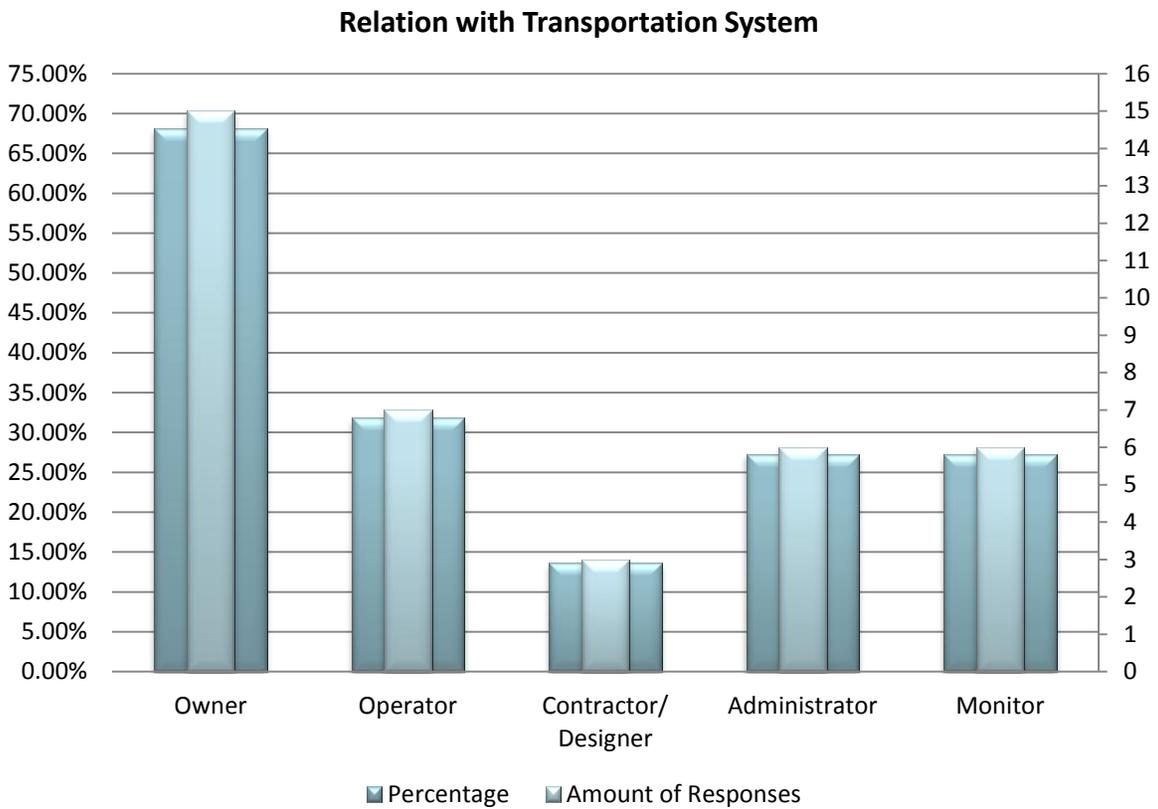


Figure 6-2 shows the respondents' institutions relation with the transportation system. As can be observed in the figure, most of them (68%) were owners, followed by the group of operators (32%).

Figure 6-2 Relation of Institution with Transportation System



The Figure 6-3 shows the nature of the service area represented by respondents of the survey. As can be observed in the figure, most of them (52%) were institutions of regional character, followed by state (19%), municipal (14%), county (10%) and federal (5%).

Figure 6-3 Service Area Extension

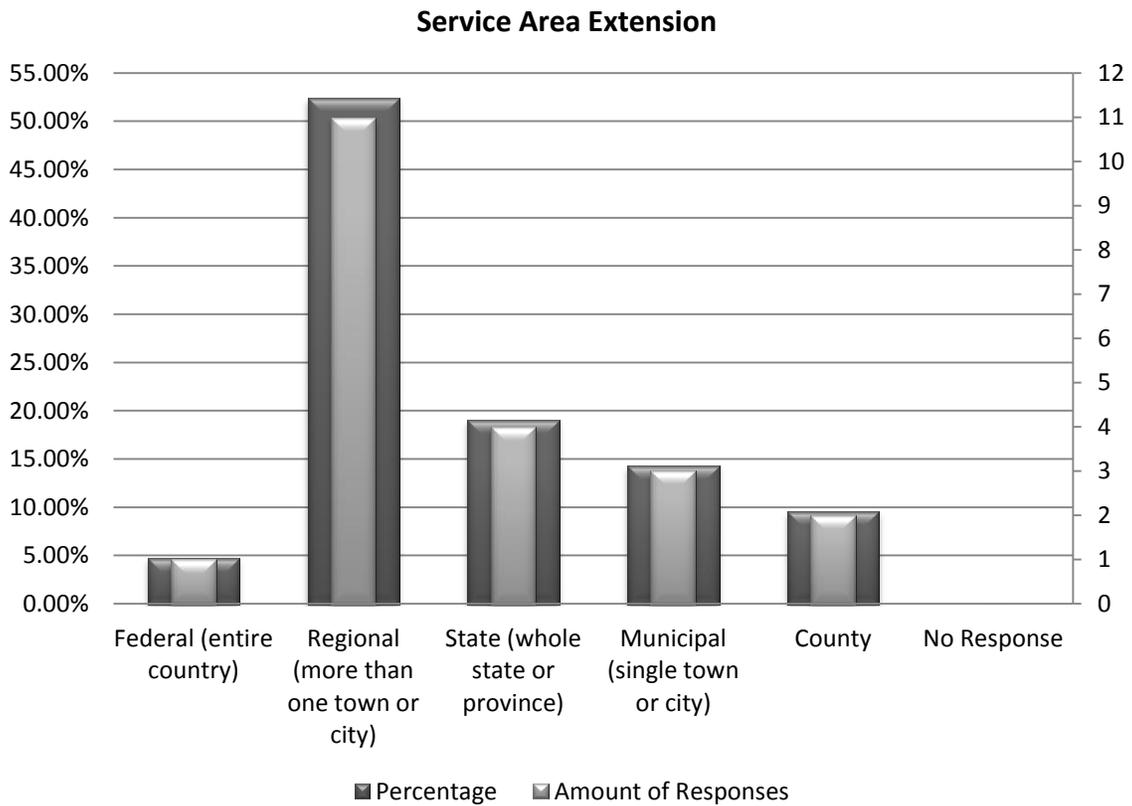


Figure 6-4 shows the year of the most recent data that respondents have available. As can be observed from the figures, most of them (81%) have data updated to the last concluded natural year, in this case, year 2010.

Figure 6-4 Latest Data Available

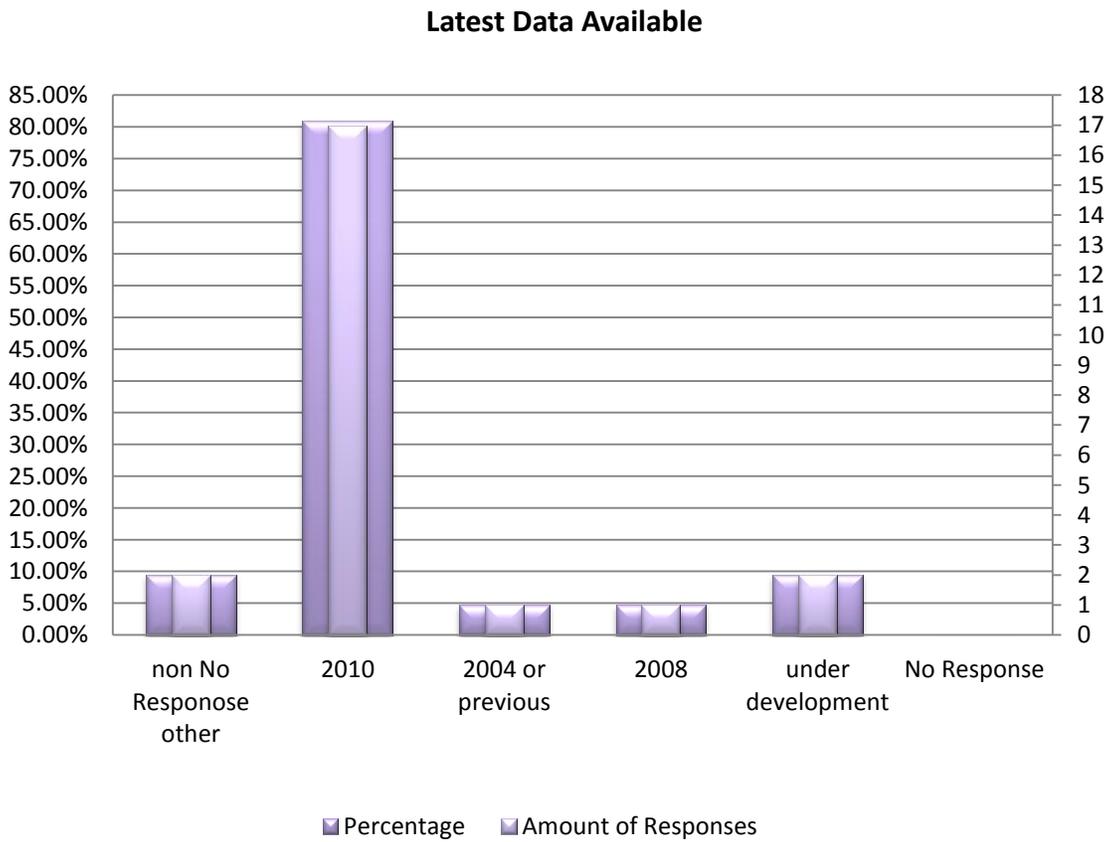


Figure 6-5 shows the owner of the institutions represented in the survey. As can be observed from the figure, the biggest proportion corresponds to regional governments with 36%, followed by state government with 14%.

Figure 6-5 Owner of Institution

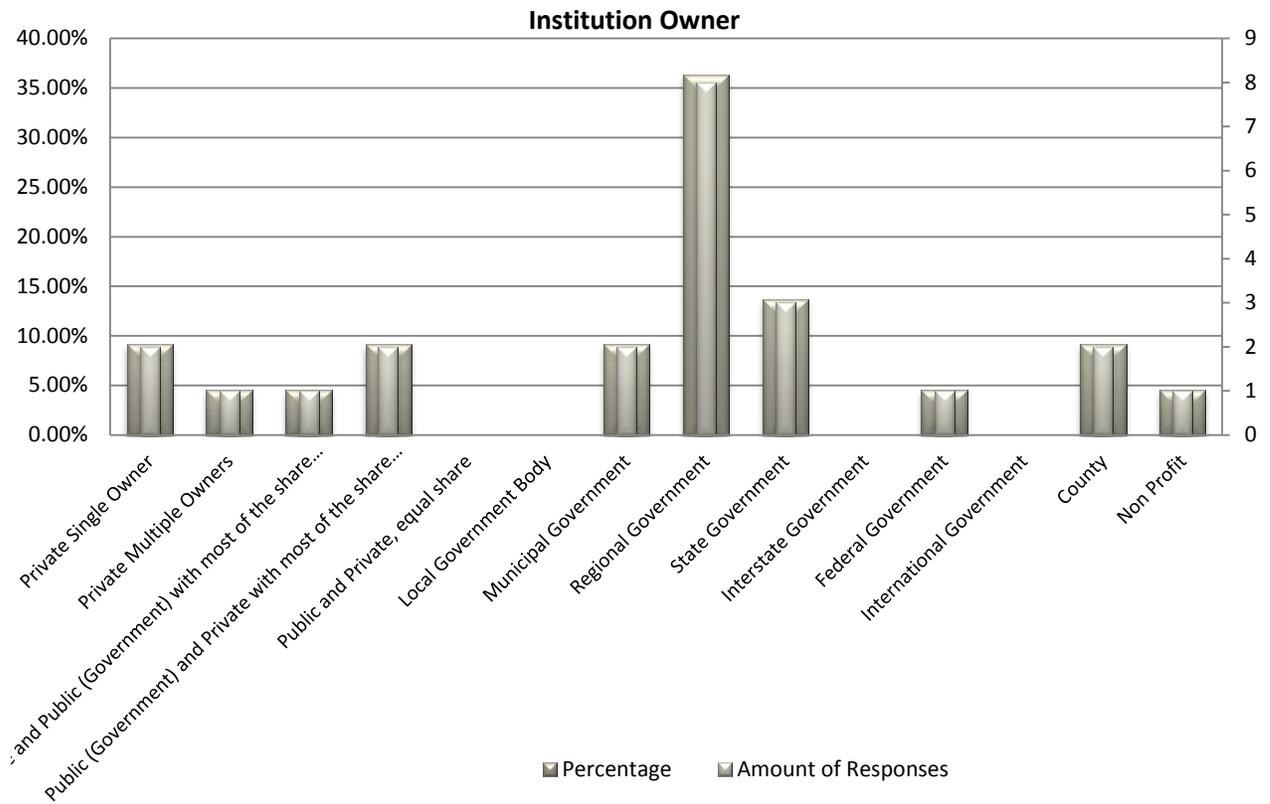


Figure 6-6 shows the type of company represented by respondents of the survey. The greater proportion corresponds to government public corporations (41%) followed by public agencies (32%).

Figure 6-6 Company Type

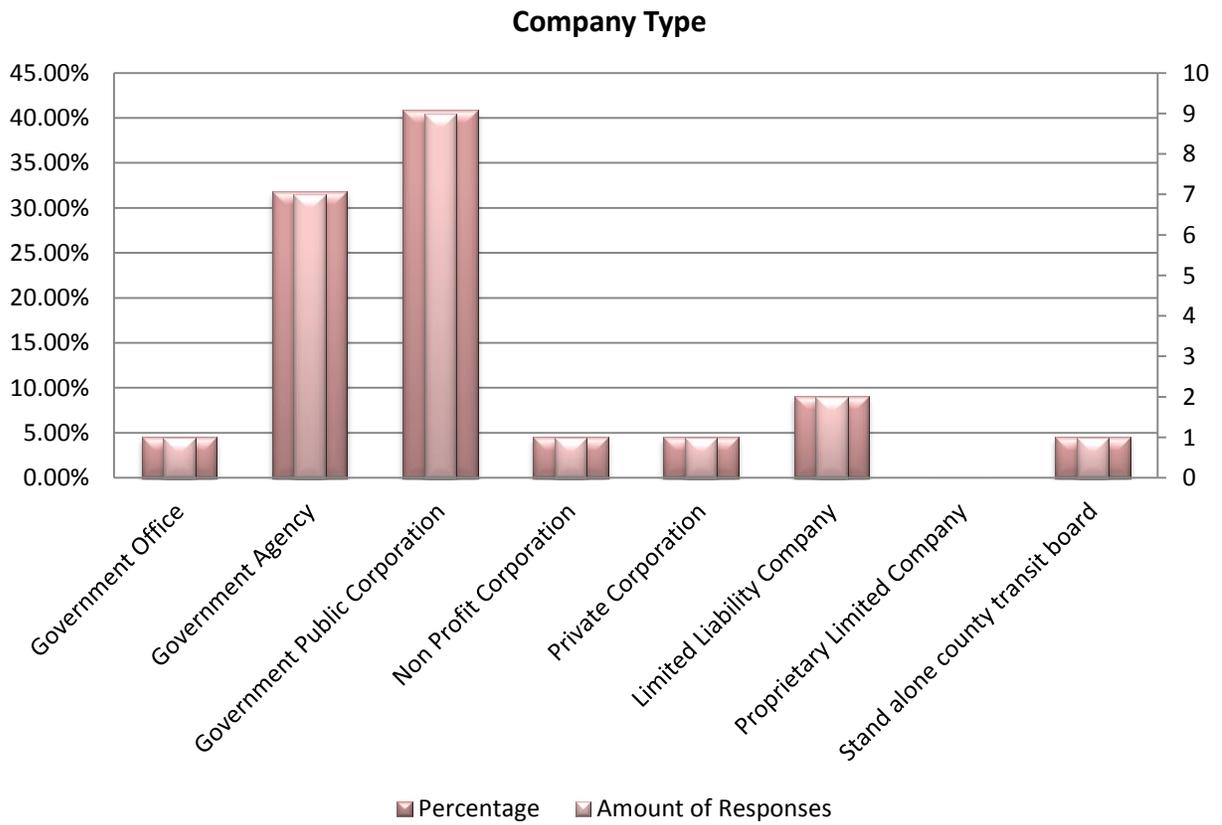


Figure 6-7 shows the nature of service subcontracted by the respondents. As can be observed from the figure, the greater proportion (45%) subcontracts services that include operation of transportation. The next biggest proportion (36%) does not subcontract services.

Figure 6-7 Services Subcontracted

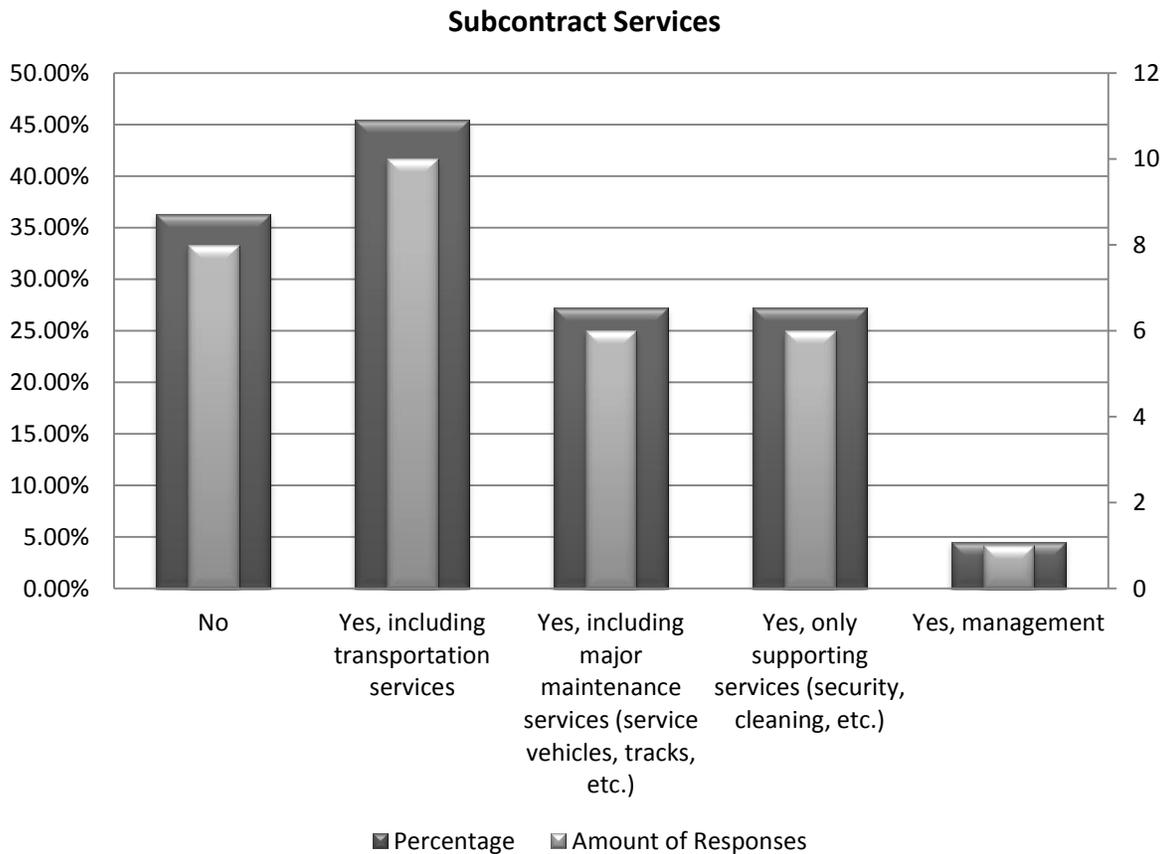


Figure 6-8 shows the portion of the business subcontracted as indicated by respondents. The survey shows that 32% of respondents subcontract 25% or less of the business. The next largest proportion corresponds to no subcontracts with 4%.

Figure 6-8 Portion of Business Subcontracted

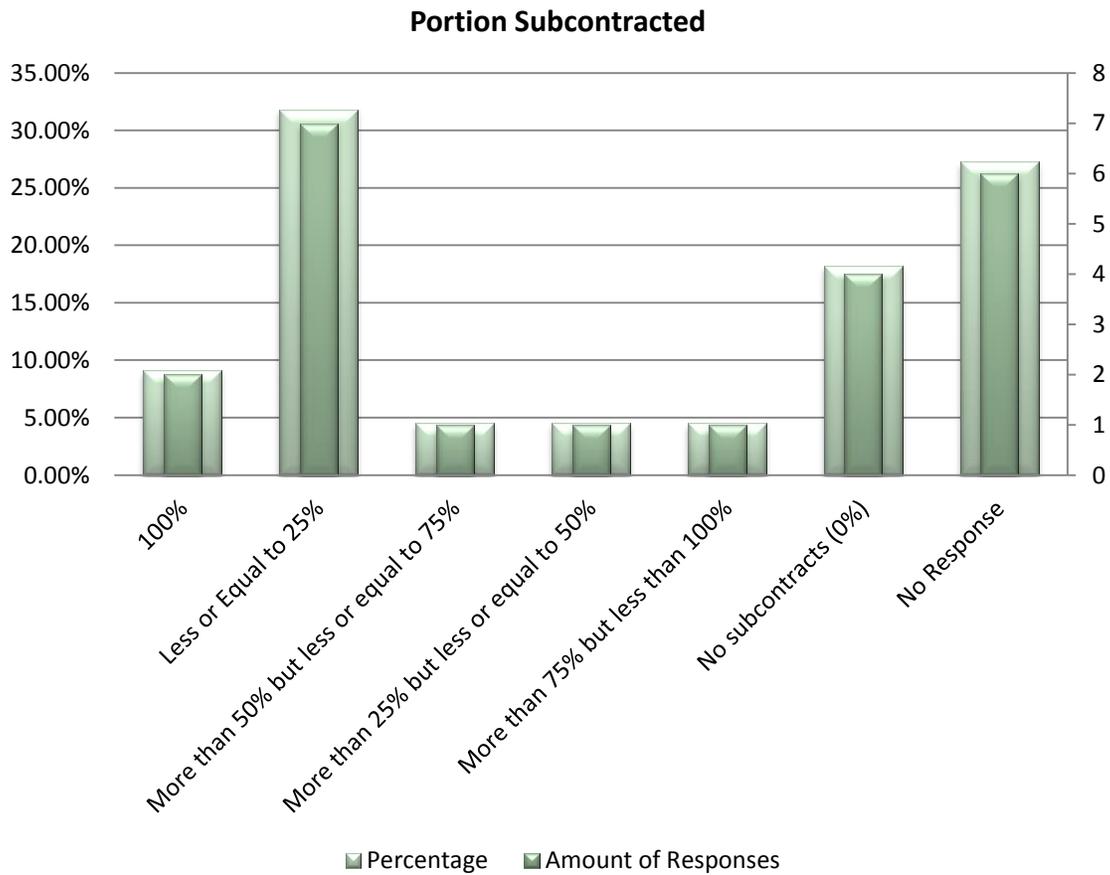


Figure 6-9 shows the existence and nature of integration of services engaged by respondents. The greater proportion corresponds to the existence of integration with services outside their service area (32%). The next biggest percentage (27%) claims to have integration, including integration with services within their service area that are administered by other entities.

Figure 6-9 Integration of Services

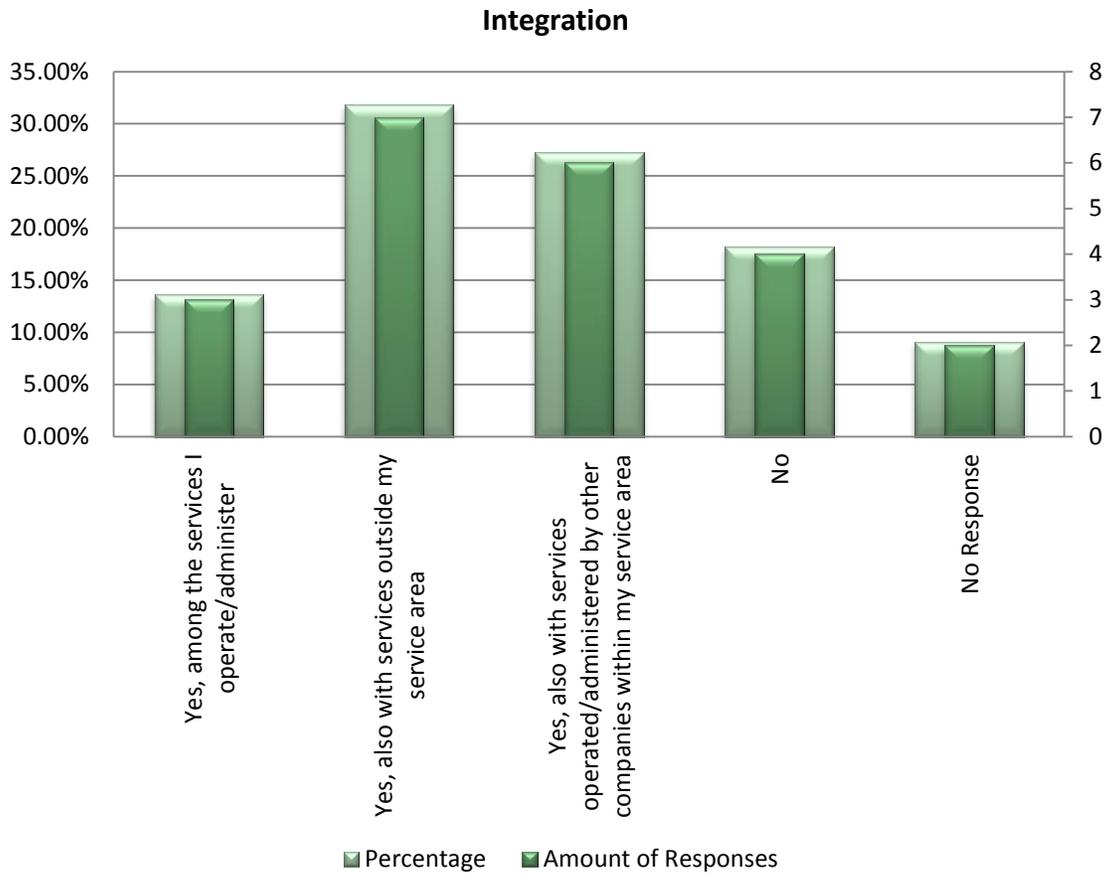


Figure 6-10 shows the elements integrated in the services procured by respondents. The greatest proportion (45%) indicates that the routes are integrated. The next biggest proportion corresponds to integration of transfer terminals (41%) followed by schedule integration (36%).

Figure 6-10 Elements Integrated

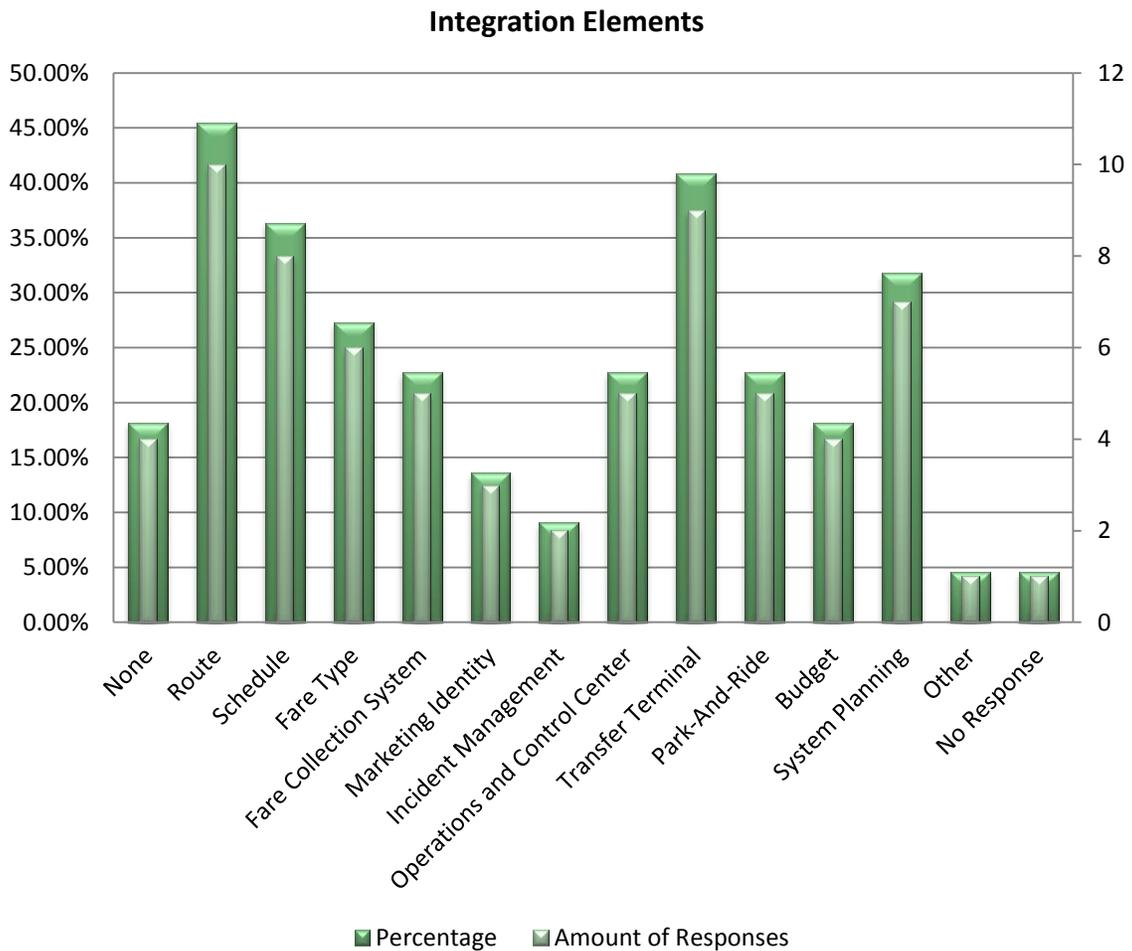


Figure 6-11 shows the styles of top level leadership. The sample indicates that 41% of respondents claimed that their top level leadership had, among others, a participative style. The next biggest proportion was the transformational style with 27%.

Figure 6-11 Top Level Leadership

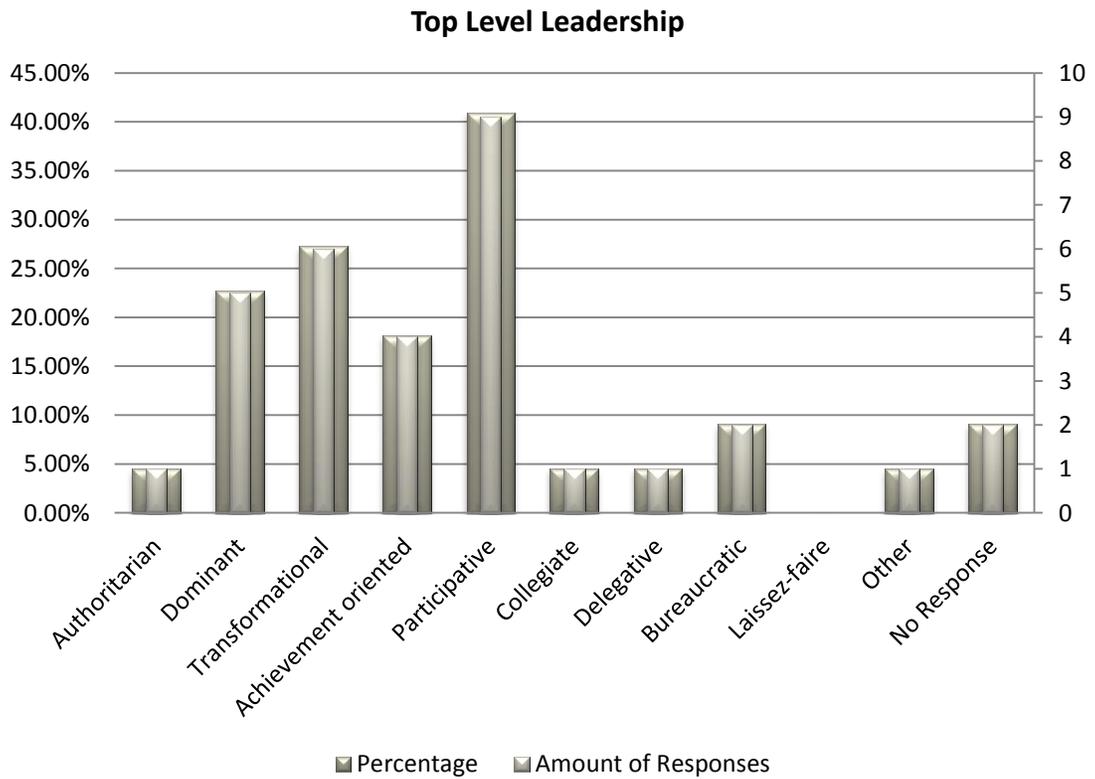


Figure 6-12 shows the medium level leadership style. At mid-level, the leadership style appears to be more diverse than at top level. The greatest proportion was for achievement oriented with 27%, followed by dominant with 23%.

Figure 6-12 Medium Level Leadership Style

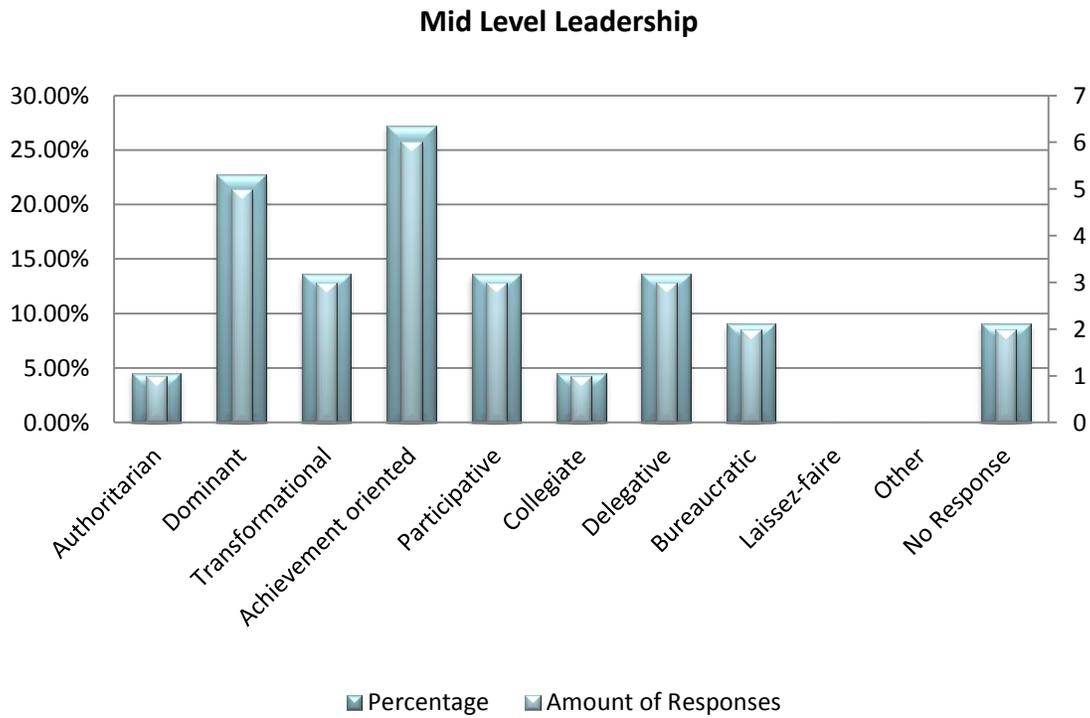


Figure 6-13 shows five organizational culture characteristics. The respondents were asked to indicate how much they agree to the sentence referring to each characteristic. Most respondents agree to some level in the existence of sense of belonging and pride in the job performed. Note also that 23% and 18% somehow disagree to the statements indicating that a change in administration and in political party, respectively, does not necessarily mean a change in vision, mission and objectives of the business.

Figure 6-13 Some Organizational Culture Characteristics

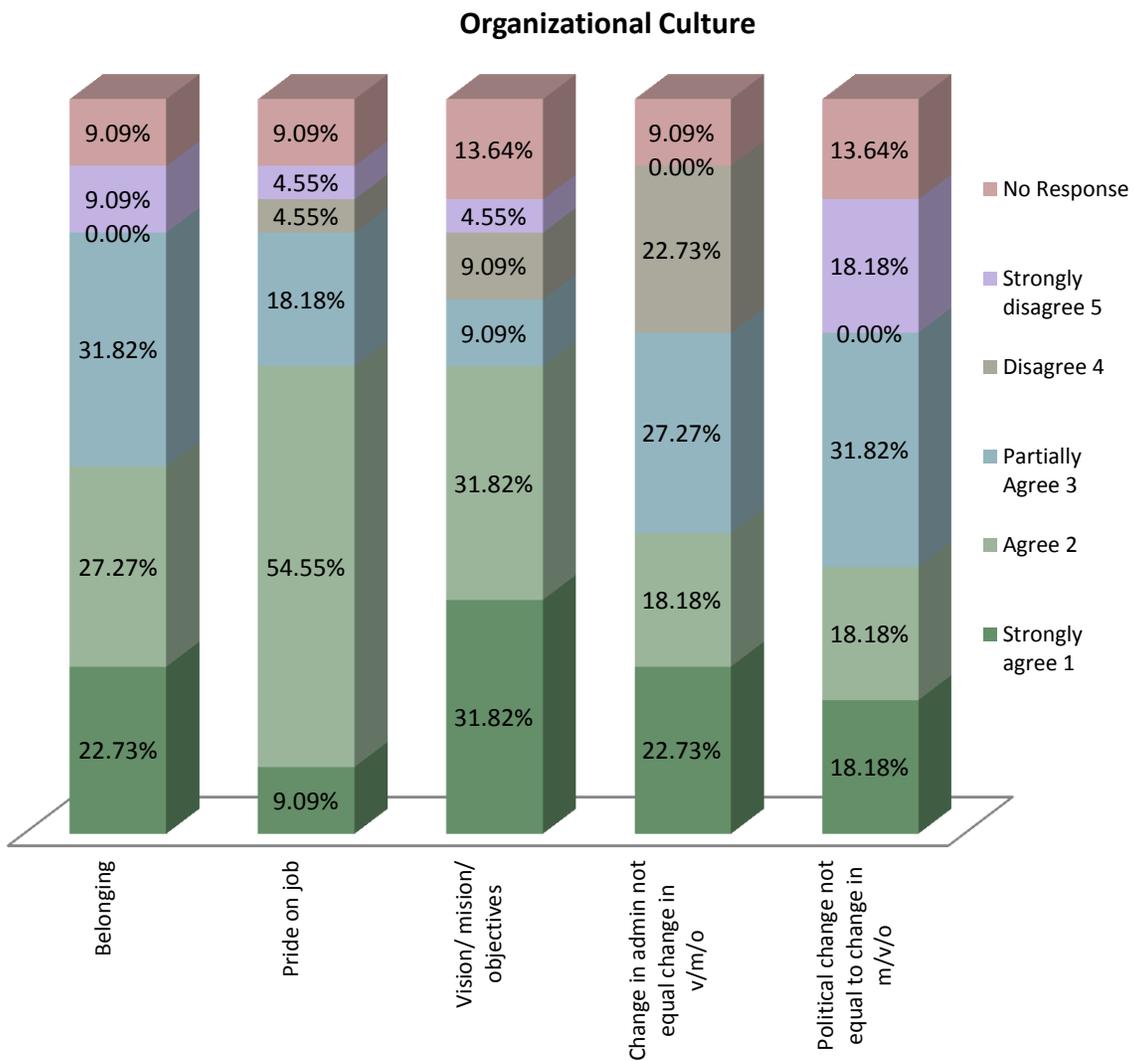


Figure 6-14 shows the frequency of change in vision/mission/objectives. The greatest proportion (41%) indicated that the frequency of change was more than two years but less or equal to five. The next biggest group was the frequency of more than five years but less than 10 years, with a 32%.

Figure 6-14 Frequency of Change of Vision/Mission/Objectives

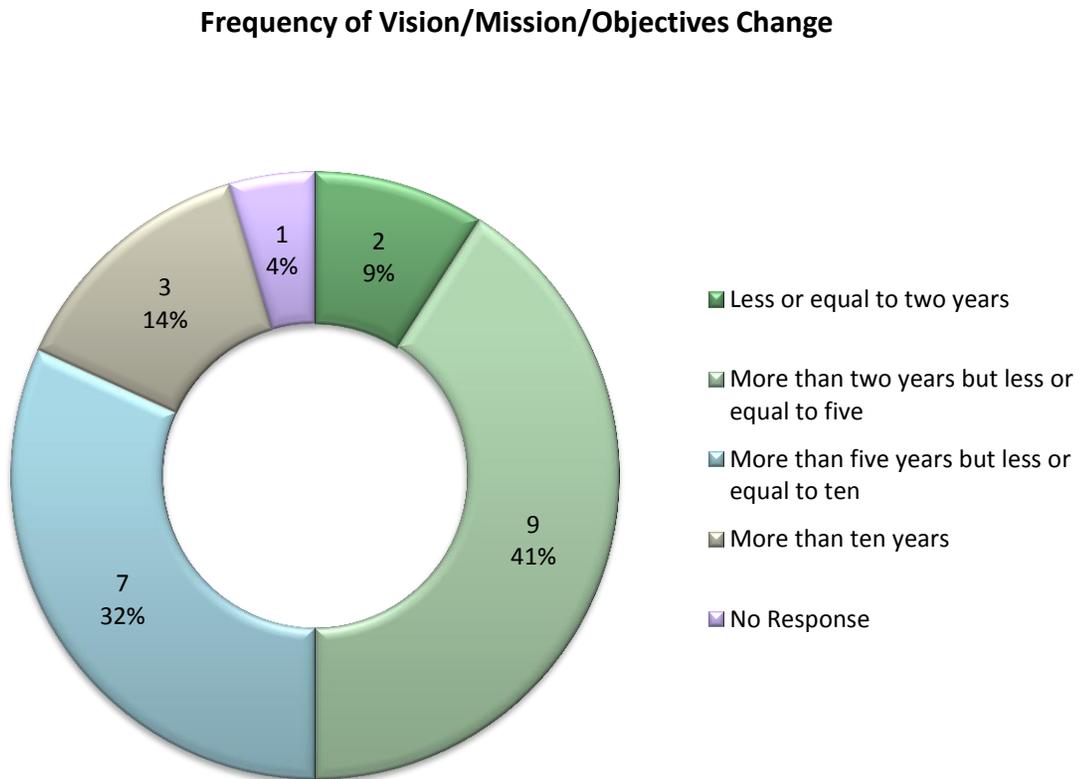
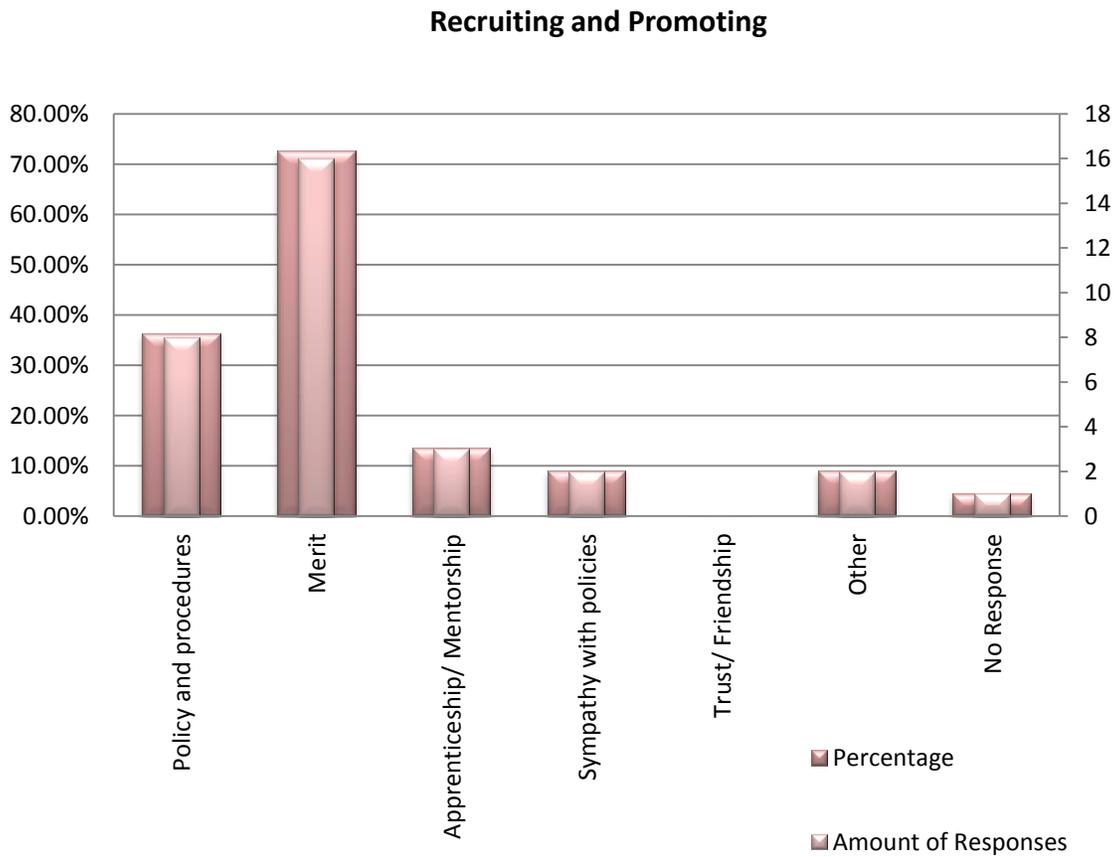


Figure 6-15 shows that most respondents (73%) indicated that recruiting and promoting includes a merit basis, followed by policies and procedures (36%). A 10% indicated that sympathy with policies influences recruiting and promoting.

Figure 6-15 Recruiting and Promoting Strategies



The respondents were asked about their level of agreement with phrases regarding their employer’s culture and policies regarding employees. Figure 6-16 shows that a majority agree on the existence of side benefits, policies for recruiting and promoting, and employment stability. A significant portion disagree on the existence of employee retention program (32%), the participation of employees on decision making process (27%), patron’s advertisement as employer (23%) and promotion opportunities (23%).

Figure 6-16 Employee Policy Culture

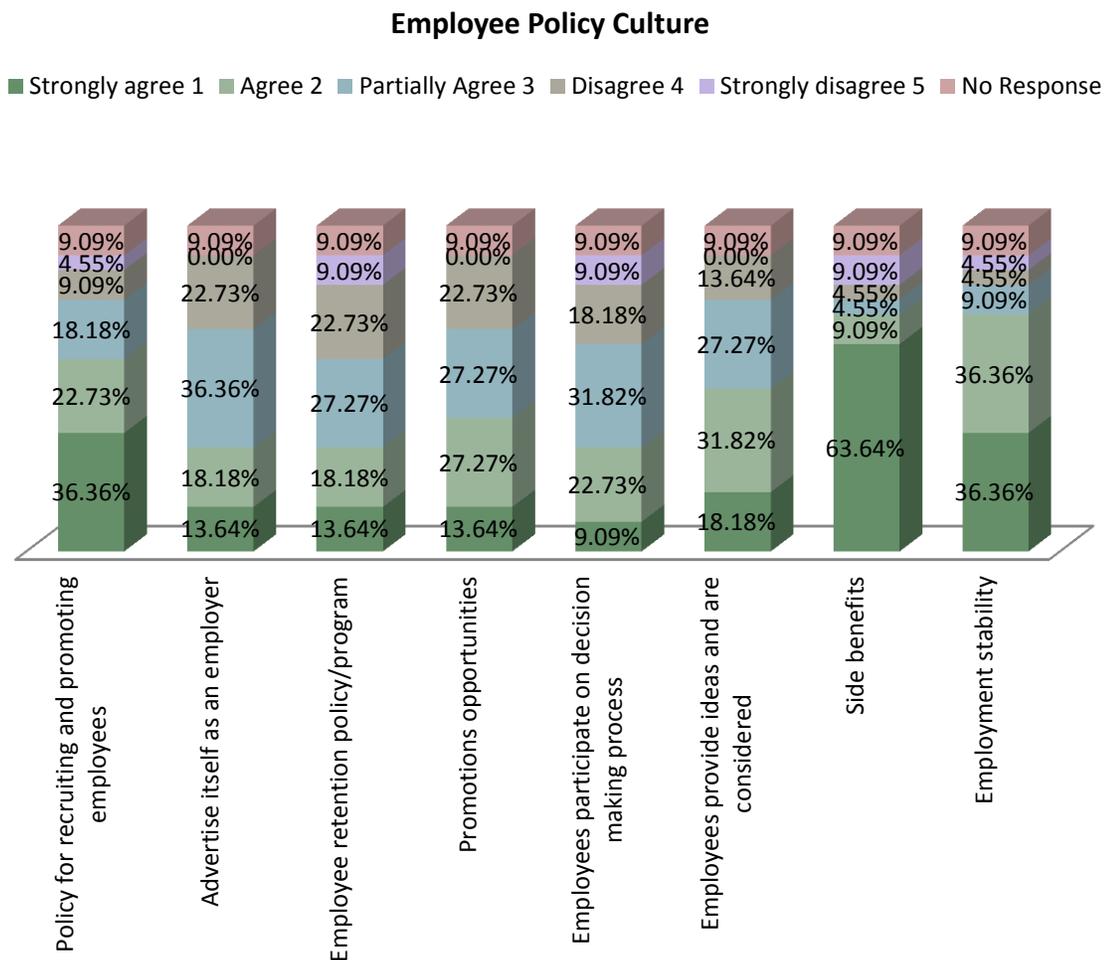


Figure 6-17 shows that the greatest proportion of responses (32%) was for the indication of the non-existence of employee retention benefits. The next largest proportions were for monetary, promotion and others, each with 27%.

Figure 6-17 Employee Retention Benefits

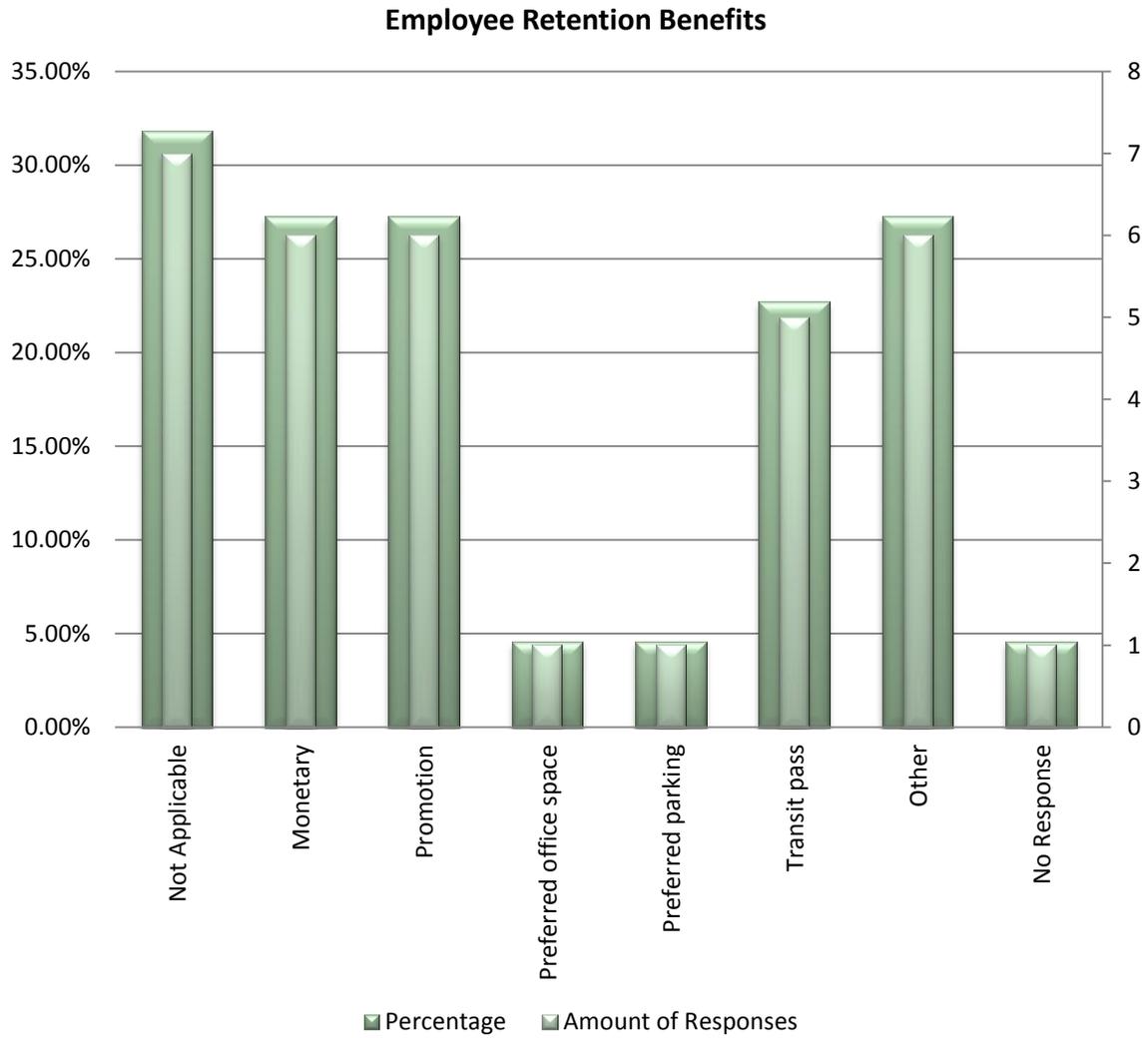


Figure 6-18 shows that the response of “more than two years but less or equal to five” was the greatest, with a 36%. The next largest response was “more than five years but less than ten years”, with 32%. The response of “more than ten years” was selected by a 23% of survey respondents. These proportions were somehow compatible with the indicated frequency of change of vision/mission/objectives.

Figure 6-18 Administration Lifespan

Typical Administration Lifespan

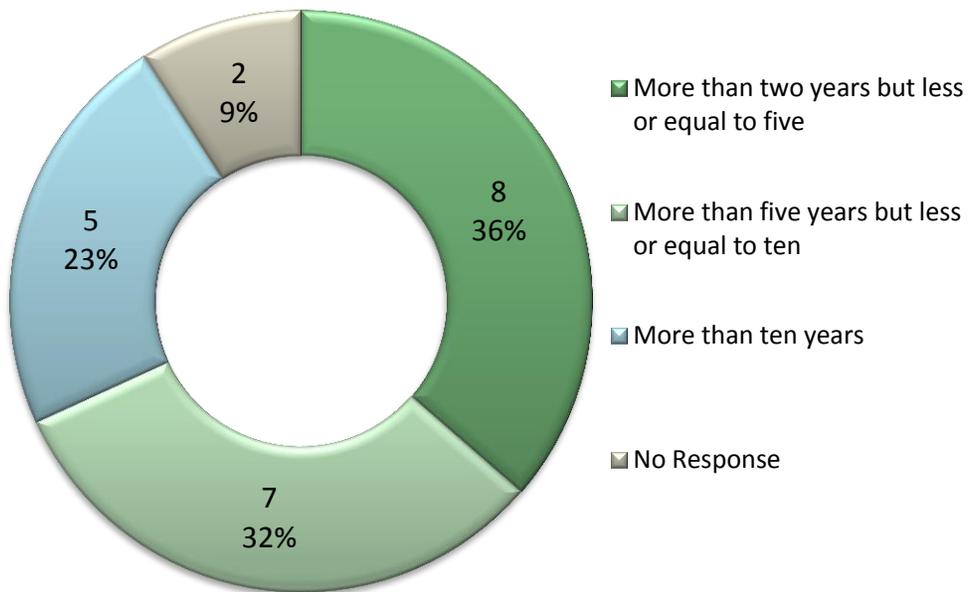


Figure 6-19 shows that the greatest proportion of respondents were top management (36%), followed by mid-level management (23%) and professional employees (23%).

Figure 6-19 Respondents' Employee Type

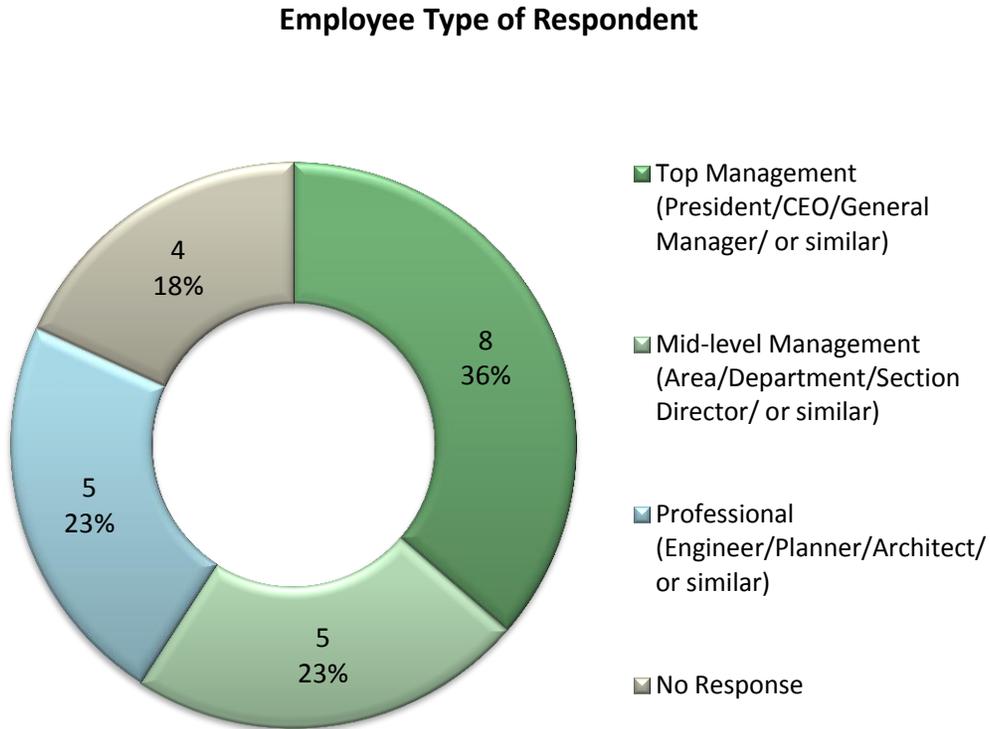


Figure 6-20 shows that 45% of respondents agreed to be acknowledged as well as their institution, 18% agreed to acknowledge the institution only, 9% agreed to be acknowledged personally only.

Figure 6-20 Acknowledgement Mention

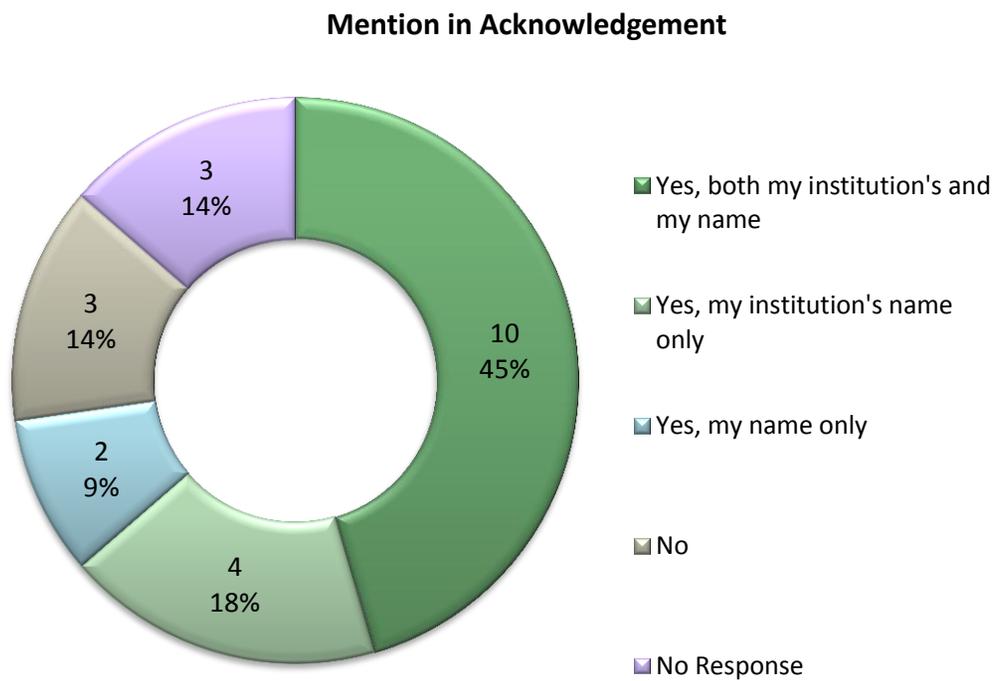


Figure 6-21 shows that the greater proportion of respondents (23%) had a yearly ridership (defined as yearly unlinked passenger trips) to service population ratio of one or less. The next biggest proportion (18%) was for such ratio between 40 and 60.

Figure 6-21 Ridership / Service Population

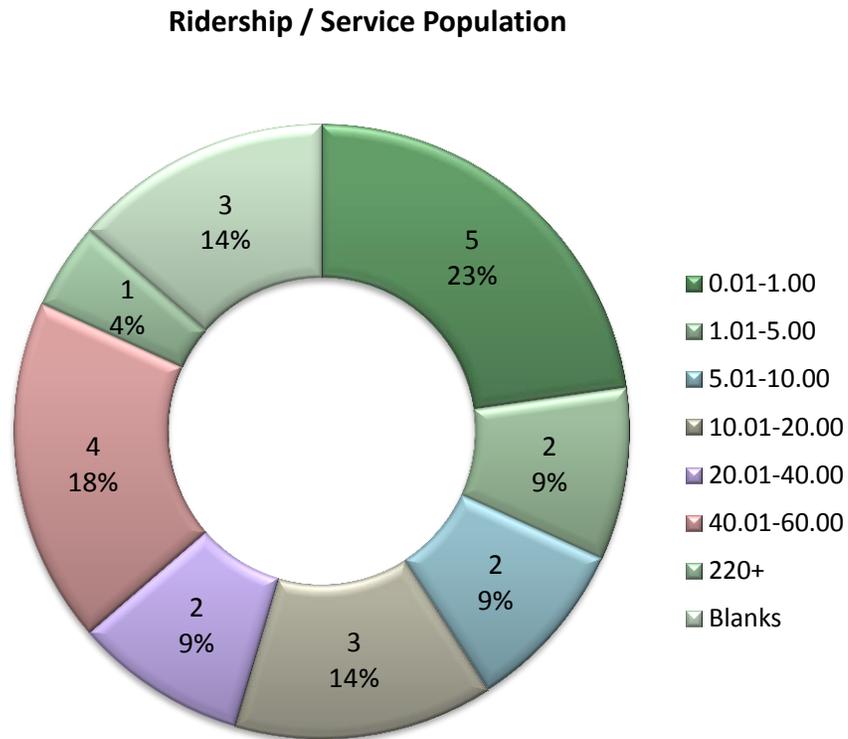


Figure 6-22 shows the ratio of service population over employees. The greatest proportion was for the ratios ranging from 300 to 800 and from 1,000 to 2,500, with 23% each. The next proportion was for the ratios ranging from 2,501 to 10,000 and from 17,000 to 30,000 with 18% each.

Figure 6-22 Service Population / Employees

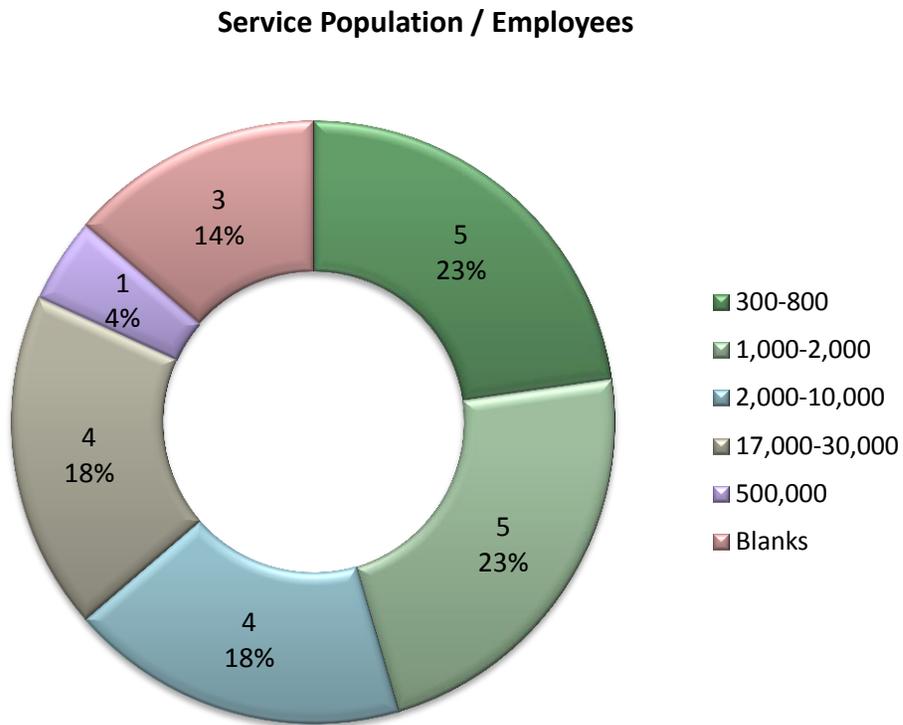


Figure 6-23 shows that most respondents were non-responsive regarding budget. The ratio of budget to service population with the greatest percentage of responsive answers was from 100 to 200, with 18%.

Figure 6-23 Budget / Service Population

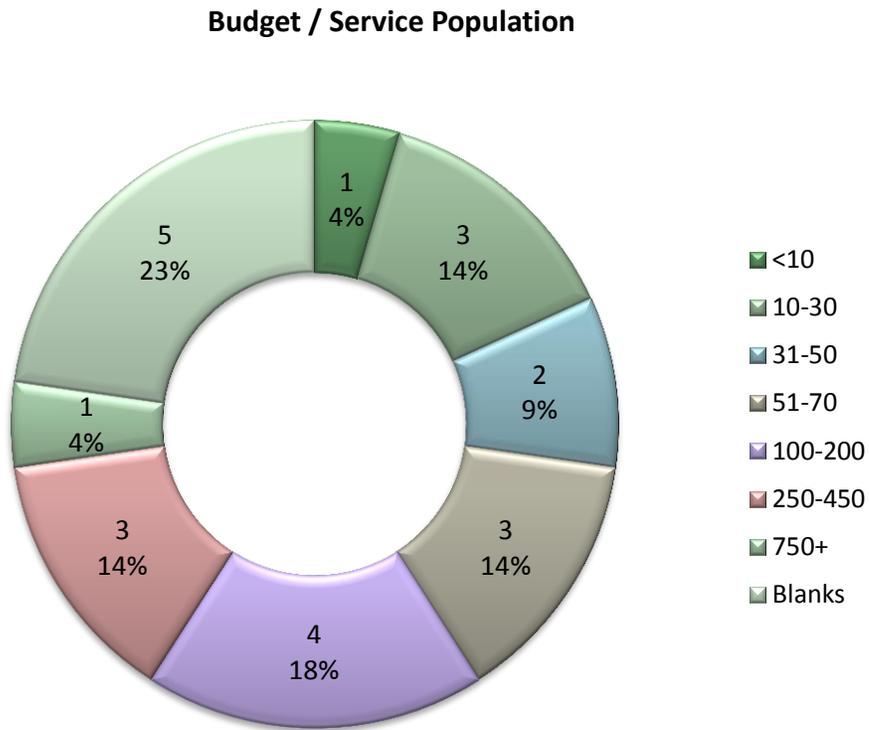
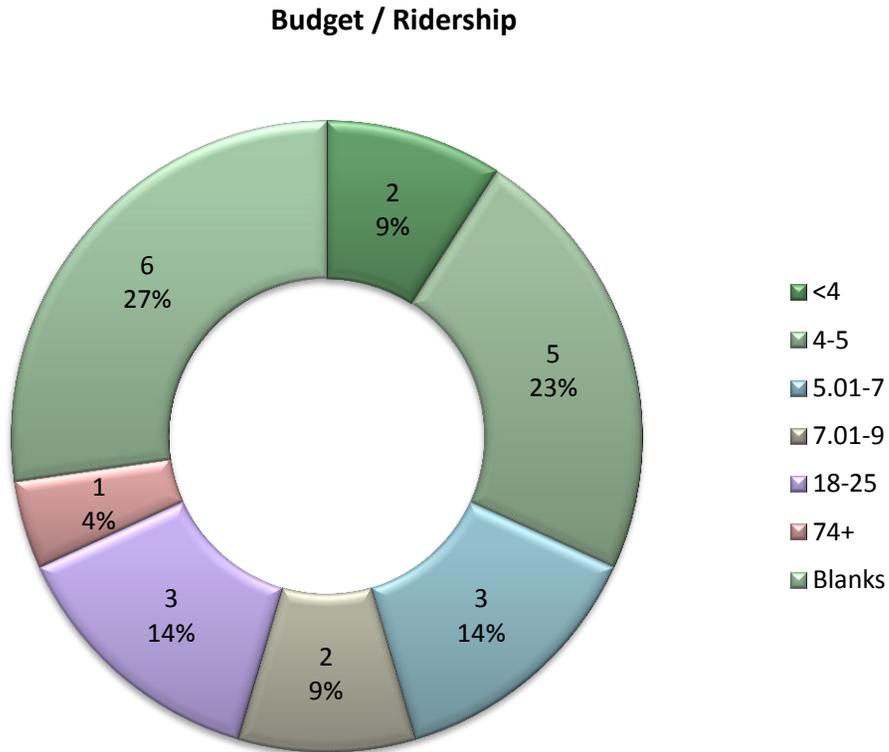


Figure 6-24 shows the ratio of budget over ridership. The greatest proportion of responsive respondents (23%) indicated that such ratio was between four and five.

Figure 6-24 Budget / Ridership



A summary of Respondents' Profile is presented in Table 6-4.

Table 6-4 Respondents' Profile Summary

Characteristic	Profile Detail
Internal Organization Environment	About 55% agree or strongly agree that the employees have strong sense of belonging to the company
	About 60% agree or strongly agree that employees have pride on their job
	About 65% agree or strongly agree that employees have clear knowledge of the vision/mission/objectives of the company
	About 40% agree or strongly agree that changes in the administration does not imply changes in the vision/mission/objectives of the company
	About 35% agree or strongly agree that political changes does not imply changes in the vision/mission/objectives of the company
	About 41% indicated that vision/mission/objectives typically change between two and five years, while 32% indicated that they typically change between five to ten years
	About 70% indicated that recruiting and promoting is due merit
	About 60% agree or strongly agree on having a policy for recruiting and promoting
	About 30% agree or strongly agree regarding their company advertising themselves as employers
	About 40% agree or strongly agree on having promotion opportunities
	About 30% agree or strongly agree on having their employees participating on the decision making process
	About 50% agree or strongly agree on considering their employees' ideas
	About 70% agree or strongly agree on having side benefits for their employees
	About 70% agree or strongly agree on having employment stability on their company
	About 30% indicate not having employee retention benefits
Modes	About 70% include paratransit
	About 65% include regular bus service
Relation	About 70% were owners of the transportation system
Service Area	More than 50% were regional institutions
Most Recent Data	About 80% have 2010 data available
Owner	More than 35% of institutions are owned by regional government
Company Type	About 40% were Government Public Corporations, about 30% were Government Agencies
Subcontracts	About 45% subcontract transportation services
Portion Subcontracted	About 30% subcontract 25% or less of their business. About 25% did not answer.
Integration	About 30% have integration with services outside their service area, about 25% have integration with services administered by others within their service area
Integrated Elements	About 45% have route integration, about 40% have integration at the transfer terminal, about 35% have schedule integration, about 30% have integration in their system planning

Characteristic	Profile Detail
Top Management Leadership	About 40% includes the Participative style
Mid Management Leadership	About 25% includes a style Achievement Oriented, while about 20% includes a Dominant style
Administration Lifespan	About 36% indicate having a typical administration lifespan between two and five years, while 32% indicated that it lasts between five and ten years
Respondent	About 36% of respondents were top management, 23% mid management and 23% professional employees
	About 45% agreed to have their name and institution acknowledged for participating, 18% the institution's name only

6.5 Definition of Variables from Survey

There were twenty-seven (27) questions regarding the organization in the survey; some included multiple possible responses related to the system and transit company. Out of the questions with significant responsiveness, a total of 35 variables were developed. Such variables and their classifications for further analyses are presented in Table 6-5.

Table 6-5: Variables and Classifications

	Variable	Classifications
1	Amount of Modes	1-2, 3-4, 5-6
2	Type of Modes	includes train, includes bus (no train), demand response only
3	Amount of Roles	1, 2, 3, 4+
4	Type of Roles	administrate/monitor, owner, contractor, own + operate
5	Service Area	municipal/county, regional, state or federal
6	Percent Transit Use	<6%, 6-12%, 12-18%, 18-24%
7	Owner (Institution)	government, private, public + private
8	Company Type	government office, government agency, public corporation, limited liability corporation, non-profit corporation
9	Contracts/Subcontracts	yes, no
10	Percent of Business Contracted	none, up to 25%, more than 25%
11	Population/ Employees	less than 5k, 5k or more
12	Budget/ Population	less than 20, 36 to 66, more than 100
13	Integration	none or within services our company provide, within service area, outside service area
14	Amount Elements Integrated	up to 3, more than 3
15	Integrated Elements	none, planning &/or budget, operation

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

	Variable	Classifications
16	Top Leadership Style	single, combination
17	Mid Leadership Style	single, combination
18	Sense of Belonging	strongly agree & agree, partially agree, disagree & strongly disagree
19	Pride in Job	strongly agree & agree, partially agree, disagree & strongly disagree
20	Understand Vision/ Mission/ Objectives (VM)	strongly agree & agree, partially agree, disagree & strongly disagree
21	Change in Administration Doesn't Change VMO	strongly agree & agree, partially agree, disagree & strongly disagree
22	Change in Political Party Doesn't Change VMO	strongly agree & agree, partially agree, disagree & strongly disagree
23	VMO Frequency of Change	5 years or less, more than 5 years
24	Policy to Recruit and Promote	strongly agree & agree, partially agree, disagree & strongly disagree
25	Company Advertise itself as Employer	strongly agree & agree, partially agree, disagree & strongly disagree
26	Retention Program	strongly agree & agree, partially agree, disagree & strongly disagree
27	Promotion Opportunities	strongly agree & agree, partially agree, disagree & strongly disagree
28	Participation in Decision Making	strongly agree & agree, partially agree, disagree & strongly disagree
29	Employees' Ideas Considered	strongly agree & agree, partially agree, disagree & strongly disagree
30	Side Benefits	strongly agree & agree, partially agree, disagree & strongly disagree
31	Employment Stability	strongly agree & agree, partially agree, disagree & strongly disagree
32	Amount of Retention Benefits	0, 1, 2, 3, 4
33	Benefits	n/a, fringe only, bonus or promotion opportunity to deserving
34	Bonus or Promotion Opportunity to Deserving	yes, no
35	Administration Span (years)	[2,5], (5,10], 10<

7 STUDY POPULATION AND SAMPLE REPRESENTATION

The study population is the one composed from National Transit Database (NTD) reporting institutions. For this research, 2009 NTD data was used. This study population was selected mostly due the following reasons:

- This population represents transit systems in the United States of America.
- Most Puerto Rico's transit systems reports to the NTD.
- The population is known, so its parameters can be calculated and compared to the sample.
- Most survey respondents belong to this known population.
- The NTD is an official, established and systematic data collection process that gathers and publically publishes important information for transportation planners, engineers and policy makers. The NTD could consider the results of this study for future data collection, so its users could benefit from such information.

The analysis performed includes the following:

- Test for normality
- Calculation of parameters such as mean and standard deviation of the ridership per service population
- Re-definition of NTD organization-related variables for further statistical analysis
- Calculation of correlation for NTD re-defined variables, using Eta and Spearman as applicable.

As previously indicated, ridership is the variable of interest and is also the indicator used to represent flows in the proposed framework.

7.1 Test for Normality

The first step was to determine if the subject population follows a normal distribution in relation to ridership. As higher ridership could be expected in bigger systems, each ridership

data point was divided by its service population so fair comparisons can be made (“normalization”).

The dependent variable (ridership/service population) was tested for normality. All available NTD 2009 data points were used. They are 710 data points, from which 603 included ridership data. As not all systems operated the same amount of days during the reporting year, Unlinked Passenger Trips (UPT) reported for year 2009 was divided by the amount of days each system and mode operated in such year. The data from all modes operated by each institution was added and included as a single data value for the single institution. SPSS 10.0 was used to perform the test. Results are shown on Table 7-1 and Figure 7-1. As can be observed, the null hypothesis of normality is rejected as the Significance value is less than selected alpha value of 0.05 (Schofield & Smith, 1999). It can also be observed on the histogram that it does not have a bell shape, hence, does not appear to follow the normal distribution. Also, the Normal Q-Q Plot does not follow a distribution close to the line⁶, as the Detrended Plot distribution is not around the zero line⁷. Therefore, it was concluded that this variable does not follow a normal distribution.

This information is useful for selecting the statistical analysis that can be used in further analysis. Those analyses include: the estimation of confidence intervals for the representation that the statistics holds regarding parameters and making inferences about model parameters.

For example, inferring about least square regression parameters requires that the disturbances or errors will be approximately normally distributed with expected value of zero

⁶ The Normal Q-Q plot shows observed values against the normal distribution. If the distribution is normal, the plot would have observations distributed closely around the straight line. (Chico, Fiddler, Hecht, Nelson, Nelson, & James Ross, 2000)

⁷ The Detrended Normal Q-Q plot, shows the differences between the observed and expected values of a normal distribution. If the distribution is normal, the points should cluster in a horizontal band around zero with no pattern. (Chico, Fiddler, Hecht, Nelson, Nelson, & James Ross, 2000)

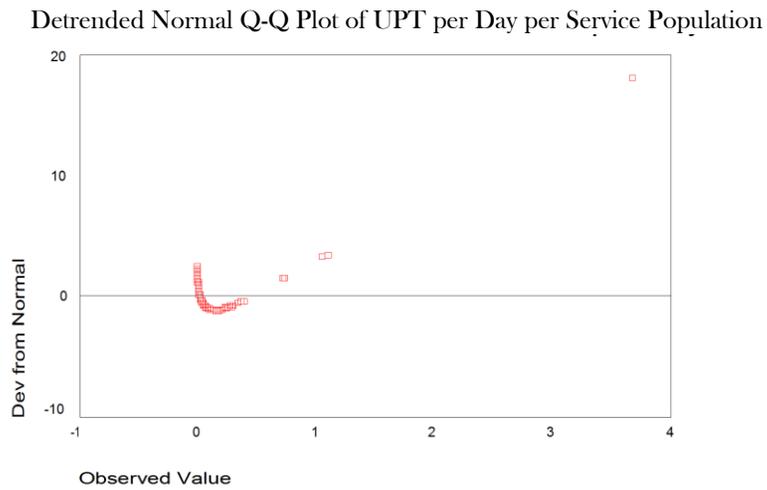
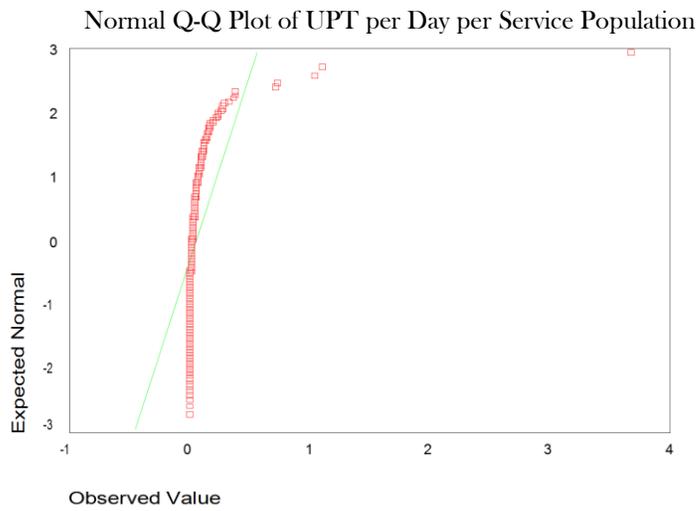
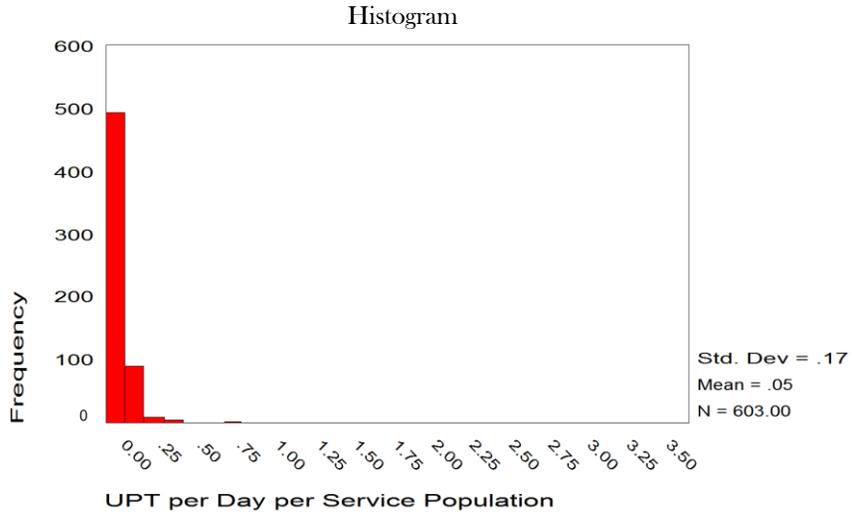
and variance equal for all observations [$\varepsilon \approx N(0, \sigma^2)$]. This results on dependent values following a normal distribution. (Washington, Karlaftis, & Mannering, 2003)

Therefore, in this case, inferences about a possible model derived from least squares regression will not be feasible.

Table 7-1 Normality Test Results

Case Processing Summary						
		Cases				
		Valid		Missing		Total
		N	Percent	N	Percent	N
UPT per Day per Service Population		603	84.9%	107	15.1%	710 100.0%
Descriptive						
		Statistic			Std. Error	
UPT per Day per Service Population	Mean	5.05925E-02			6.99759E-03	
	95% Confidence Interval for Mean	Lower Bound	3.68499E-02			
		Upper Bound	6.43352E-02			
	5% Trimmed Mean	3.24760E-02				
	Median	2.30419E-02				
	Variance	2.953E-02				
	Std. Deviation	.171833				
	Minimum	4.6022E-05				
	Maximum	3.6762				
	Range	3.6761				
	Interquartile Range	4.16036E-02				
	Skewness	16.616			.100	
Kurtosis	334.559			.199		
Tests of Normality						
		Kolmogorov-Smirnov(a)				
		Statistic		df	Sig.	
UPT per Day per Service Population		.384		603	<0.001	
a Lilliefors Significance Correction						

Figure 7-1 Normality Test - UPT per Day per Service Population (NTD 2009)



7.2 NTD Organizational Variables

The main interest of this research is in the organizational variables that are related to the internal environment of the transportation organization. Most NTD variables are related with organizations' capacity (i.e. amount of vehicles, budget, etc.) and service provided (i.e. vehicle miles, employee hours, etc.). The NTD (2009) also records other organizational variables such as Amount of Strikes, Agency Type and Institution Type, which are more related to the internal environment. As the Amount of Strikes is extremely non-responsive or mostly zero, this variable cannot be used for analysis.

The Agency Type variable records one of the following alternatives:

1. Public agency or authority that directly operates all transit service (not a State DOT)
2. Public agency or authority that contracts for some or all transit service (not a State DOT)
3. State Department of Transportation
4. Private transportation provider reporting on behalf of a public agency or authority (not a broker)
5. Private transportation broker reporting on behalf of a public agency or authority
6. Others

The Institution Type variable records one of the following alternatives:

1. Independent Agency with an elected Board of Directors
2. Independent Agency with an appointed Board of Directors
3. Subsidiary Operating Unit of Regional Agency
4. Unit of City or Municipal Government
5. Unit of County Government
6. Unit of State Government
7. Private Operator
8. Other

The information contained in these two variables is very comprehensive and mixed. Therefore, they were used to define more specific variables as follows:

- Unit of Government - Defines whether the institution is
 1. Independent agency
 2. Unit of City or Municipal government
 3. Unit of County government
 4. Unit of Regional agency
 5. Unit of State government
 6. Other that is not a State DOT

- Board Type of Independent Institutions as
 1. Appointed
 2. Elected
 3. Not Applicable

- Type of Operation as
 1. Public
 2. Private
 3. Contracts some or all and is not a State DOT

The information, however, have some issues:

- It cannot be determined the level of transportation services contracting, as the option allows for some or all.
- The type of operation of State DOT's, whether public or private, cannot be determined, as it has its own selection as State DOT or unit of State government.
- It cannot be determined if other than independent agencies (i.e. public corporations that can be classified as units of state government if they are part of an umbrella agency, State DOT's, etc.) may have Boards of Directors and if they are elected, appointed or mixed (e.g. some appointed members and some elected).
- For any case, it cannot be determined if they have a mixed Boards of Directors.

- If the information regarding the private operator or broker is used for the Agency or Institution type, it cannot be determined what kind of agency of institution is contracting the private respondent.

Despite the data issues, a correlation analysis was performed between Unlinked Passenger Trips per Day per Population and the defined variables. The entire population of 710 institutions was used. However, 107 of them did not report their unlinked passenger trips, hence, only 603 data points were usable.

7.2.1 Correlation Test

As it is known that the population does not follow a normal distribution and there is not known if the relation between the dependent variable and independent variables will be linear, the Eta Correlation Ratio was found to be the best option in order to inspect for any association among the dependent variable (UPT/day/service population) and independent variables, as neither a linear relationship nor dependent variable normality is required (Hale & Astolfi, 2011). This ratio requires that the dependent variable be an interval or ratio variable, while the independent variables needs to be categorical (Garson, 1996-2012). Independent variable may be of any data level, including nominal (Garson, 1996-2012).

Eta is a measure of strength of relationship based on sums of squares computed in analysis of variance. Eta equals the square root of the sum of squares for an interval variable y between classes divided by the total sum of squares. The numerator and denominator in this formula have meanings as in ANOVA, and to the extent that x and y are linearly or nonlinearly related, the numerator will be as large as the denominator and eta will approach 1.0. (Garson, 1996-2012)

The equations describing Eta are shown from Equation 7-1 to Equation 7-5.⁸

⁸ Sum of Squares equations' nomenclature adapted from Jones (2012).

Equation 7-1 Eta Correlation Ratio

$$Eta = \sqrt{Eta^2}$$

Equation 7-2 Eta Squared

$$Eta^2 = \frac{SSB}{SST}$$

Equation 7-3 Sum of Squares between Groups

$$SSB = \sum_{j=1}^k n (\bar{y}_j - \bar{Y}_{GM})^2$$

Equation 7-4 Total Sum of Squares

$$SST = \sum_{i=1}^n (y_i - \bar{Y}_{GM})^2$$

Equation 7-5 Grand Mean

$$\bar{Y}_{GM} = \frac{\sum_{i=1}^n y_i}{n}$$

Where:

n = sample size

y_i = dependent variable observations

\bar{Y}_{GM} is the grand mean of all dependent variables' observations.

\bar{y}_j = dependent variable mean for category j of the independent variable

k = amount of categories within the independent variable

Eta Squared measures the proportion of variability of the dependent variable explained by the independent variable (Garson, 1996-2012), through comparing the variations in the dependent variable mean at the different categories of the independent variable.

The Eta Correlation Ratio results and its p-value (Sig. or alpha level) are presented in Table 7-2. For correlation testing, null hypothesis is that there is no significant relationship between the variables (Key, 1997). The null hypothesis is rejected if p-value is less than or equal to 0.05 (Patel, 2008). For this test, an alpha value of 0.10 was selected to accept statistical significance.

The analysis was performed using SPSS 10.0 software. The Eta correlation ratio was not significant, as can be observed in Table 7-2.

Table 7-2 NTD Nominal Data Correlation

Variable	ETA	Sig.
Unit of Government	0.088	0.50
Operation Type	0.040	0.62
Board Type (with N/A value)	0.056	0.39
Board Type (N/A as blank)	0.033	0.60

As per results, a conclusion regarding the influence of these variables to ridership cannot be made. It is possible that the information issues discussed affected the analysis.

In addition, a correlation analysis was performed for two scalar variables: Annual Non-Capital Employee Hours per Population and Annual Operating Expense per Population. These variables were selected as they basically summarize the main characteristics of capacity: human and monetary resources. Given that the population of NTD reporting institutions' Unlinked Passenger Trips (UPT) per Population does not follow a normal distribution, Spearman (described in Equation 7-6) and Eta correlation coefficients were used. Before

applying Eta, scalar values were converted into nominal by a Cluster Analysis⁹ with SPSS 10.0 software. These variables were found to be much correlated to UPT and among them, as can be observed in Table 7-3.

Table 7-3 NTD Scalar Data Correlation

Variable Correlations	UPT / Population		Annual Employee Hours / Population	
	Spearman	Eta	Spearman	Eta
UPT / Population	1			
Annual Employee Hours / Population	0.859	0.955	1	
Annual Operating Expenses / Population	0.906	0.958	0.924	0.998*

Note: The results are significant at the 0.01 level (2-tailed) for Spearman and 0.001 for Eta.

* Expense as independent and Employee Hour cluster as dependent.

Equation 7-6 Spearman Correlation Coefficient

$$\rho = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2}}$$

Where:

x_i = independent variable for i^{th} observation

y_i = dependent variable for i^{th} observation

n = sample size

(Lund Research Ltd)

⁹ There is no assumption of normality in Cluster Analysis ((Kendall, Cluster Analysis and Normality, 2004).

7.3 Sample Representation of the Population

As indicated in Chapter 7, the study population was composed of the institutions reporting the U.S. National Transit Database, which were 710 institutions in year 2009. A 2.2 % of such population answered the survey¹⁰. The sample used for the analysis constitute a 2.11% of such population, as Puerto Rico data was used later to compare with the results obtained from analyses.

The normality test was also applied to the sample. The test was executed using SPSS 10.0, using a confidence level of 90%. In this case, the Shapiro-Wilk test was used as the sample is small (e.g. less than 20 observations). The form of the Shapiro-Wilk statistic is shown in Equation 7-7.

Equation 7-7: Shapiro-Wilk Statistic

$$W = \frac{\sum_{i=1}^n a_i y_i^2}{\sum_{i=1}^n (y_i - \bar{y})^2}$$

Where:

y_i is the sample data point, ordered from smallest to largest

\bar{y} = the sample mean

$a_i = \frac{m^T V^{-1}}{(m^T V^{-1} V^{-1} m)^{1/2}}$, where:

m = expected value from the standard normal distribution

V = variance-covariance matrix

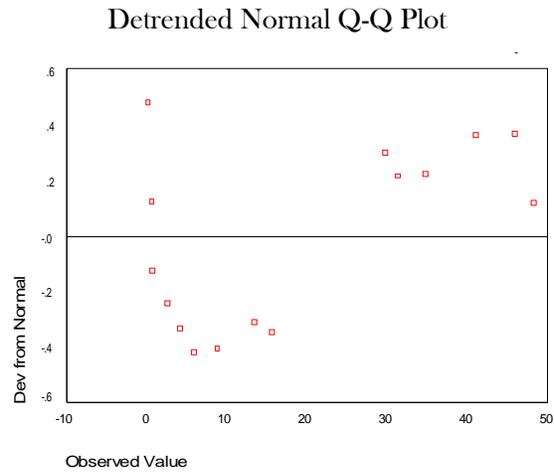
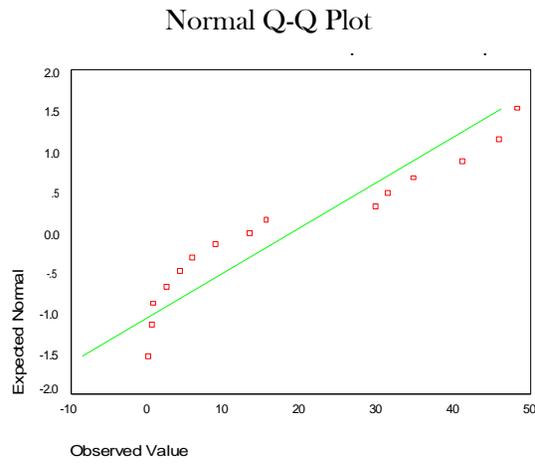
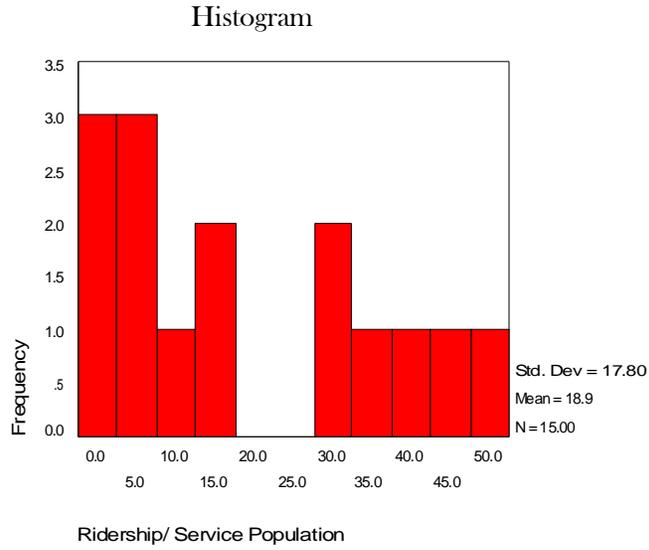
¹⁰ For one of the sample points, budget and ridership data was obtained from their organization's 2010 Annual Report, published on the internet. For other sample point, budget and ridership data was extracted from documents published on the organization's website for the year 2010.

Test results shown in Table 7-4 and Figure 7-2. As can be observed, the sample did not follow a normal distribution either. Note that null hypothesis of normality is rejected as the Significance value is less than selected alpha value of 0.1.

Table 7-4: Sample Normality Test

Case Processing Summary							
		Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
Ridership/ Service Population		15	100.0%	0	.0%	15 100.0%	
Descriptive Statistics							
		Statistic			Std. Error		
Ridership/ Service Population	Mean	18.89500			4.59623		
	90% Confidence Interval for Mean	Lower Bound		10.79962			
		Upper Bound		26.99038			
	5% Trimmed Mean		18.30311				
	Median		13.33300				
	Variance		316.880				
	Std. Deviation		17.80111				
	Minimum		.111				
	Maximum		48.333				
	Range		48.222				
	Interquartile Range		32.33300				
	Skewness		.497			.580	
Kurtosis		-1.433			1.121		
Tests of Normality							
		Shapiro-Wilk					
		Statistic		df	Sig.		
Ridership/ Service Population		.870		15	.038		

Figure 7-2: Sample Normality Test



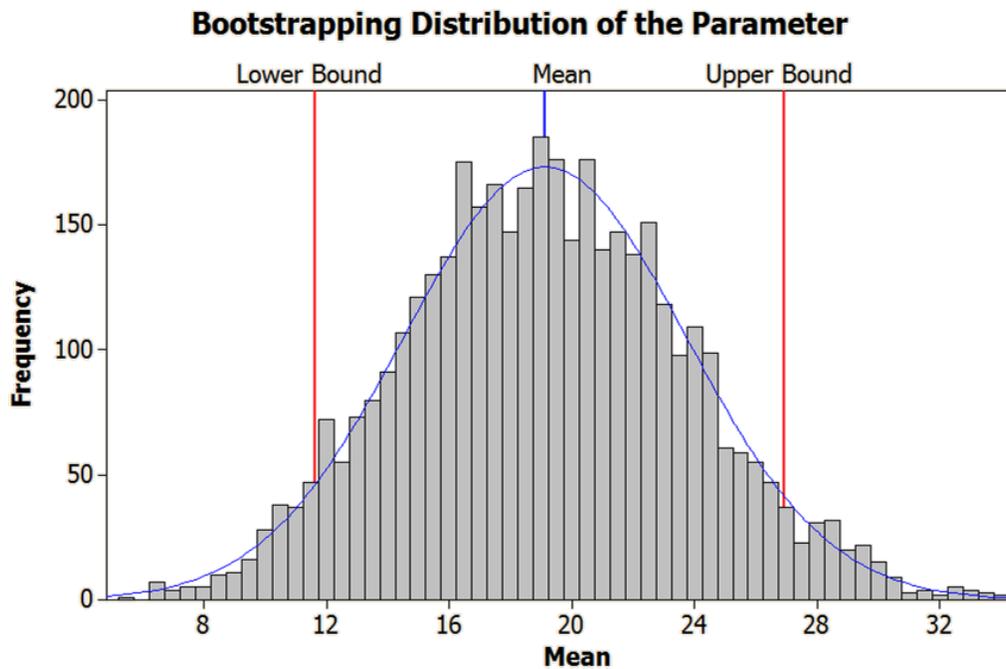
In order to have an idea of the extent to which the sample is able to represent the population, a confidence interval was determined. As the data is non-parametric (not normal), a bootstrap percentile method was used, by applying a macro (Griffith & Santiago, 2006) on Minitab (Minitab, Inc., 2004).

Bootstrapping is a method for dealing with non-normal samples; based on the principle that the obtained random sample is a fair representation of the population distribution, and that by re-sampling the sample, estimates of parameters and their standard errors can be obtained from the empirical distribution as defined by the re-sampling... sampling distribution can be reasonably approximated by data obtained from a single sample (Washington, Karlaftis, & Mannering, 2003). In other words, the bootstrap method uses the collected sample to produce a considerable amount of other samples of the same size by randomly selecting from the original sample with replacement. A parameter (the mean in this case) is evaluated for each of the new re-samples. For a large amount of re-samples (or iterations), a normal distribution of their means is built. From there, an empirical¹¹ sampling distribution¹² or probability distribution (McClave & Benson, 1991) is obtained. The sampling distribution will tend to be approximately normal, hence, a confidence interval can be estimated through percentiles. This method was applied to estimate a two-sided 90% confidence interval for the mean based on 4,000 iterations. Hence, the significance level α is 0.10 and the confidence interval will be between the 5th and the 95th percentiles. The results are shown in Figure 7-3.

¹¹ An empirical distribution is one composed of some set of variates —that is, values of X —which have either been observed or are capable in principle of being observed. (Lowry, 1999-2012)

¹² A sampling distribution is a distribution of samples' statistics.

Figure 7-3: Bootstrapping Distribution of the Sample Mean



The 90% Bootstrap Confidence Interval (Percentile Method)

Lower Bound	Mean	Upper Bound
11.64	19.14	26.91

Therefore, it can be inferred that, with a 90% confidence, the true mean is between 11.6 and 26.9, which includes the original sample mean of 19.2.

A comparison between the annual ridership per service population parameters of the 2009 NTD and the statistics of the survey sample was also performed. They are presented in Table 7-5.

Table 7-5: Population Parameters and Sample Estimators

Annual Ridership/Service Population	NTD 2009 Population	Survey Sample
Mean	16.81	19.23
Standard Deviation	48.61	18.39

As can be observed in Table 7-5, population mean is within the confidence interval; equal to the sample mean minus 2.42. Therefore, the sample will be considered to be useful in describing or estimating population's mean ridership. Note that the standard deviation of the population is higher than the one of the sample.

8 SAMPLE ANALYSIS

This section presents the analysis performed to the sample data.

8.1 Correlation Analysis

The next step of the sample data analysis is to determine which, if any, of such variables are related to ridership. That is, if there are variations in ridership per service population when there are variations in the values or categories of the variables.

The survey data consist of primarily nominal variables. In addition, there is no guarantee that the relation between the dependent variable and independent variables will be linear. Therefore, the Eta Correlation Ratio is the best option in order to inspect for any association among the dependent variable (annual ridership/service population) and independent variables.

To apply this procedure, the variables that are continuous, such as budget, were classified into ranges. Since the data points are few, the variables were classified in, at most, three categories.

Eta Correlation Ratio resulting from each individual variable with the annual ridership/service population and their p-values (Sig. or alpha level) are presented in Table 8-1. For correlation testing, null hypothesis is that there is no significant relationship between the variables (Key, 1997). The null hypothesis is rejected if p-value is less than or equal to 0.05 (Patel, 2008); this amount (0.05) is the probability of rejecting a true null hypothesis (error type I).

The following variables have high Eta values (appear to explain a large association with the dependent variable ridership/service population) and are statistically significant:

1. Amount of Modes
2. Modes
3. Percent Contracted
4. Budget/ Population

5. Sense of Belonging
6. Bonus / Promotion Opportunity
7. Overall Benefits

Table 8-1: Eta Correlation Ratio Results

	Variable	Sig	Eta
1	Amount of Modes	0.01	0.72
2	Modes	0.01	0.76
3	Amount of Roles	0.50	0.35
4	Roles	0.19	0.61
5	Service Area	0.14	0.53
6	Percent Transit Use	0.97	0.02
7	Owner	0.64	0.27
8	Company Type	0.41	0.58
9	Contract/ Subcontract	0.13	0.41
10	Percent Contracted	0.02	0.73
11	Population/ Employees	0.90	0.04
12	Budget/ Population	0.00	0.96
13	Integration	0.66	0.26
14	Amount Elements Integrated	0.96	0.02
15	Integration Elements	0.99	0.05
16	Amt. Top Leadership Styles	0.30	0.29
17	Amt. Mid Leadership Styles	0.42	0.23
18	Sense of Belonging	0.04	0.64
19	Pride in Job	0.43	0.36
20	Clear Vision/ Mission/ Objectives	0.33	0.43
21	Change in Top No Change VMO	0.68	0.25
22	Change in Party not equal to Change VMO	0.12	0.57
23	VMO Frequency of Change	0.90	0.04
24	Policy to Recruit & Promote	0.40	0.38
25	Advertise as Employer	0.14	0.53
26	Retention Program	0.76	0.22
27	Promotion Opportunities	0.57	0.30
28	Participation in Decision Making	0.73	0.23
29	Ideas Considered	0.38	0.39
30	Side Benefits	0.20	0.35
33	Employment Stability	0.43	0.36
32	Amount of Retention Benefits	0.33	0.43
34	Overall Benefits	0.03	0.67
31	Bonus / Promotion Opportunity to Deserving	0.01	0.65
35	Administration Span	0.49	0.33

Dependent variable = Annual Ridership / Service Population

The description and classifications used on the variables with high correlation with ridership are shown in Table 8-2.

Table 8-2: Classifications of Variables with High Correlation to Ridership

Variable	Description	Classifications		
Budget/ Population	Yearly budget divided by service population	Less than 20	36 to 66	More than 100
Modes	Indicates if the systems has rail, if it does not but has bus, or if it only have demand response services	Includes rail	Includes bus (no train)	Demand response only
Portion Contracted or Subcontracted	Indicates the portion of business that is contracted and/or subcontracted	0%	Up to 25%	More than 25%
Amount of Modes	Indicates the amount of modes managed by the company. Each type of service or technology is counted separately (i.e. express bus is different from regular bus). Highways are counted as a separate mode. Bike and pedestrian ways are counted as a single “non-motorized” mode.	1-2	3-4	5-6
Overall Benefits	It describes if the company does not provide additional benefits, provides only fringe benefits or provides benefits to compensate good performance that includes additional monetary compensation or a promotion opportunity.	None	Fringe Only	Bonus/ Promotion Opportunities
Bonus and/or Promotion Opportunity	It describes if a compensation for performance in the form of monetary or promotion opportunity exists.	Yes	No	
Sense of Belonging	It describes the level of acceptance to the phrase: “Employees of my company have a sense of belonging to it”.	Strongly Agree or Agree	Partially Agree	Disagree or Strongly Disagree

8.2 Multiple Classification Analysis

A Multiple Classification Analyses (MCA)¹³ was used to study if a set of the correlated variables can describe the mean ridership of systems having a particular category of the independent variables. It will also allow inspecting the relative impact of each of the independent variables if they are together in a single model.

A MCA is a quantitative analysis procedure that allows the assessment of differences in subgroup means, which may have been adjusted for compositional differences in related factors and/or covariates and their effects (Hardy & Baird, 2004). The MCA accepts nominal predictor variables and it does not assume linearity of the regression (UNESCO, 2011). Therefore, this is the most appropriate analysis option.

Mathematically, MCA is presented in Equation 8-1 (Obinna, Owei, Ayodele, & Okwakpan, 2009).

Equation 8-1 Multiple Classification Model

$$\mu_{ijk} = \mu + \alpha_i + \beta_j + \epsilon_{ij}$$

Where:

$\mu_{ij...n}$ = The score (on the dependent variable) of individual n who falls in category j of predictor B, etc.

μ = Grand mean on the dependent variable.

α_i = The “effect” of membership in the i^{th} category of predictor A.

β_j = The “effect” of membership in the j^{th} category of predictor B.

$\epsilon_{ij...n}$ = Error term for this individual.

¹³ MCA was developed by Frank Andrews & others at the Institute for Social Research in Ann Arbor. The approach and program are described in a small book by Andrews, et al., entitled *Multiple Classification Analysis*, 2nd edition, 1973. (Kendall, Listserv at The University of Georgia, 2006)

MCA yields three key coefficients:

1. *Eta and Eta² - Eta indicates the ability of the predictor, using the categories given, to explain variation in the dependent variable. Eta² is the correlation ratio and indicates the proportion of the total sum of squares explainable by the predictor (Obinna, Owei, Ayodele, & Okwakpam, 2009).*

2. *Beta and beta²: these are directly analogous to the eta statistics, but are based on the adjusted means rather than the raw means. Beta provides a measure of the ability of the predictor to explain variation in the dependent variable after adjusting for effects of all other predictors. This is not in terms of percent of variance explained (Obinna, Owei, Ayodele, & Okwakpam, 2009).*

The beta is equivalent to the standardized partial regression coefficient¹⁴ that would be obtained by assigning the unadjusted deviations to each factor category and regressing the dependent variable on the resulting variables (SPSS Inc., 1999). The rank order of these betas indicates the relative importance of the various predictors in their explanation of the variance in dependent variable, if all other predictors were held constant (UNESCO, 2011). Therefore, the relative influence of each independent variable to the variance of the dependent variable can be compared. It is important to remember that with the MCA could be determined if any, some or all levels of independent variables have influence on the variance of the dependent, however, which of the levels do influence cannot be determined.

3. *R²- A multiple correlation coefficient, squared (adjusted for degrees of freedom). This coefficient estimates the proportion of variance in the dependent variable explained by all predictors together (Obinna, Owei, Ayodele, & Okwakpam, 2009):*

¹⁴ The standard partial regression coefficient is the number of standard deviations that Y would change for every one standard deviation change in X_i, if all the other X variables could be kept constant. (McDonald, 2009)

The coefficient of determination is defined as expressed in Equation 8-2.

Equation 8-2: Coefficient of Determination

$$R^2 = \frac{SSM}{SST}$$

Where:

$$SSM = \text{Model Sum of Squares} = \sum(\hat{y}_i - \bar{y})^2,$$

Where: \hat{y}_i is the estimate and \bar{y} is the average

$$SST = \text{Total Sum of Squares} = \sum(y_i - \bar{y})^2$$

Where: y_i is the observed value

Advantages of MCA (UNESCO, 2011):

- *Ability to show the effect of each predictor on the dependent variable, both before and after taking into account the effects of all other predictors.*
- *The predictors are always treated as sets of classes or categories; hence, it does not matter whether a particular set represents a nominal scale (categories) or ordinal scale (ranking) or an interval scale (classes of numerical variable).*
- *All coefficients are expressed as deviations from the overall mean.*
- *The constant term in the predicting equation is the overall mean.*
- *Adjusted and unadjusted subgroup means are available in the same results (output) table, which can be used to detect the amount of inter-correlations between the predictors.*

For the analysis, only the seven variables showing high correlation ratio and statistical significance were used.

To perform the analyses, SPSS 10.0 was used. In this version of SPSS, syntax command is required to perform the MCA. This tool also allows considering interactions between predictors. However, due limitations in amount of data points, only a maximum of 2-way interactions can be considered in models up to two predictors. To maximize the possibilities,

also the predictors were grouped to have the smallest possible number of categories without losing meaning. This modification did not affect the level of association of Eta or its statistical significance level.

Due aforementioned limitations, different combinations were tested, based on the most correlated and statistically significant variables as per Eta Correlation Ratio analysis performed. First, single predictors were tested, followed by two predictor combinations.

For MCA, the null hypothesis is that the means of groups of observations are identical (e.g. betas are zero). Otherwise, the groups of observations are different, or were generated by some different process, or come from different underlying populations (Bartlein, 2012). This null hypothesis was rejected if $p < 0.05$.

8.2.1 *Single Variable Models*

Table 8-3 shows the MCA result for single independent variables models. The determination coefficient (R Squared) is highest and have $p < 0.05$ for the models including Budget (0.962), Modes (0.758) and Percent Contracted (0.726). R Squared is the square of the correlation coefficient and indicates the proportion of total variability explained by the model (McClave & Benson, 1991).

Table 8-3: Single Independent Variable Models

	Variable	Sig	Eta = Beta = R	R Squared
1.	Budget/ Population	<0.001	0.962	0.925
2.	Modes	0.006	0.758	0.575
3.	Percent Contracted	0.024	0.726	0.527
4.	Amount of Modes	0.012	0.721	0.520
5.	Overall Benefits	0.027	0.673	0.453
6.	Bonus / Promotion Opportunity	0.009	0.649	0.421
7.	Sense of Belonging	0.041	0.642	0.412

The fit (R Squared) of the model is high for the variable of Budget, and it is moderate for the variables of Modes, Percent Contracted, Amount of Modes, Overall Benefits, Bonus and/or Promotion Opportunity and Sense of Belonging (see Table 8-3).

8.2.2 Two-Variable Models

Two-variable models were tested with all the combinations of the seven variables of the simple models. As a first approach, the models included interactions among independent variables. However, such interactions resulted insignificant. Therefore, models were tested again without interactions. Results of such later models are the ones discussed in this document. Table 8-4 shows the two-variable models' p-values.

Table 8-4 Two-Variable Model Test - Significance or P Values

Sig	Amount of Modes	Modes	Percent Contracted	Budget/ Population	Sense of Belonging	Bonus / Promotion Opportunity	Overall Benefits
Amount of Modes							
Modes	0.462 0.250						
Percent Contracted	0.006 0.003	0.133 0.148					
Budget/ Population	0.460 0.001	0.057 <0.001	0.020 <0.001				
Sense of Belonging	0.283 0.778	0.051 0.260	0.044 0.192	<0.001 0.841			
Bonus / Promotion Opportunity	0.131 0.165	0.032 0.067	0.046 0.063	<0.001 0.964	0.321 0.127		
Overall Benefits	0.207 0.399	0.032 0.114	0.049 0.128	<0.001 0.865	Singular Singular	Singular Singular	

Bold values: Model with high statistical significance.

Green cells: Models with moderate significance.

As can be observed, the models that appear to have the accepted statistical significance are the ones combining:

- High significance:
 - Percent Contracted and Amount of Modes
 - Percent Contracted and Budget
- Moderate significance:
 - Percent Contracted and Bonus/Promotion Opportunities
 - Percent Contracted and Sense of Belonging
 - Percent Contracted and Overall Benefits
 - Modes and Overall Benefits

Table 8-5 shows the two-variable models coefficient of determination or R Squared. As can be observed, all models including budget have a high R Squared.

Table 8-5: Two-Variable Models' R Squared

R Squared	Amount of Modes	Modes	Percent Contracted	Budget/ Population	Sense of Belonging	Bonus / Promotion Opportunity	Overall Benefits
Amount of Modes							
Modes	0.636						
Percent Contracted	0.868	0.714					
Budget/ Population	0.938	0.963	0.976				
Sense of Belonging	0.543	0.676	0.687	0.928			
Bonus / Promotion Opportunity	0.600	0.691	0.684	0.925	0.529		
Overall Benefits	0.600	0.725	0.717	0.927	Singular	Singular	

Bold values: Model with high model representation.
 Green cells: Models with moderate representation.

The R² was also high for the models including:

- Percent contracted and amount of modes
- Percent contracted and budget

The R² was moderately high for the modes with moderate “Sig” which are:

- Percent contracted and bonus/promotion
- Percent contracted and sense of belonging
- Percent contracted and overall benefits
- Modes and overall benefits

Table 8-6 shows the Beta coefficients for the two-independent variables’ models. The budget variable carries the highest portion of the variability explained by the models where it is present. For the models with percent contracted (with no budget), this variable is also the one carrying most of the models’ variability; however, the difference from the other variable is not very high (less than 0.2). A similar situation occurs with the models containing the variable of modes and amount of modes.

Table 8-6: Two Variables Models’ Beta Coefficient

Beta	Amount of Modes	Modes	Percent Contracted	Budget/ Population	Sense of Belonging	Bonus / Promotion Opportunity	Overall Benefits
Amount of Modes							
Modes	0.339						
Percent Contracted	0.608 0.695	0.588 0.443					
Budget/ Population	0.129 0.908	0.241 0.835	0.264 0.889				
Sense of Belonging	0.555 0.226	0.622 0.370	0.627 0.413	0.963 0.057			
Bonus / Promotion Opportunity	0.518 0.349	0.548 0.383	0.588 0.423	0.958 0.006	0.401 0.419		
Overall Benefits	0.511 0.354	0.589 0.430	0.593 0.479	0.948 0.054	Singular	Singular	

The following two-variable models improved the single models counterparts:

- Budget and Percent Contracted - Both variables have $p < 0.05$ and the R Squared is higher than the one for Budget alone, which was the highest (0.976 vs. 0.925). Budget carries more than three times the variability explained by the model as compared to the carried by Percent Contracted.
- Amount of Modes and Percent Contracted - Both variables have $p < 0.05$ and the R Squared is significantly higher than the one for either of the variables alone (0.868 vs. 0.520 and 0.527, respectively). The model variability is fairly shared between the two variables (with betas of 0.608 and 0.695, respectively).
- Modes and Bonus/Promotion Opportunity - R Squared for this model is 0.691, which is higher than the one for each individual variable (0.575 and 0.421, respectively). Modes p value is smaller than 0.05 while Bonus/Promotion one is less than 0.07. Mode beta is 1.4 times the one of Bonus/Promotion.
- Percent Contracted and Bonus/Promotion - R Squared for this model is 0.684, which is higher than the one for each individual variable (0.527 and 0.421, respectively). Percent Contracted p value is smaller than 0.05 while Bonus/Promotion one is less than 0.07. Percent Contracted's beta is 1.39 times the one of Bonus/Promotion.
- Modes and Overall Benefits - R Squared for this model is 0.725, which is higher than the one for each individual variable (0.575 and 0.453, respectively). Modes p value is smaller than 0.05 while Overall Benefits one is 0.11. Modes's beta is 1.37 times the one of Overall Benefits.
- Percent Contracted and Overall Benefits - R Squared for this model is 0.717, which is higher than the one for each individual variable (0.527 and 0.453, respectively). Percent Contracted p value is smaller than 0.05 while Overall Benefits one is 0.13. Percent Contracted's beta is 1.2 times the one of Overall Benefits.
- Percent Contracted and Sense of Belonging - R Squared for this model is 0.687, which is higher than the one for each individual variable (0.527 and 0.412, respectively). Percent Contracted p value is smaller than 0.05 while Sense of Belonging one is 0.19. Percent Contracted's beta is 1.5 times the one of Sense of Belonging.

8.2.3 Three-Variable Models

Models with three variables were also tested to see if two-variable models were improved. The results of selected three-variable models are shown in Table 8-7. The models shown correspond to those having the best combination of "Sig" values for all variables among all models.

From Table 8-7 can be observed that R Squared improved, as compared with two-variable modes; however, the "Sig" values decreased.

Table 8-7 Three Variable Models' Results

Model Variables	Significance	Beta	R Squared
Overall Benefits	0.108	0.434	0.864
Portion Contracted/ Subcontracted	0.073	0.461	
Modes	0.111	0.544	
Bonus/ Promotion Opportunity	0.418	0.140	0.881
Portion Contracted/ Subcontracted	0.008	0.656	
Amount of Modes	0.033	0.538	
Bonus/ Promotion Opportunity	0.128	0.325	0.800
Portion Contracted/ Subcontracted	0.147	0.402	
Modes	0.203	0.485	
Sense of Belonging	0.264	0.383	0.817
Portion Contracted/ Subcontracted	0.110	0.527	
Modes	0.200	0.699	
Budget	0.001	0.956	0.981
Portion Contracted/ Subcontracted	0.022	0.284	
Bonus/ Promotion Opportunity	0.318	0.095	

Note that the models that best describe the sample are the ones containing the following variable combinations:

- Budget, Portion Contracted/ Subcontracted, Bonus/ Promotion Opportunity
- Portion Contracted/ Subcontracted, Amount of Modes, Bonus/Promotion Opportunity
- Modes, Portion Contracted/ Subcontracted, Overall Benefits

Also, note on the Beta values that the variable Bonus/ Promotion Opportunity has much less impact to the dependent variable than the other two variables on the models of Portion Contracted/ Subcontracted & Amount of Modes and Budget & Portion Contracted/ Subcontracted does not represent much. It is also reflected at its Sig. value, which is much higher than the ones for the other two variables in those models.

8.3 Variables of Interest

Further inspection on variables of interest was performed. The main interest of this study is focused on internal environment characteristics of the transit organization and its relation to ridership. The internal organization environment variables that resulted significantly correlated to ridership were those related to Benefits, Sense of Belonging and Portion Contracted. In addition, the capacity variables related to Modes are also discussed. The variable related to Budget is analyzed separately, as this is a capacity variable that has a great influence on ridership. Finally, a chi-square test of independence among independent variables is discussed.

8.3.1 Benefits

This variable resulted from a combination of two questions on the survey. One asked about fringe benefits and the other asked about benefits to deserving employees in order to recognize them. The resulting Overall Benefit variable had the following categories:

- No benefits
- Fringe benefits only
- Productivity bonuses and promotion opportunities

The MCA for this single variable had the following results:

- Sig. = 0.027 => The model is statistically significant with a 97.3% of probability (2.7% probability that the result was due chance)
- Eta = 0.673 => 67.3% of the sum of total squares (difference between ridership observations and the overall simple ridership mean) is explained by the Overall Benefits as per the classifications used
- $R^2 = 0.452$ => 45.2% of the variability in ridership is explained by the model (by Overall Benefits)
- Predicted mean for ridership/service population from model:
 - No benefits = 3.4
 - Fringe benefits only = 13
 - Bonus/ Promotion Opportunities = 35.5

The average ridership is smallest when there are no benefits for the employees. The average is higher when there are only fringe benefits. Average ridership is maximized on those systems where there are productivity bonuses and promotion opportunities due to performed labor.

The component of Bonus and Promotion Opportunities was also tested by itself, as a YES/NO variable. It resulted with statistical significance (“Sig” = 0.009), a fairly high correlation (Eta = 0.649) and with sample variability moderately explained by the model ($R^2 = 0.421$). The average ridership per service population was greater (35.54) for the YES group than for the NO group (11.08).

8.3.2 *Sense of Belonging*

The survey asked if the company’s employees have sense of belonging to the company. The respondents were asked to indicate the level of agreement to the statement. The final categories for the MCA are as follows:

- Strongly Agree or Agree
- Partially Agree

- Disagree or Strongly Disagree

The MCA results for the single variable model are as follows:

- Sig. = 0.041 => Statistically significant model with a 95.9% of probability (4.1% probability that the result was due chance)
- Eta = 0.642 => 64.4% of the total sum of squares (difference between ridership observations and overall sample ridership mean) is explained by the Overall Benefits as per classifications used
- $R^2 = 0.412$ => 41.2% of the variability in ridership is explained by the model (by Sense of Belonging)
- Predicted mean ridership/service population from model:
 - Strongly Agree or Agree = 28.52
 - Partially Agree = 6.27
 - Disagree or Strongly Disagree = 3.38

It is observed that the average ridership is the smallest when there is no sense of belonging among company's employees. Average ridership is medium for the neutral cases. Average ridership maximizes when there was sense of belonging.

8.3.3 Percent Contracted

The survey asked about the proportion of the company's business that is contracted or subcontracted. The final categories for the MCA are as follows:

- No Contracts/Subcontracts
- Up to 25%
- More than 25%

The MCA results for the single variable model are as follows:

- Sig. = 0.024 => Statistically significant model with a 97.6% of probability (2.4% probability that the result was due chance)

- $\text{Eta} = 0.726 \Rightarrow 72.6\%$ of the total sum of squares (difference between ridership observations and overall sample ridership mean) is explained by the Portion Contracted as per classifications used
- $R^2 = 0.527 \Rightarrow 52.7\%$ of the variability in ridership is explained by the model (by Portion Contracted)
- Predicted mean ridership/service population from model:
 - No Contracts/Subcontracts = 7.15
 - Up to 25% = 37.18
 - More than 25% = 17.84

It is observed that average ridership is the smallest when there are no subcontracted services. Average ridership is medium for those who contracts more than 25% of their business. Average ridership maximizes when there are contracts for up to 25% of business. This result was not exactly as expected, which was an average ridership proportional to increase in contracts, as the results obtained for bus systems (Leland & Smirnova, 2008). Perhaps not contracting at all, or contracting too much, creates a sense of absence of competition, or responsibility in the latter case, which restrains somehow the motivation.

8.3.4 Modes

As defined, amount of modes and type of modes are very similar variables. It was found that for systems with greater amount of modes had average ridership greater than other options. This is expected as different modes typically have different purposes; hence more areas can be reached. Similarly, systems with higher capacity modes had greater ridership averages.

Average means for each Amount of Modes category resulted as follows:

- 1-2 modes - 3.97
- 3-4 modes - 25.14
- 5-6 modes - 32.83

Average means for each type of Modes category resulted as follows:

- Includes rail - 36.75
- Includes bus (no rail) - 14.75
- Demand response only - 0.53

Every single mode was counted separately, that is, express bus is different from regular bus, and so on. Highways were counted as a different mode. Other mode was the non-motorized category, where both bike and pedestrian were grouped as several facilities combine the two usages.

8.3.5 Budget Variable

The variable observed to be most influential to ridership variability is Budget. This positive influence was expected, as per correlation results from UITP data presented in the INTRODUCTION in Chapter 1. Predicted means for each category are as follows:

- Less than 20 - 1.03475
- 36 to 66 - 9.5332
- More than 100 - 38.9448

The correlation of this variable with the other variables in the study was inspected. For this analysis, Eta correlation was used, applying the continuous Budget variable without grouping it. Only the variables of Amount of Modes and Percent Contracted/Subcontracted resulted correlated with statistical significance, as shown in Table 8-8.

Table 8-8 Budget Correlation

Variable	Sig.	Eta	R ²
Amount of Modes	0.022	0.687	0.473
Percent Contracted/ Subcontracted	0.039	0.691	0.478

Both variables are related to the organization capacity. Percent contracted is also related to the organization internal environment. The Amount of Modes is related with the organization capacity and the transportation system. Table 8-9 shows that, the average budget per service population increases as the amount of modes increase.

Table 8-9 Amount of Modes - Budget Predicted Mean

Amount of Modes	Predicted Mean for Budget/ Service Population
1-2	25
3-3	103
5-6	189

The average budget per service population is the lowest when there are no contracts and it is medium when more than 25% of business is contracted (see Table 8-10). However, the budget average is significantly higher when the portion contracted is more than zero but less or equal to 25%.

Table 8-10 Portion of Business Contracted - Budget Predicted Mean

Percent Contracted	Predicted Mean for Budget/ Service Population
0	42
(0-25]	203
25<	77

8.3.5.1 Effects Impacting Budget

It was no surprise that other organizational characteristics did not significantly impact budget. The following subsections will show that total expense, and hence budget, is extremely related to service characteristics and that such characteristics basically explain the same variability. Therefore, a single independent variable is enough to describe most of expense variability.

8.3.5.1.1 Heavy Rail Costs

Data from the National Transit Database (2004) was used in order to perform a Regression Analysis (RA). The RA was used to determine which of the several service characteristics are useful to describe operational costs. The main objective of this analysis was to compare costs with the Tren Urbano (TU). Therefore, the resulting regression model would be used to estimate Tren Urbano operating cost and then it would be compared with the actual cost. In this case, the sample of interest was that composed of systems that included Heavy Rail (as TU). Data was arranged as follows:

- Mode (Heavy Rail)
- Total Expense (calculated through the sum of the expenses related to general administration, maintenance not related to vehicles, vehicle maintenance and vehicle operation)
 - Operational salaries
 - Non-operational salaries
 - Fringe benefits
 - Services¹⁵
 - Fuel/ lubricants
 - Wheels/ tubes
 - Maintenance
 - Utilities

¹⁵ The labor and other work provided by outside organizations for fees and related expenses. In most instances, services from an outside organization are procured as a substitute for in-house employee labor, except in the case of independent audits, which could not be performed by employees in the first place. The substitution is usually made because the skills offered by the outside organization are needed for only a short period of time or are better than internally available skills. The charge for these services is usually based on the labor hours invested in performing the service. Services include (Federal Transit Administration, 2012):

- Management service fees
- Advertising fees
- Professional and technical services
- Temporary help
- Contract maintenance services
- Custodial services and security services

- Insurances
- Taxes
- Miscellaneous¹⁶
- Adjustments/ expenses re-classification
- Length of alignment or alignments
- Fleet size
- Vehicle/ train miles
- Vehicle/ train hours
- Amount of stations

As the population of NTD reporting Heavy Rail systems is small, 14 agencies in 2004, all available data were used for the calibration or model development. Data used was the most recent available at the time this particular analysis was performed.

The data summary is shown in Table 8-11.

¹⁶ The expenses that cannot be attributed to any of the other major expense categories (object class's labor, fringe benefits, services, materials and supplies, utilities, casualty and liability costs, taxes and purchased transportation. (Federal Transit Administration, 2012)

Table 8-11 Characteristics of Heavy Rail Systems in 2004 as per NTD

Agency Code	Mode	Service	Total Expense	Right of Way Length (miles)	Fleet Size	Vehicle/Train Miles	Vehicle/Train Hours	Amount of Stations
1003	Heavy Rail	Directly Operated	\$214,246,802	114.45	408	4605497	209341	53
2008	Heavy Rail	Directly Operated	\$2,537,639,748	740.67	6207	39213055	2191529	468
2075	Heavy Rail	Directly Operated	\$34,157,876	47.25	121	1142784	39406	13
2098	Heavy Rail	Directly Operated	\$179,792,177	85.8	327	1893798	125529	13
2099	Heavy Rail	Directly Operated	\$26,374,887	42.9	64	593469	27650	23
3019	Heavy Rail	Directly Operated	\$125,380,076	74.9	378	3238430	165618	75
3030	Heavy Rail	Directly Operated	\$525,516,163	309.9	952	12222595	506864	83
3034	Heavy Rail	Directly Operated	\$41,810,635	44.1	100	1014325	41001	14
4022	Heavy Rail	Directly Operated	\$123,208,332	144.09	327	4799684	188352	38
4034	Heavy Rail	Directly Operated	\$61,437,722	67.56	136	1753678	77510	22
5015	Heavy Rail	Directly Operated	\$23,869,102	57.12	60	1736075	80657	18
5066	Heavy Rail	Directly Operated	\$399,863,818	309.42	1193	11892175	696313	144
9003	Heavy Rail	Directly Operated	\$375,024,594	313.56	669	8682944	268094	43
9154	Heavy Rail	Directly Operated	\$65,828,765	47.85	104	1237108	59201	16

8.3.5.1.2 Correlation Analysis

The Pearson correlation was selected to inspect if there is linear correlation among continuous variables presented in Table 8-11. Pearson’s equation for a sample is shown in Equation 8-3. The correlation analysis was performed using the statistical software SPSS (Statistical Package for Social Sciences, Version 10.0). Results are shown in Table 8-12. As the absolute value of the correlation coefficient approaches to one (1), more correlated are the variables.

Equation 8-3 Pearson’s Correlation

$$r_{xy} = \frac{n \sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n \sum x_i^2 - (\sum x_i)^2} \sqrt{n \sum y_i^2 - (\sum y_i)^2}}$$

Where:

n is the simple size

x and y are the values for two variables of the observation i.

Table 8-12 Correlation Table Heavy Rail Systems NTD 2004

Variables	TOTAL EXPENSE	FLEET SIZE	RIGHT OF WAY LENGTH	AMOUNT OF STATIONS	VEHICLE MILES	VEHICLE HOURS
TOTAL EXPENSE						
Pearson Correlation	1	0.996	0.942	0.977	0.984	0.986
Sig. (2-tailed)	.	<0.001	<0.001	<0.001	<0.001	<0.001
N	14	14	14	14	14	14
FLEET SIZE						
Pearson Correlation	0.996	1	0.932	0.989	0.981	0.991
Sig. (2-tailed)	<0.001	.	<0.001	<0.001	<0.001	<0.001
N	14	14	14	14	14	14
RIGHT OF WAY LENGTH						
Pearson Correlation	0.942	0.932	1	0.924	0.98	0.955
Sig. (2-tailed)	<0.001	<0.001	.	<0.001	<0.001	<0.001
N	14	14	14	14	14	14
AMOUNT OF STATIONS						
Pearson Correlation	0.977	0.989	0.924	1	0.976	0.992
Sig. (2-tailed)	<0.001	<0.001	<0.001	.	<0.001	<0.001
N	14	14	14	14	14	14
VEHICLE MILES						
Pearson Correlation	0.984	0.981	0.98	0.976	1	0.992
Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001	.	<0.001
N	14	14	14	14	14	14
VEHICLE HOURS						
Pearson Correlation	0.986	0.991	0.955	0.992	0.992	1
Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001	<0.001	.
N	14	14	14	14	14	14

All variables in Table 8-12 are statistically and highly linearly correlated as the following is met: Pearson correlation coefficients are very high (close to one) and the null hypothesis that the coefficient equals zero (e.g. there is no correlation) is rejected as the “Sig.” Values (e.g. P-Values or probability that the null hypothesis is true) are less than alpha value. (IBM Corporation, 2009)

8.3.5.1.3 Factor Analysis

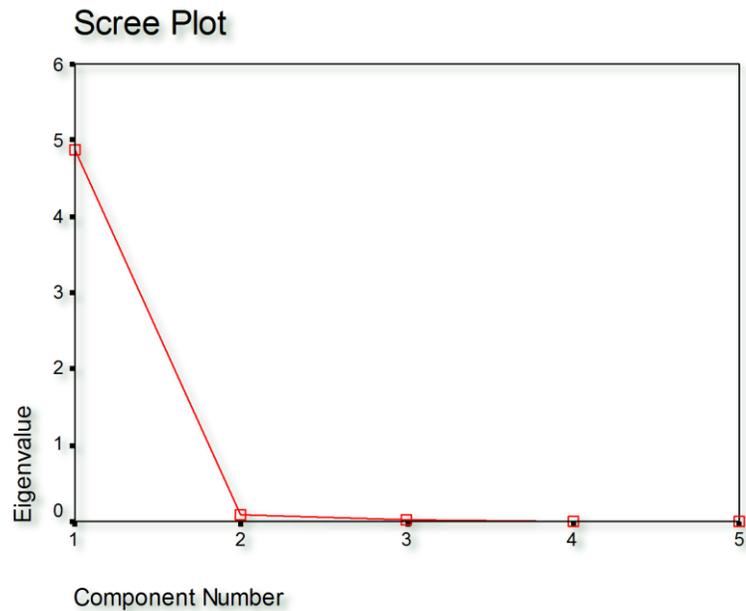
All variables appeared to be correlated among them. A Factor Analysis was performed, using SPSS (Statistical Package for Social Sciences, Version 10.0), to examine if some of them could represent others in further analysis. Results are shown in Table 8-13 and Figure 8-1.

Table 8-13 Factor Analysis

Total Variance Explained	Initial Eigenvalues			Extraction Sums of Squared Loadings	
Component					
Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1					
4.885	97.705	97.705	4.885	97.705	97.705
2					
9.796E-02	1.959	99.664			
3					
1.158E-02	.232	99.895			
4					
3.313E-03	6.627E-02	99.962			
5					
1.919E-03	3.839E-02	100.000			

Extraction Method: Principal Component Analysis. Only one component was extracted. The solution cannot be rotated.

Figure 8-1 Scree Plot



As can be observed from the results, all variables can be explained by a single factor (e.g. a single variable can explain most of the variability). The Eigen value is 4.885, therefore, a single factor represents practically the 5 variables and a 97.7% of the total variability. This can be appreciated in the Scree Plot on Figure 8-1.

8.3.5.1.4 Regression Analysis

It is known from the Correlation and Factor Analysis that linear regression function of a single variable will most likely describe the Heavy Rail expenses. SPSS (Statistical Package for Social Sciences, Version 10.0) tool as used in order to perform a linear regression. As all variables can be grouped in a single factor (e.g. one variable can explain most variability), the Stepwise method was used, so the regression will start with the most significant, while the variable could be deleted from the model if the fact of adding other variable affects its significance.

As the model should be simple, small probability values were used to restrict the variables entering the model. Criteria and results are shown in Table 8-14.

Table 8-14 Regression Analysis

Variables Entered/Removed

Model	Variables Entered	Variables Removed
1	FLEET	Stepwise (Criteria: Probability-of-F-to-enter <= .020, Probability-of-F-to-remove >= .050).

a Dependent Variable: TOTALEX

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.996	.993	.992	57195235.9802	.993	1680.560	1	12	<0.001

a Predictors: (Constant), FLEET

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
1					
Regression	5497607159445630000.000	1	5497607159445630000.000	1680.560	<0.001
Residual	39255540225902590.000	12	S ² = 3271295018825216.000		
Total	5536862699671540000.000	13			

a Predictors: (Constant), FLEET

b Dependent Variable: TOTALEX

Coefficients

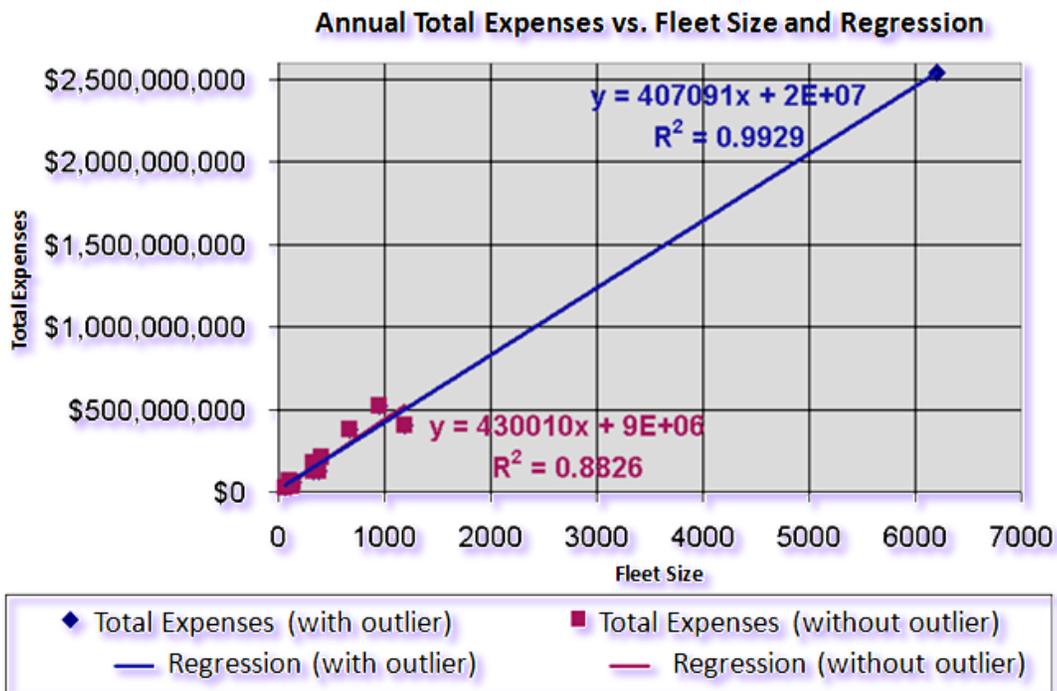
		Model 1	
		(Constant)	FLEET
Unstandardized Coefficients	B	16959158	407090.58
Std. Error		17177070	9930.338
Standardized Coefficients	Beta		0.996
t		0.987	41
Sig.		0.34	0
95% Confidence Interval for B	Lower Bound	-20466459	385454.23
	Upper Bound	54384775	428726.92
Correlations	Zero-order		0.996
	Partial		0.996
	Part		1
Collinearity Statistics	Tolerance		1
	VIF		1

a Dependent Variable: TOTALEX

As expected, a simple model resulted, in function of the independent variable with the greatest correlation to the dependent variable, which is the fleet size. It make sense that this variable be representative of most of the variability as the fleet size depends on the vehicles required for maximum service, which depends on the *headway*¹⁷ and travel time (Vuchic, 2005), and travel time depends on the alignment length and the amount of stops. The hypothesis test that the fleet coefficient is zero is rejected, as the “Sig” value is less than alpha value.

Plotted data with the regression line is shown in Figure 8-2.

Figure 8-2 Expenses vs. Fleet Size (Data and Regression)



¹⁷ Headway: Time between transit units' arrival to a stop, terminal or station.

8.3.5.1.5 Comparison with Tren Urbano

The model was applied to the case of Tren Urbano. It is important to point out that all other Heavy Rail systems in the simple are directly operated¹⁸, while Tren Urbano is purchased transportation¹⁹ (e.g. privately operated under a contract with HTA).

Resulting model is shown in Equation 8-4.

Equation 8-4 Regression Model Total Expense as Function of Fleet Size

$$\mathbf{TE = 16959157.803 + 407090.575 \times FS}$$

Where: TE is the annual total expense and FS is the fleet size

Tren Urbano characteristics are shown in Table 8-15.

¹⁸ Directly Operated - This is a transportation service provided directly by a transit agency, using their employees to supply the necessary labor to operate the revenue vehicles. This includes instances where an agency's employees provide purchased transportation services to the agency through a contractual agreement. (Federal Transit Administration, 2012)

¹⁹ Purchased Transportation - This is a transportation service provided to a public transit agency or governmental unit from a public or private transportation provider based on a written contract. The provider is obligated in advance to operate public transportation services for a public transit agency or governmental unit for a specific monetary consideration, using its own employees to operate revenue vehicles. Purchased transportation (PT) does not include (Federal Transit Administration, 2012):

- Franchising
- Licensing operations
- Management services
- Cooperative agreements, or
- Private conventional bus service

Table 8-15 Tren Urbano Characteristics

Agency	Mode	Service	Total Expense	Length (miles)	Fleet Size	Train Miles	Train Hours	Stations
Tren Urbano	Heavy Rail	Purchased Transportation	\$95.9 million	10.7	74	1748550	115301	16

For comparison purposes, Tren Urbano total expenses include the items shown in Table 8-16, except the related to other modes' services.

Table 8-16 Tren Urbano Cash Flow

Item	Annual Amount	Notes
MBA Contract	\$8,000,000	Amount estimated for contract
Metrobús	\$5,500,000	Amount estimated for contract
Minibus	\$5,800,000	Estimate for budget
Sub Total Complementing Transportation Systems	\$19,300,000	
Police Contract	\$5,400,000	Amount estimated for contract
Public Relations	\$2,500,000	Estimate for budget
Sub Total Other Complementing Services	\$7,900,000	
Energy	\$9,000,000	Average estimated with available monthly data
Insurances	\$2,000,000	Estimate for budget
Operations and Maintenance Contract	\$52,661,000	Amount estimated for contract
Contract Oversight	\$5,019,000	Estimate for budget
Sub Total Operating Expenses	\$68,680,000	
Total Expenses Except other Transportation	\$76,580,000	
Total Expenses	\$95,880,000	
Fare Collected	\$8,471,614	Special passes not available the first four months
Net Expense	\$87,408,386	

* Estimate from 2004-2005 ATI data.

Applying the model to Tren Urbano it is obtained the following:

$$TE = 16959157.803 + 407090.575 \times 74 = \$47,083,860$$

Therefore, as per the model, Tren Urbano annual expense is estimated around \$47 million, which is about \$20 million less than 2005 estimated Tren Urbano operating expense²⁰, about \$30 million less than total expenses without considering other related transportation services and about \$48 million less than actual budgeted total expense.

8.3.6 *Chi-Square Test of Independence*

Chi-square tests were developed in order to inspect the correlation among independent variables. Tests were performed using SPSS (Statistical Package for Social Sciences, Version 10.0). As the sample is small, all results indicated that 100% of the cells will have frequencies of less than 5. Therefore, the sample size is not adequate for the test (Kim, 2004). Nevertheless, the results are shown in Table 8-17, where the green cells indicate the correlated variables. Although the sample size is small for the tests, the results make sense:

- **Benefits and Sense of Belonging** - These are two variables related to the organizational environment. It could be understandable that the quality of benefits received may be related to the sense of belonging to a company. As observed in subsections 8.3.1 and 8.3.2, higher ridership averages are observed as the sense of belonging and the benefits increases.
- **Amount of Modes and Modes** - These variables are related to organizational capacity and the transportation system. This correlation was expected as per the way the

²⁰ The 2009 NTD reported an operating-only expense of \$61.2 million for Tren Urbano heavy rail.

variable Modes was defined. The type of Modes was defined as having train and any other mode, having bus and any other mode but train, and paratransit only.

- Amount of Modes and Sense of Belonging - It could be understandable that the amount of modes a company handles (related to organizational capacity) may be related to the sense of belonging (related to internal organizational environment) of its employees. It was observed that the ridership averages is greater with more amount of modes and more sense of belonging.
- Amount of Modes and Budget - The correlation among these two capacity variables was expected. Bigger amount of modes typically implies more diverse necessities, hence, increase in the costs.
- Budget and Modes - This correlation was expected as per the way the variable Modes was defined. Typically, heavy rail systems cost more than bus systems.

Table 8-17 Chi-Square Test of Independence

Sig.	Sense of Belonging	Overall Benefits	Percent Contracted	Modes	Budget	Amount of Modes	Bonus / Promotion
Sense of Belonging							
Overall Benefits	0.01						
Percent Contracted	0.312	0.441					
Modes	0.113	0.204	0.153				
Budget	0.272	0.209	0.335	0.037			
Amount of Modes	0.063	0.148	0.662	0.023	0.042		
Bonus / Promotion	0.082	0.001	0.451	0.205	0.057	0.078	

Green cells would show correlated pairs. Sample size is small for the test.

Models would be selected such as the independent variables are not correlated among them.

9 MODELS' APPLICATION

The most statistically significant models (e.g. the ones with the highest “Sig” and R Squared) were applied for the case of San Juan, Puerto Rico (PR), which was originally excluded in the sample used for the models' development. The values for the models' related variables corresponding to PR, as per survey answers, are shown in Table 9-1.

Table 9-1: Models' Variables Values for Puerto Rico Agency

Variable	PR Agency
Amount of Modes	4 (Train, Express Bus, Non-Motorized, Highway)
Modes	Contains Train
Portion Contracted	50% - 75%
Overall Benefits	Side or Fringe Only
Sense of Belonging	Partially Agree
Bonus and/or Promotion Opportunities	No
Budget / Service Population	780.7 (more than 100) This value is greater than any other in the sample.
Ridership / Service Population	10.5

The average values and standard deviations for the dependent variable Ridership / Service Population for both the sample and population are given in Table 9-2. Note that PR value is less than both sample and population mean. Also note that the sample mean is higher than the population mean. In addition, the sample standard deviation is smaller than the population standard deviation.

Table 9-2: Dependent Variable Average Value for Sample and Population

Annual Ridership / Population	
Sample Overall Mean	19.23
Sample Standard Deviation	18.39
2009 NTD Population Mean	16.81
2009 NTD Population Standard Deviation	48.61

Next subsections will present the prediction for PR agency calculated as follows:

Equation 9-1: One-Variable Model

$$M_h = \frac{R_i}{P_i} \approx \left(\frac{\overline{R}}{\overline{P}} \right) + \alpha_j$$

Equation 9-2: Two-Variable Model

$$M_h = \frac{R_i}{P_i} \approx \left(\frac{\overline{R}}{\overline{P}} \right) + \alpha_j + \beta_k$$

Equation 9-3: Three-Variable Model

$$M_h = \frac{R_i}{P_i} \approx \left(\frac{\overline{R}}{\overline{P}} \right) + \alpha_j + \beta_k + \gamma_s$$

Where:

M_h = prediction from model h (ridership/service population)

$$\left(\frac{\overline{R}}{\overline{P}} \right) = \frac{\sum_{i=1}^n R_i}{\sum_{i=1}^n P_i}$$

R = ridership (unlinked passenger trips per unit of time)

P = service population

n = amount of observations

α_j = deviation from grand mean due membership of i^{th} observation in j^{th} category of variable A

β_k = deviation from grand mean due membership of i^{th} observation in k^{th} category of variable B

γ_s = deviation from grand mean due membership of i^{th} observation in s^{th} category of variable C

9.1 Single Variable Models

The model application results for single variable models are shown in Table 9-3. The table also has some observations regarding the tendencies derived from the models. As indicated in section 8.2.1, seven (7) variables resulted correlated with significance and their R squared were greater than 0.41. Three (3) variables, especially one, were able to closely predict PR value of 10.5 (sense of belonging, overall benefits and mainly promotion/bonus). The best model estimate is marked in color purple on the table, while the other two are marked in color green.

Table 9-3: Model Application - Single Variable

	Variable	Sig	Eta - R	R ²	PR Estimated Mean	Other Group Means		Model Observations
1	Amount of Modes	0.012	0.721	0.5198	25.136	3.974	32.827	The greater the amount of modes, the greater the mean.
2	Modes	0.006	0.758	0.5746	36.746	0.526	14.745	The greater the capacity of individual transit units available (train>bus>demand response), the greater the mean.
3	Percent Contracted	0.024	0.726	0.5271	17.844	7.146	37.180	Mean is smaller for no subcontracts, followed by subcontracts of more than 25%. The greater mean was for subcontracts up to 25%.
4	Budget/Population	0	0.962	0.9254	38.945	1.035	9.533	The greater the budget, the greater the mean.
5	Sense of Belonging	0.041	0.642	0.4122	6.268	3.384	28.521	The greater the sense of belonging, the greater the mean.
6	Bonus / Promotion Opportunity	0.009	0.649	0.4212	11.083	35.540	N/A	Mean is greater if there is bonus/promotion.
7	Overall Benefits	0.027	0.673	0.4529	13.007	3.384	35.54	The greater the benefits (no < side < bonus/promotion), the greater the mean.

It is interesting that for a system with the characteristics of **PR**, most estimates (except one, related to the variable **Sense of Belonging**) are over the real value. It is also noticeable that such estimates are diverse. The estimates range from 6.27 to 38.95, with an average of 21.29 and a standard deviation of 12.75.

9.2 Two-Variable Models

The model application results for two-variable models are shown in Table 9-4 . The red colored numbers on the table correspond to such models which have significance or “Sig” value of less than 0.05 for one variable and less than 0.07 for the other. Green colored numbers correspond to such models which have Significance value of less than 0.05 for one variable and less than 0.2 for the other. The pink cell demarks the estimate that best match the **PR** case, while the blue cell demarked the second best estimate. Estimates were calculated by adding SPSS results for Deviation Adjusted for Factors corresponding to **PR** categories to the overall sample mean, as previously explained in chapter 8.2 of this document.

Note from Table 9-4 that for a system with the characteristics of **PR**, the most positive influences on ridership are those related to the budget, modes and amount of modes, while the most negative influences are those related to availability of bonus/promotion opportunities, benefits and portion contracted.

As indicated in section 8.2.2, in some instances, **R squared** was significantly improved when adding a second variable. The model closest to **PR** value is composed of the addition of the variable **Portion Contracted** to the single-variable model that best estimated the **PR** case (**Bonus / Promotion Opportunity**). Although the **R Square** improves on the model, the **PR** estimate is a bit farther from true value than the one with the single variable model.

For a system with the characteristics of **PR**, most two-variable estimates (except one, related to the variable **Sense of Belonging** and **Portion Contracted**) are over the real value. It is also noticeable that such estimates are diverse. The estimates range from 4.91 to 34.11, with an average of 21.49 and a standard deviation of 11.00.

Table 9-4: Model Application - Two Variables

	Model Sig.			PR Estimated Mean		
	Amount of Modes	Modes	Percent Contracted	Amount of Modes	Modes	Percent Contracted
Percent Contracted	0.003	0.006		27.545		
Budget/ Population			0.020 <0.001			34.110
Sense of Belonging			0.044 0.192			4.907
Bonus / Promotion Opportunity		0.032 0.067	0.046 0.063		28.079	11.277
Overall Benefits		0.032 0.114	0.049 0.128		29.526	14.969

	Deviation Adjusted for Factors			R Squared		
	Amount of Modes	Modes	Percent Contracted	Amount of Modes	Modes	Percent Contracted
Percent Contracted	8.076 0.233			0.868		
Budget / Population			-4.200 19.080			0.976
Sense of Belonging			-4.397 -9.931			0.687
Bonus / Promotion Opportunity		13.659 -4.815	-2.093 -5.865		0.691	0.684
Overall Benefits		12.823 -2.532	0.078 -4.344		0.725	0.717

9.3 Three-Variable Models

The model application results for two-variable models are shown in Table 9-5. The models presented correspond to those having the Significance values as follows:

- It is less than 0.05 for two of the variables and less than 0.5 for the third.
- It is less than 0.15 for all three variables in the model.
- It is equal or less than 0.2 for two of the variables and is less than 0.3 for the third.

The pink cell demarks the estimate that is closest to the value for PR case. Estimates were calculated by adding SPSS results for Deviation Adjusted for Factors corresponding to PR categories to the overall sample mean, as previously explained in chapter 8.2 of this document. Note that all estimates with three-variable models are much larger than the actual PR value.

Table 9-5: Model Application - Three Variables

Model Variables	Sig	Beta	R Squared	Deviation Adjusted for Factors	PR Estimate
Overall Benefits	0.108	0.434	0.864	-1.995	34.859
Portion Contracted/ Subcontracted	0.073	0.461		7.078	
Modes	0.111	0.544		10.540	
Bonus/ Promotion Opportunity	0.418	0.140	0.881	-1.937	24.934
Portion Contracted/ Subcontracted	0.008	0.656		0.400	
Amount of Modes	0.033	0.538		7.236	
Bonus/ Promotion Opportunity	0.128	0.325	0.800	-4.502	28.341
Portion Contracted/ Subcontracted	0.147	0.402		3.652	
Modes	0.203	0.485		9.955	
Sense of Belonging	0.264	0.383	0.817	4.029	45.864
Portion Contracted/ Subcontracted	0.110	0.527		9.109	
Modes	0.200	0.699		13.491	
Budget	0.001	0.956	0.981	20.517	36.091
Portion Contracted/ Subcontracted	0.022	0.284		-4.837	
Bonus/ Promotion Opportunity	0.318	0.095		1.176	

As indicated in section 8.2.2, in some instances, R squared was improved when adding a third variable. However, the significance of the variables is reduced and the estimate for PR is far from the real value in all cases.

For a system with the characteristics of PR, all three-variable estimates are well over (more than twice) the real value.

9.4 Models Comparison

When applying the models for the case of PR, it was observed that the estimates from the models were diverse. Table 9-6 shows some observations regarding the diversity of results with the models. It was observed that with more variables, the standard deviation among estimates is reduced; however, the estimate for PR was farther from the real value.

Table 9-6: Models' Estimates Comparison

PR Estimate	One Variable	Two Variables	Comments	Three Variables	Comments	All Models
Amount of Models	7	7		5	Variables' significance decrease when the amount of variables increases.	19
Minimum	6.27	4.91	Minimum estimate among models decreased with increase in variables in models	24.93	Minimum estimate is considerably larger with three-variable models.	4.91
Maximum	38.94	34.11	Maximum estimate among models decreased with increase in variables in models	45.86	Maximum estimate is larger with three-variable models.	45.86
Average	21.29	21.49	Average estimate among models increase with increase in amount of variables in models	34.02	Average estimate is larger with three-variable models.	24.71
Standard Deviation	12.75	11.00	Standard deviation among models decrease with increase in amount of variables in models	8.06	Standard deviation is significantly smaller among three-variable models.	11.90

9.5 Model Selection for Estimates

A set of various possible models was obtained. Such models were tested for the case of PR. As shown in previous section 9.4, each model estimates a different average for the same case. Therefore, it is proposed to use a model averaging technique in order to produce a single estimate.

Model averaging approaches provide a way to make more stable inferences based on a set of models...One approach is to use re-sampled data as a proxy for multiple samples that are drawn from some conceptual probability distribution. A model is selected for each re-sampled set of data, and a predictive model is built by averaging the predictions of these selected models...Re-sampling-based methods, in which samples are obtained by drawing with replacement from your data, fall under the umbrella of the widely studied methodology known as the bootstrap. (SAS Institute, 2010)

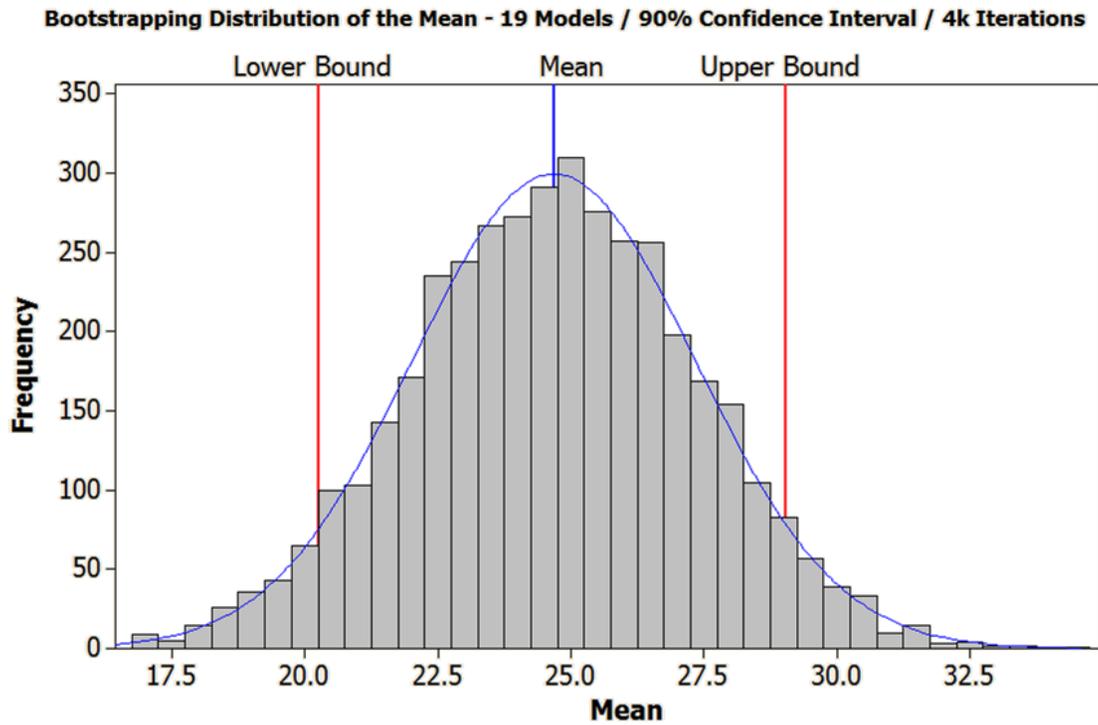
The proposed approach that is to use a percentile bootstrap method in order to obtain a confidence interval for the estimate. This is performed by applying bootstrapping to the set of estimates obtained from the different models. The bootstrapping technique was combined with an iterative process as follows:

- The confidence interval width of the empirical mean distribution was compared to the distance between predicted means for each of the categories of the individual variable models. If the distance between categories' predicted means was smaller than the bootstrap confidence interval, the variables' categories were revised. If reasonable, the categories were modified and the model was re-run with the modified categories.
- If the Significance value for any of the variables in a single model was greater than 0.10, the model was discarded.
- The process was repeated until all of the following met:

- The confidence interval width is smaller than the distance between any (consecutive if applicable) categories' predicted means for the single variable models
- The absolute value of the difference between consecutive calculated confidence intervals (means and each of the boundaries) is 5% or less for all three values (boundaries and mean).

This technique was applied to the study case of **PR**. The first approach used all possible models as identified in sections 9.1, 9.2 and 9.3. A total of 4,000 iterations were performed, for a 90% confidence interval. Results are presented in Figure 9-1. Note that the confidence interval's width (8.7 passenger trips per serving population) is smaller than the one obtained for the population mean from the sample (15.27 passenger trips per service population), shown in sub-section 7.3. As can be observed, annual ridership/service population is over-estimated for **PR**; the lower bound resulted in 20.26 while the true value is 10.5. Also, it is important to consider that such models' results are mean values for a group of systems with similar characteristics. The over-estimation of the mean, for the case of **PR**, is mainly due the variables of Budget and Modes. Hence, for **PR**'s Budget and Modes, mean ridership tends to be higher.

Figure 9-1: Model Averaging Results - 19 Models' Predictions



Lower	Mean	Upper
20.26	24.68	29.03

In order to refine the models, single variable model ranges were inspected and compared to the confidence interval of the bootstrapped 19 models. Note in Table 9-7 that shaded difference between means is smaller than the confidence interval. Therefore, the difference between such categories is not significant. Such variables were re-defined the models were re-run. The results are shown in Table 9-8.

Table 9-7 Difference between Means

Variable	Categories			Difference between Means	
Budget/ Population	Less than 20	36 to 66	More than 100		
MCA Averages	1.04	9.53	38.95	8.49	29.42
Modes	Includes train	Includes bus (no train)	Demand response only		
MCA Averages	36.75	14.75	0.53	22	14.22
Percent Contracted	0%	Up to 25%	More than 25%		
MCA Averages	7.15	37.18	17.84	10.69	19.34
Amount of Modes	1-2	3-4	5-6		
MCA Averages	3.97	25.14	32.83	21.17	7.69
Overall Benefits	None	Fringe Only	Bonus/ Promotion Opportunities		
MCA Averages	3.4	13	35.5	9.6	22.5
Bonus and/or Promotion Opportunity	Yes	No			
MCA Averages	35.54	11.08		24.46	
Sense of Belonging	Strongly Agree or Agree	Partially Agree	Disagree or Strongly Disagree		
MCA Averages	28.32	6.27	3.38	22.05	2.89

Table 9-8: Variables Re-Defined

	Variable	Sig	Eta = Beta = R	R Squared	Predicted Mean for Classifications		Difference of Means	PR
1	Amount of Modes	0.010	0.640	0.410	1-3	4-6	23.227	9.944
					9.944	33.171		
2	Budget/ Population	<0.001	0.929	0.863	<66	100+	33.697	39.453
					5.756	39.453		
3	Sense of Belonging	0.010	0.640	0.410	Neutral/ No	Yes	23.214	5.307
					5.307	28.521		

As can be observed in Table 9-8, the difference between means is larger than the previously obtained confidence interval. Therefore, the related multi-variable models were also re-run. Results are shown in Table 9-9 for two-variable models and in Table 9-10 for three variable models. For convenience, results from all previous multi-variable models, including those that were not modified, are shown. Unmodified models are shown in brown letters. Yellow

highlighted results are those having all variables with Significance value less than 0.10. Those will be the new multi-variable models selected.

Table 9-9 Two Variable Models Re-defined

Variables	Sig			R Squared			PR		
	Amount of Modes	Modes	Percent Contracted	Amount of Modes	Modes	Percent Contracted	Amount of Modes	Modes	Percent Contracted
Percent Contracted	0.052								
Budget / Population	0.032			0.696			7.521		
Sense of Belonging			0.117 <0.001			0.907			29.622
Bonus / Promotion Opportunity			0.030 0.062			0.685			3.282
Overall Benefits		0.032 0.114	0.046 0.128		0.691 0.725	0.684 0.717		28.07882 29.52565	11.27749 14.96941

Table 9-10 Three Variable Models Re-defined

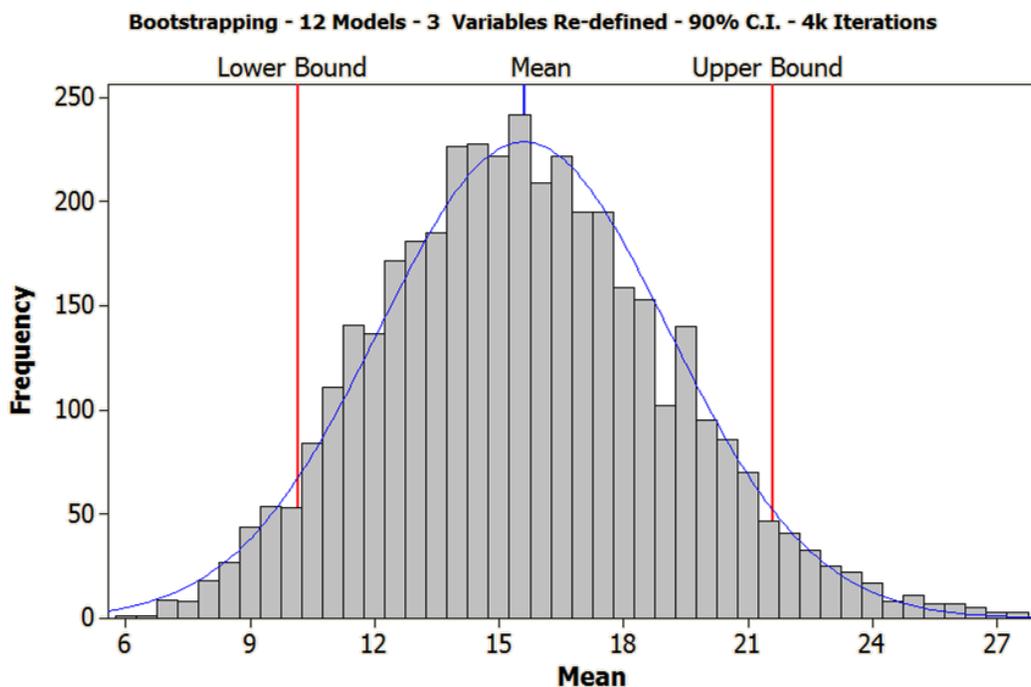
Model Variables	Sig	Beta	R Squared	Deviation Adjusted for Factors	PR Predicted
Overall Benefits	0.108	0.434	0.864	-1.995	34.859
Portion Contracted/ Subcontracted	0.073	0.461		7.078	
Modes	0.111	0.544		10.540	
Bonus/ Promotion Opportunity	0.069	0.249	0.911	-3.449	2.871
Portion Contracted/ Subcontracted	0.037	0.385		-2.171	
Amount of Modes	0.002	0.567		-10.744	
Bonus/ Promotion Opportunity	0.128	0.325	0.800	-4.502	28.341
Portion Contracted/ Subcontracted	0.147	0.402		3.652	
Modes	0.203	0.485		9.955	
Sense of Belonging	0.288	0.293	0.760	-7.713	16.499
Portion Contracted/ Subcontracted	0.168	0.471		-1.033	
Modes	0.388	0.366		6.009	
Budget	0.001	0.748	0.918	14.156	27.100
Portion Contracted/ Subcontracted	0.159	0.246		-4.546	
Bonus/ Promotion Opportunity	0.342	0.126		-1.745	

Now there are 12 models as follows:

- The seven single variable models (four original and three as re-defined)
- The four two-variable models having both variables with Significance value less than 0.1 (two original and one with a re-defined variable)
- A three-variable model, with one re-defined variable, having all variables' Significance value less than 0.1.

The PR predictions for these eleven models were bootstrapped. The results are shown in Figure 9-2.

Figure 9-2: Bootstrapping Model Averaging - Twelve Models' Predictions with 3 Variables Re-Defined



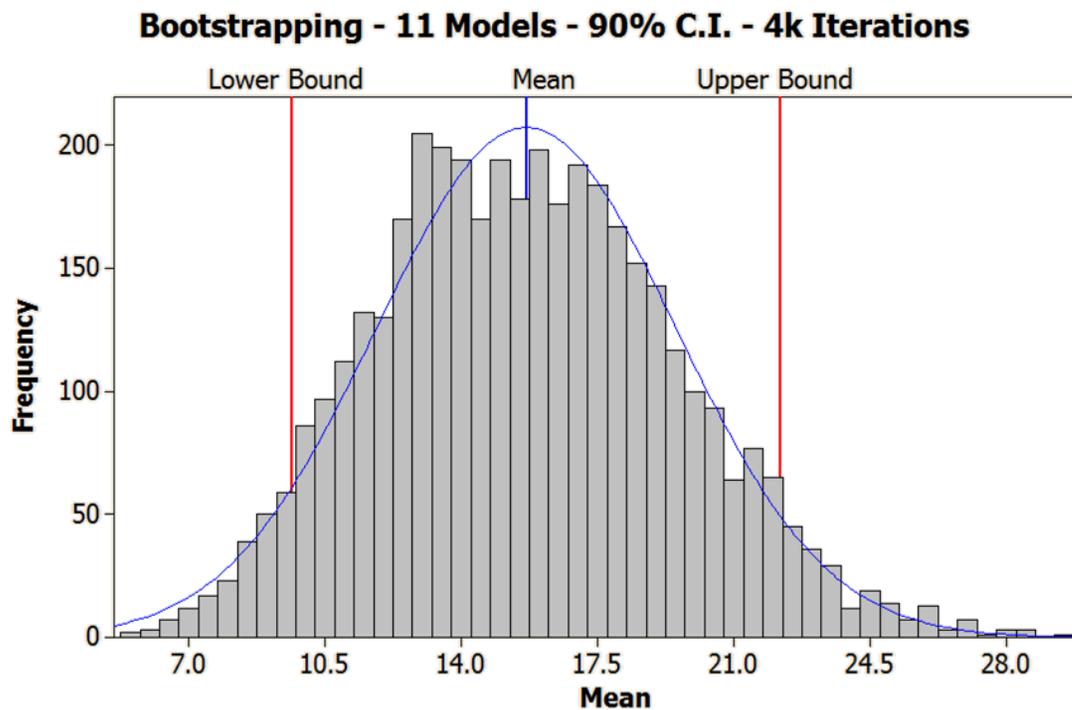
Lower	Mean	Upper
10.14	15.6	21.59

As can be observed from Figure 9-2, the new selection resulted in a confidence interval which includes PR value. However, the interval increased in size to 11.4, which is still smaller than the one obtained for the sample mean.

Individual variables were re-inspected for the difference between means and the resulting confidence interval. Overall Benefits had one of the two differences smaller than such interval. If Overall Benefits is re-grouped, it results equal to the already considered Bonus or Promotion Opportunities variable. Hence, the models with Overall Benefits variable will be discarded. Note also that the Portion Contracted variable has a difference between means that is smaller from the resulting confidence interval. However, such difference is not among contiguous portions; differences among continuous portions are bigger than the confidence interval. Therefore, models with this variable will be maintained.

The remaining model results were again bootstrapped. Results are shown in Figure 9-3.

Figure 9-3: 11 Models



Lower	Mean	Upper
9.65	15.67	22.18

Note in Figure 9-3 that the confidence interval is very similar to the one calculated just before. Also note that the real value lays more comfortable within the confidence interval. The range of the confidence interval is smaller than the one for the sample. Also note that

none of the remaining single variables has a difference between means smaller than the resulting confidence interval.

The “model reduction” technique applied was useful to obtain a confidence interval of the mean annual ridership per service population that contains the true value for year 2009 in the study case of PR.

Therefore, in order to broadly estimate an average annual ridership per service population, it is proposed to perform percentile bootstrapping to model results from the MCA resulting models shown in Table 9-11.

The bootstrapping used was for a 90% confidence interval, performed through 4,000 iterations. The confidence interval of 90% in this research was chosen as is enough to have some representation while is not too restrictive, given the limitation of amount of data. The big amount of iterations resulted in an empirical mean distribution more approximately to a normal one. Please have in mind that the obtained result is not a precise prediction of the ridership, but a predicted mean for a set of various data points (i.e. different agencies, different years) with similar characteristics.

Table 9-11 also shows a comparison of the PR’s agency value with the predicted results from the models, which were derived from other organizations with similar characteristics. As per models, for the PR budget and modes, it should have higher ridership. However, PR’s agency has higher ridership than systems with similar sense of belonging. PR’s agency ridership is similar to the one having organizations with equivalent levels of benefits.

Table 9-11: Final Selection of MCA Models

ID	Variables in Model	Sig.	Model R-Squared	PR Predicted Mean (Annual Ridership/ Service Population)	Comparison of PR Real Value with Prediction for Organizations with Similar Characteristics
1	Amount of Modes	<0.001	0.753	9.944	PR ridership is comparable to the one that other organizations with similar amount of modes have.
2	Budget/ Population	<0.001	0.863	39.453	Systems with budgets similar to PR's one have significantly higher transit ridership.
3	Sense of Belonging	0.010	0.410	5.307	PR ridership is higher than the one having organizations with similar sense of belonging.
4	Modes	0.006	0.575	36.746	Systems with modes similar to PR's ones have significantly higher transit ridership.
5	Bonus / Promotion Opportunity	0.009	0.421	11.083	PR ridership is comparable to the one that other organizations with similar benefits have.
6	Percent Contracted	0.024	0.527	17.844	Systems with percent contracted similar to PR have slightly higher transit ridership
7	Amount of Modes & Percent Contracted	0.001	0.863	7.521	Systems with a combination of amount of modes and percent contracted similar to PR have slightly lower ridership.
		0.038			
8	Modes & Bonus/Promotion	0.032	0.691	28.0788	Systems with a combination of type of modes and benefits similar to PR have significantly higher ridership.
		0.067			
9	Sense of Belonging & Percent Contracted	0.062	0.685	3.28176	Systems with a combination of sense of belonging and percent contracted similar to PR have lower ridership.
		0.03			
10	Bonus/ Promotion & Percent Contracted	0.063	0.684	11.2775	PR ridership is comparable to the one that other organizations with similar combination of benefits and percent contracted have.
		0.046			
11	Bonus/ Promotion Opportunity	0.069	0.911	2.81	Systems with a combination of sense of belonging, percent contracted, and amount of modes similar to PR have lower ridership.
	Portion Contracted/ Subcontracted	0.037			
	Amount of Modes	0.002			

10 CONCLUSIONS AND RECOMMENDATIONS

A transportation organization is defined here as a social construct created to facilitate the movement of people and goods by means of planned & coordinated activities. Such organization, the construct and its means, can be described by several factors or characteristics. Such characteristics are related to capacity (resources) and internal environment (internal factors influencing the direction of the organization and the energy displayed on the activities).

This research evaluated the hypothesis that transportation organization has an impact on their transit ridership. The applicable proposed conceptual framework combines transportation and organization theories from Manheim, Florian, González and Horton, et.al.

The study population is composed of transportation organizations that report to the National Transit Database (NTD). On the Background section it was presented that, for this population, ridership was linearly correlated to service-related characteristics such as fleet size, revenue miles, and revenue hours. Additional correlation analyses were performed to other NTD variables in order to determine if they are correlated to ridership. Categorical data was re-arranged to subdivide some of the categories. Eta correlation ratio was applied to categorical variables while both Eta and Spearman Correlation Coefficient were used in continuous data. The tested variables were: Unit of Government, Operation Type, Board Type, Annual Employee Hours / Service Population, Annual Operating Expenses / Service Population. It was found that the categorical variables were not correlated, but the continuous variables (employee hours and operating expense) were correlated to ridership.

As the variables available at the NTD were limited, the hypothesis was tested through Multiple Classification Analyses (MCA) applied to organizational data collected from a survey. The survey content was determined through literature review and case studies. The survey was tested with two subjects, prior formal distribution. Distribution was made to published contacts for transportation institutions and professional associations, through electronic mail. The electronic mail included a link for the online survey. The analyses' sample consisted of 15 organizations, or 2.11% of the study population of 710. A

bootstrapping of the sample was used to determine a 90% confidence interval for the population mean.

Eta correlation analysis was used to inspect correlation among survey variables. Out of 35 variables tested, seven were found to be correlated to ridership: Amount of Modes, Type of Modes, Percent Contracted, Budget/ Service Population, Sense of Belonging, Bonus / Promotion Opportunity, Deserving Benefits, and Overall Benefits. Note that the variables related to organization type (Owner, Company Type) that were similar to the tested for the NTD population (Operation Type, Unit of Government) also resulted non-correlated to ridership for the survey sample.

MCA was found to be the best analysis tool for the type of variables that were going to be studied: a continuous dependent variable and several categorical independent variables. The MCA also allowed inspecting variable interactions and relative influence among them. Continuous variables were divided by the applicable service population, so comparisons among them could be made. Continuous independent variables were divided into ranges prior applying the MCA.

MCA was applied to combinations of up to three variables from the seven variables that were found to be correlated to ridership. Interactions among variables were not significant. It was found that ridership per service population increased as follows: with greater amount of modes, with modes carrying greater vehicle capacity, with greater budgets, with greater sense of belonging to the organization, with greater benefits, and with subcontracts greater than zero but less or equal to 25% of organization's business.

It was found that the following combinations of variables produced MCA models with improved goodness of fit as compared to modes of single variables, while maintaining a fair level of significance: Amount of Modes & Percent Contracted, Modes & Bonus/Promotion, Sense of Belonging & Percent Contracted, Bonus/Promotion & Percent Contracted, and Bonus/Promotion Opportunity, Portion Contracted/Subcontracted & Amount of Modes.

From pair comparison of the Beta coefficients, it was also found that the variable with the greater influence was Budget per Service Population. The next most influencing variables, in descending order are: Amount of Modes, Type of Modes, Percent Contracted/Subcontracted, Sense of Belonging, Bonus/Promotion Opportunities, and Benefits.

Several models of one to three variables resulted from the MCA. An initial amount of 19 models were selected as possible mean predictors. Selection criteria for models were as follows: $Eta > 0.6$, $Sig < 0.05$ for single-variable models and for at least one of the variable of multiple-variable models, and $Sig < 0.2$ for the other variables in multiple-variable models.

The case of a Puerto Rican transportation agency, not included in the development of models, was used as an example to validate and derive model selection criteria. It was observed that the estimates from the models were diverse. It was found that the estimate for PR case was very close to the real value among single-variable models related to internal environment characteristics such as sense of belonging to the organization and available benefits. The incorporation of the variable related to the percent of business subcontracted results on an estimate that is similar to the real value. However, the prediction was highly overestimated when the variables related to budget and modes were incorporated. This makes sense as the greatest part of the transit budget pertains to a heavy rail system that was overdesigned in terms of amount of vehicles needed, amount of stations and station size. In this case, the design considered feeder systems that didn't fully developed and current ridership is about 20% of the originally expected one.

Groups of models with the same amount of variables were inspected. It was observed that among models having multiple variables, the standard deviation among estimates is reduced; however, the estimate for PR case was farther from the real value.

As the prediction from models refers to a mean for systems having similar category memberships, the use of model averaging was found to be more appropriate than just selecting a single model. Given that model parameters depend on the category memberships,

a combination of forecasts is a more feasible and simpler way to obtain a single mean prediction from the set of models.

In order to combine forecasts, a percentile bootstrap method was used. This also allowed obtaining a confidence interval for the predicted mean. The process included the application of bootstrapping to the set of estimates obtained from the different models. The bootstrapping technique was combined with an iterative process. The process required that the confidence interval would be smaller than the distance between the consecutive categories of the variables, and that the Significance value for any of the variables in a single model be equal or less than 0.1. When possible, categories were revised in order to increase the distance between them. Otherwise, models were discarded. The process was repeated until the absolute value of the difference between consecutive calculated confidence intervals (means and each of the boundaries) was 5% or less for all three values (boundaries and mean). The final selection includes eleven models. Bootstrapping was performed for a 90% confidence interval through 4,000 iterations. The resulting predicted mean was 15.67 and a confidence interval between 9.65 and 22.18, which includes the true value of 10.5.

Given that several organization variables were found to be directly correlated to ridership and the combination of forecasts derived from the models containing such variables provided a feasible mean ridership prediction, it can be concluded that organization is directly related to ridership as shown in the proposed framework. Note that the general form of the models contains a representation of the components of the framework. Also note that the scope of this study was limited to the relation of the organization to the ridership, hence, not all the components of the transportation system were included. However, the new component to the framework, the direct relation of organization, was tested and proved.

10.1 Commentary

Additional discussion and concluding remarks related to the overall research are presented in this section. They are related to survey responsiveness, profile of respondent transportation organizations, correlation analysis, multiple classification analysis, model applicability, and suggested scheme.

10.1.1 Responsiveness

It was observed that responsiveness to the survey was more active when the prospective respondents could professionally relate to the researcher. Also was noted that most respondents answered the survey shortly after receiving the invitation.

10.1.2 Respondents Profile

In relation to respondents' tendencies, several of responsive transit institutions currently offer accessible service and a good employment background, as 65% or more of respondents have the following characteristics:

- Include paratransit
- Include regular bus service
- Have available data up to the most recent finished natural year
- Their employees have clear knowledge of the vision/mission/objectives of the company
- Recruitment and promoting is through merit
- Employees enjoy side or fringe benefits
- Employees enjoy employment stability
- Own their system

Therefore, to respond the survey appealed mostly to representatives of organizations who owned their transportation system and indicated having generally perceived as positive characteristics (i.e. accessibility, recognition of merit, etc.). Therefore, it is important to consider for future surveys oriented to organizations that questions should be put in a way that the respondent might feel he/she is rating the organization.

10.1.3 Correlation between Organization and Ridership

As some of the questions had a very low rate of responsiveness, the information derived from them could not be used as part of the analysis. Such questions were related to modal split, type of company and average trips per person per day.

It was found that, among all 35 variables tested, seven were found to be correlated to ridership. In this research, ridership is defined as annual unlinked passenger trips per service population.

In general, it was found that there is not enough evidence to discard that some organizational characteristics do have influence in the variations of average ridership.

There is not enough evidence to discard that the following variables, individually, explain some of the variability in annual ridership per service population:

- Amount of Modes
- Bonus and/or Promotion Opportunities due Performance
- Budget per Service Population
- Overall Benefits
- Portion of Business Contracted or Subcontracted
- Sense of Belonging
- Type of Modes

10.1.4 Multiple Classification Analysis

Single, two and three variable models were tested. As expected, increasing the amount of variables resulted in improved fit. However, at most models, the significance of some or all the variables was reduced, as the lesser amount of variables was able to explain most of the variability.

From the pair comparison of Beta coefficient, the organization's characteristics that presented an influence in the ridership/population variable of transit institutions, in descendent order, are:

- Budget/ Population
- Modes
- Percent Contracted
- Amount of Modes
- Overall Benefits
- Bonus / Promotion Opportunity
- Sense of Belonging

The following tendencies were found:

- The mean ridership per service population increases with greater the amount of modes.
- The mean ridership per service population is greater for systems having greater capacity vehicles (train>bus>demand response).
- The mean ridership per service population is smaller for no subcontracts, followed by subcontracts of more than 25%. The greater mean was for subcontracts up to 25%.
- The mean ridership per service population increases with greater budgets.
- The mean ridership per service population is greater for organizations having greater sense of belonging to the institution.
- The mean ridership per service population is greater if there are productivity bonuses or promotion opportunities.
- The mean ridership per service population is greater for systems having side benefits than for those with no benefits at all.

It is also concluded, as can be observed from the two-variable models combined, the following:

- The influence of budget per service population is about nine times the influence of amount of modes, and about four times the influence of type of modes and percent contracted.
- The influence of amount of modes is about three times the influence of sense of belonging and about twice the influence of bonus/promotion and benefits, and about the same as percent contracted.
- The influence of modes is about 1.5 times the one of sense of belonging and bonus/promotion.
- The influence of percent contracted is about 1.5 the influence of sense of belonging.
- The influence of sense of belonging and bonus/promotion is about the same.

The influence of organizational characteristics can be measured or determined through a survey. They can be used as estimators of the mean ridership per service population for a group of systems sharing same categories for one or several of such characteristics by applying prediction averaging of the Multiple Classification models derived.

The following combinations of variables produce MCA models with improved goodness of fit as compared to modes of single variables, while maintaining a fair level of significance:

- Amount of Modes & Percent Contracted
- Modes & Bonus/Promotion
- Sense of Belonging & Percent Contracted
- Bonus/ Promotion & Percent Contracted

The following combination of three variables produced an MCA model with improved goodness of fit as compared to modes of two variables, while maintaining a fair level of significance.

- Bonus/ Promotion Opportunity, Portion Contracted/ Subcontracted & Amount of Modes

10.1.5 Model Application

When applying the models for the case study of San Juan, Puerto Rico, the models produced diverse values for a predicted mean. The models with the variables of budget and mode type tend to over-estimate the true value while the models with the variable of sense of belonging tend to under-estimate the true value. Therefore, a model averaging was applied

As observed from the analyses on Chapter 9 Models' Application, specifically section 9.5, averaging results from models containing organization's internal environment related variables resulted in an estimate that, for the case study of PR, was much more closer to the real one than considering the models related to capacity or transportation variables alone. Therefore, it can be concluded that there is not enough evidence to discard that the transit organization have a direct impact to transit ridership.

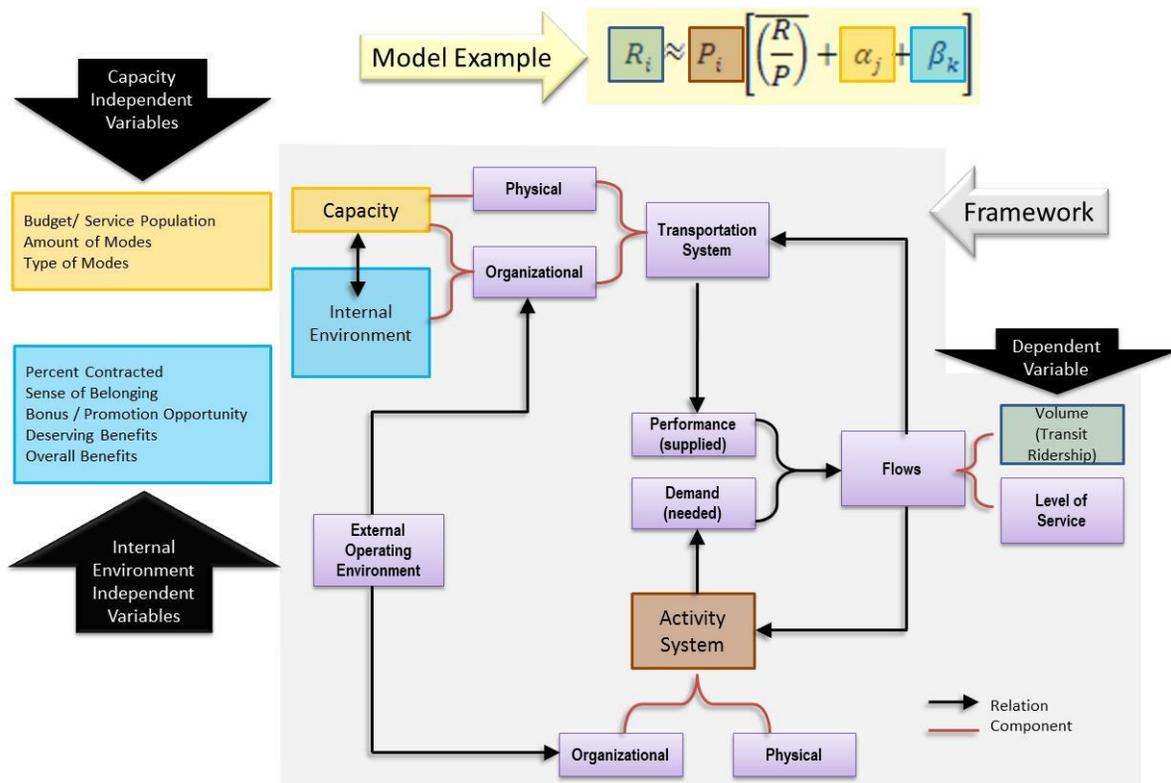
From the models' results, PR's agency ridership is similar to the one having organizations with equivalent levels of benefits. Also, PR's agency has higher ridership than systems with similar sense of belonging. However, for the PR budget and modes, it should have higher ridership. It makes sense as PR's agency (HTA) was originally created for managing highways and it is still its major business. Also, around 100 million yearly (12.2% of total budget) pertains to a heavy rail system (Tren Urbano) that was overdesigned in terms of amount of vehicles needed, amount of stations required, and station size. Its design also considered a feeder systems that didn't fully developed, and current ridership is about 20% of the originally expected one.

10.1.6 Transportation Framework

It was concluded from the results of the Eta Correlation Ratio, Multiple Classification Analysis, and Predicted Mean Bootstrap Averaging and Model reduction that there is a direct correlation between organizational characteristics of transit institutions and transit ridership, as presented in the proposed scheme. This can be appreciated in Figure 10-1. Therefore, a

framework describing current transportation should keep the organizational component as a direct influencing factor to flows, specifically to transit patronage.

Figure 10-1: Framework Demonstration with Model Example



The proposed transportation framework also shows the relation between the Transportation and Activity systems to Flows through the combination of the demand and offer. It also shows two components of both systems, which are the Organizational and the Physical. The transportation organizational component includes Capacity (resources) and Internal Environment (direction of the organization energy displayed in its activities) elements. In addition, it shows how the External Operating Environment (external legal and administrative system, policies, social and cultural environment, and available technology) influences organizational components of both systems.

10.2 Recommendations

The main recommendations from this study are regarding the conceptual network, National Transit Database (NTD) information collection, future related survey design, and model calibration.

10.2.1 Conceptual Framework

As it was demonstrated that organizational characteristics influence ridership and can be used as estimators, a framework describing current transportation relations should keep the organizational component. The organizational component should be directly linked to transit flows. It is also recommended the multiple classification analysis as a method to measure the influence of such components. Combining predictions is also recommended if multiple models with different combinations of variables are found to be appropriate, as occurred in this research.

10.2.2 NTD

It would be beneficial for research that the NTD would collect more segregated data regarding types of agencies and institutions.

- It would be beneficial to have separation between types of agencies and institutions that do the reporting and operation from the owners of the system.
- To have the proportion and type of contracted services will also help in future research.
- Other variables that should be good to incorporate, for research purposes, are those related to top leadership style and benefits and/or incentives to employees.

10.2.3 Survey Development

For future research, the survey should be designed simpler and more streamlined.

- The survey of this research was a first filter, hence, too many variables were included as well as several open options as part of the “Other” choice. As this research gave a key to which variables may have more influence, future research can be focused on them. Multiple choice answers should be preferred, as they are simpler to interpret and code.
- In order to encourage responsiveness, even if not all information was available, the respondent of this research’s survey was able to go to the next question without having to answer the previous. For the future, this should be more controlled, especially for the variables that might be used as dependent for different studies. Responsiveness might be encouraged by other means such as part of a requirement (such as reporting to the NTD) or other benefits to the companies such as the benefit of accessing the University’s library database for a period of time, one-year membership to a professional organization or magazine, among others.

10.2.4 Model Calibration

The amount of data for this research was limited. The resulting confidence intervals were useful to obtain general tendencies; however, they are wide to be used for precise mean predictions. Therefore, it is recommended that, for future research, more data be acquired. With more data, a group could be separated just to calibrate the model while other group can be used exclusively to validate. As the universe of significant questions is reduced as a result of this research, future research may be able to obtain more responses.

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12 GLOSSARY

Activity Subsystem A	The activities system has a physical and an organizational component. The physical-social component is represented by Afs(t). It includes location of residences, employment, recreation, and other activities performed by a social group, habits and social patterns that determine the spatial and temporal distribution of each group's activities. The organizational one, represented by Ao(t), includes persons and organizations with participation on the physical component, and the procedures used in making decisions over the physical component. (M. Manheim, 1979)
Arrogation right	The right to arrogate documents and administrative cases (except for those concerning administrative offences), i.e. to assume responsibility for them or delegate the responsibility for their execution to other members of the City Administration. (Stadt Wien, 2010)
ATI	Integrated Transport Alternative directorate of the HTA
Cancellation right	The cancellation right means that a body or office holder is entitled, or even obliged, to cancel a decision taken by another (collegial) body. For example, the Mayor must cancel any decision taken by the City Council or the City Senate if the decision might cause serious damage to the municipality, implementing the decision would be unlawful, or the body taking the decision has exceeded the boundaries of its statutory sphere of competence. (Stadt Wien, 2010)
CESCO	Center of Services for Drivers (as per its initials in Spanish)
chartered cities	Charter cities have supreme authority over "municipal affairs", therefore, a charter city's law concerning a municipal affair will trump a state law governing the same topic. (League of California Cities, 2007)
city-state	Political system consisting of an independent city having sovereignty over contiguous territory and serving as a center and leader of political, economic, and cultural life. (Encyclopædia Britannica, Inc., 2010)
collegial	A (majority) group of persons is jointly responsible for carrying out tasks and making decisions. (Stadt Wien, 2010)
company	An entity engaging in business, such as proprietorship, partnership, or corporation. (WebFinance, Inc.)
corporation	Body that is granted a charter recognizing it as a separate legal entity having its own rights, privileges, and liabilities distinct from those of its members. (Houghton Mifflin Company, 2000/2009)
democratic	Government by the people; a form of government in which the supreme power is vested in the people and exercised directly by them or by their elected agents under a free electoral system. (Dictionary.com, LLC.)
DTPW	Puerto Rico Department of Transportation and Public Works
Duties	Tax levied upon goods as they cross national boundaries, usually by the government of the importing country. The words tariff, duty, and customs are generally used interchangeably. (Farlex, Inc.)
Dynamic	Ability to change or adapt according to time or other conditions.
Effectiveness	Ability to meet goals and objectives. The degree to which the organization achieves its objectives (Horton et. al., 2003).
Efficiency	The degree to which it generates its products using a minimum of inputs. (Horton et. al., 2003)
Emergency competence	Right to take decisions on behalf of another body (such as the City Council, City Senate or a Council Committee) if the urgency of the situation so requires. (Stadt Wien, 2010)

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

federal	In federal systems, political authority is divided between two autonomous sets of governments, one national and the other sub national, both of which operate directly upon the people. Usually a constitutional division of power is established between the national government, which exercises authority over the whole national territory, and provincial governments that exercise independent authority within their own territories. (Encyclopædia Britannica Inc., 2010)
federalist structure	A federalist structure. Several levels of government exist, say, central, regional and local, with each level having its own separately elected democratic bodies, and with each responsible for the efficient resolution of a particular set of market failures. (Mueller, Dennis C.)
financial equalization	Measures which are designed to correct the effects of the unequal distribution of potential sources of finance and of the financial burden they must support (European Charter, Article 9, Paragraph 5, October 15, 1985). Policies toward a certain equal opportunity between local authorities, to moderate the vertical imbalances, to diminish the tax competition, to limit the risks of uncertainties and also to maintain the social cohesion. (Berthier, 2005) Concept of fiscal justice based on the sense of "equal treatment for equals" or equal treatment for persons dissimilar in no relevant respect." (Buchanan, 1950)
Financial sustainability	The conditions to make an organization financially viable. (Horton et. al., 2003)
fiscal residuum	For a citizen, value of taxes paid in a period of time minus benefits received (e.g. services, infrastructure) from those taxes paid. (Definition derived from example given on Buchanan, 1950)
Flows F	Amount of persons or vehicles passing through a point in a period of time.
GDP	Gross Domestic Product. The total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports. (WebFinance, Inc.)
GMP	Gross Metropolitan Product - part of the GDP generated by the metropolitan area.
holding company	A parent corporation that owns enough voting stock in another corporation to control its board of directors (and, therefore, controls its policies and management). (Investopedia ULC)
HTA	Puerto Rico Highway and Transportation Authority
incorporated	Organized as a legal corporation. (Houghton Mifflin Company, 2000/2009)
Institution	Entity in charge of establishing and managing particularly related public policy.
limited liability corporation or company (LLC)	Type of business ownership that combines several features of both corporation and partnership structures. Owners are called members (not partners or shareholders). Numbers of members are unlimited and may be individuals, corporations or other LLC. LLC can select varying forms of distribution of profits (unlike partnerships where split is 50-50). All business losses, profits and expenses flow through the company to the individual members (no double taxation as corporate and individual). (Zahorsky)
line organization	Oldest and simplest method of administrative organization. The authority or line of command flows from top to bottom in a concern, without any gaps in communication and co-ordination taking place. Specialized and supportive services do not take place in these organizations. Unified control by the line officers can be maintained since they can independently take decisions in their areas and spheres. This kind of organization always helps in bringing

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	efficiency in communication and bringing stability to a concern. (WebCraft Inc., 2008)
livability	The environmental and social quality of an area as perceived by residents, employees, customers and visitors. This includes safety and health (traffic safety, personal security, and public health), local environmental conditions (cleanliness, noise, dust, air quality, and water quality), the quality of social interactions (neighborliness, fairness, respect, community identity and pride), opportunities for recreation and entertainment, aesthetics, and existence of unique cultural and environmental resources (e.g., historic structures, mature trees, traditional architectural styles). (Victoria Transport Policy Institute, 2010)
matrix organization	Multifunctional team structure that facilitates horizontal flow of authority, in addition to its normal (vertical) flow, by abandoning 'one person, one boss' rule of conventional organizations. Used mainly in management of large projects or product development processes, it draws employees from different functional disciplines (accounting, engineering, marketing, etc.) for assignment to a team without removing them from their respective positions. These employees report on day-to-day performance to the project or product manager whose authority flows sideways (horizontally) across departmental boundaries. And they continue to report on their overall performance to the head of their department whose authority flows downwards (vertically) within his or her department. In addition to a multiple command and control structure, a matrix organization necessitates new support mechanisms, organizational culture, and behavior patterns. Developed at the US National Aeronautics & Space Administration (NASA) in association with its suppliers, this structure gets its name from its resemblance to a table (matrix) where every element is included in a row as well as a column. (WebFinance, Inc.)
MBA	SJMA Metropolitan Bus Authority
Mechanized trips	Trips or trip segments made by any transportation mechanical device such as auto, bike, train, boat, etc. It excludes walking.
Monocratic	An individual person is in charge of carrying out tasks, taking the necessary decisions and therefore assuming full responsibility for the effects. This includes the right to give directions to junior members of staff. (Stadt Wien, 2010)
Non-motorized trips	Trips or trip segments made by non-motorized means such as walking or cycling.
Organization	Institution's instruments used to execute management.
Organization Internal Environment	Internal factors that influence the direction of the organization and the energy displayed in its activities (Horton et. al., 2003).
Organizational capacity	Ability of an organization to implement a chosen policy (M. Ting, 2004). Organization's potential to perform, or its ability to successfully apply its skills and resources to accomplish its goals and satisfy its stakeholders' expectations (Horton et. al., 2003).
Organizational performance	The ability of an organization to meet its goals and achieve its overall mission. (Horton et. al., 2003)
Paradigm	Philosophical and theoretical framework of a scientific school or discipline within which theories, laws, and generalizations and the experiments performed in support of them are formulated. (Merriam-Webster Dictionary)
parliamentary government	A system of government having the real executive power vested in a cabinet composed of members of the legislature who are individually and collectively responsible to the legislature. (Merriam-Webster, Incorporated)
Performance	Describes the extent on how goals, objectives or standards are being met.
province	An administrative district or division of a country. (Merriam-Webster, Incorporated)

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PT	Public Transit
Relevance	The degree to which the organization's objectives and activities reflect the necessities and priorities of key stakeholders. (Horton et. al., 2003)
representative democracy	Type of democracy in which the citizens delegate authority to elected representatives. (Dictionary.com, LLC.)
republic	A state in which the supreme power rests in the body of citizens entitled to vote and is exercised by representatives chosen directly or indirectly by them. (Dictionary.com, LLC.)
republican	A commonwealth; that form of government in which the administration of affairs is open to all the citizens. In another sense, it signifies the state, independently of its form of government. (The 'Lectric Law Library®)
ROW	Right Of Way
Rules of Procedure	Decreed by the Mayor with the consent of the City Council; they lay down the administrative procedures for the City Administration and contain both structural and procedural elements. (Stadt Wien, 2010)
safety audit	Safety auditing includes the implementation of all official tasks pertaining to the safety and wellbeing of human life, as well as the assessment of sufficient, appropriate and properly installed safety measures for institutions and installations managed by the municipality. (Stadt Wien, 2010)
SJMA	San Juan Metropolitan Area
Statutory Board	A statutory board is one of the three forms of public enterprise in Singapore. It is an autonomous government agency set up by special legislation to perform specific functions. (Quah, 2010) Statutory bodies are established by special Acts of Parliament. The Acts specify the functions, duties and powers of the bodies so established, and their relationship to the responsible ministers. Such special Acts also set out provisions relating to the appointment of staff, financial provisions and audit control. Government-owned companies are incorporated under the Companies Act. Each statutory board is managed by a Board of Directors appointed by the responsible Minister. The Board is headed by a chairman and consists of representatives from related ministries, professional bodies and interest groups from the private sector. Below Board level, the organization structure is similar to that of a private-sector company with a chief executive officer and a team of supporting operating staff. The chief executive officer is responsible to the Board for the day-to-day running of the organization. Statutory boards are empowered to recruit, promote and remove their own staff. Rates of staff remuneration broadly follow the rates applying to civil servants. (Asian Organisation of Supreme Audit Institutions, April, 1989)
stock	An instrument (document containing some legal right or obligation) that signifies an ownership position or equity in a corporation and represents a claim on its proportional share in the corporation's assets and profits. (WebFinance, Inc.)
stock corporation	For profit corporation which has shareholders (stockholders), each of whom receives a portion of the ownership of the corporation through shares of stock. Shares may receive a return on their investment in the form of dividends. Shares are used for voting on matters of corporate policy or to elect directors, at the corporation's annual meetings and at other meetings of the corporation. (Murray J.)
subsidiary	Corporation or company in which another, generally larger, corporation, known as the parent corporation, owns all or at least a majority of the shares. As the owner of the subsidiary, the parent corporation may control the activities of the subsidiary. (Farlex, Inc.)
TCRP	Transportation Cooperative Research Program

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Transit	Mass Transportation
Transportation	Movement of people and goods.
Transportation System T	Composed of physical elements and organizational policies. These physical elements, represented by $Tf(t)$ is the transportation component at instant or state t , includes: Technologies, networks, ways, vehicles, operation policies; Organizations that manage these elements; Organization of public and private organisms; Procedures used to plan, design, build, operate and maintain physical elements. The organizational policies, represented by $To(t)$ are the organization component at instant or state t (S. González). The organization component includes: management, organizational and institutional decisions such as number of institutions, types of institutions, functions, domains of responsibility, communication channels, coordination and control. (M. Manheim, 1979)
TU	Urban Train system at SJMA
UITP	International Organization of Public Transportation
Westminster Model	Democratic system of government modeled after that of the United Kingdom system of government and used in Westminster, the seat of government, hence its name. It is a series of procedures for operating a legislature. Although Westminster systems are parliamentary systems, there are parliamentary governments, such as Germany and Italy, whose legislative procedures differ considerably from the Westminster system. Aspects of the Westminster system include: an executive branch made up of members of the legislature; the presence of opposition parties; a bicameral or unicameral legislature, where each house usually is elected on a different basis and/or for different terms, or where the members of the upper house somehow appointed; the upper house usually has less power than the lower house, which is usually popularly elected; a ceremonial head of state who is different from the head of government, and who may possess reserve powers, which are not normally exercised. (WordIQ.com TM)

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Appendix A: Survey Approval by the Committee for the Protection of Humans in Research

UNIVERSIDAD DE PUERTO RICO EN MAYAGÜEZ
DECANATO DE ASUNTOS ACADÉMICOS
COMITÉ PARA LA PROTECCIÓN DE LOS SERES HUMANOS EN LA
INVESTIGACIÓN
(CPSHI/IRB- 0002053)

11-10-ZR-01

19 de octubre de 2010

Zaida Rico Rolón
Estudiante Graduada
Colegio de Ingeniería
UPRM

Estimada estudiante:

El comité revisó su proyecto: "*Organizational Factors in Transit Services*" y luego de evaluar la documentación sometida, aprueba de forma expedita su investigación al examinar que no existen riesgos significativos para los participantes.

La aprobación de su propuesta de investigación se extiende desde el 19 de octubre de 2010 hasta el 19 de octubre de 2011. Le recuerdo que cualquier modificación de su proyecto necesitaría pasar por una nueva revisión por parte de este Comité.

Le deseo mucho éxito en su trabajo de investigación y quedo a sus órdenes para cualquier pregunta o clarificación ulterior que estimase necesaria.

Cordialmente,

Dr. Brian Muñoz
Presidente CPSHI
UPRM

Appendix B Electronic Mail Invitation to Survey (English Version)

To:	Recipient Placeholder
From:	Zaida Rico [zaida.rico@upr.edu]
Reply-To:	zaida.rico@upr.edu
Subject:	Transportation Organization Survey/University of Puerto Rico-Mayagüez
Message:	
<p>Dear Representative of a Transportation Institution:</p> <p>You have been invited to participate in this survey, which is part of a research in the Transportation Program of the Civil Engineering Department of the University of Puerto Rico at Mayagüez. The objective of this survey is to obtain information to find out if there are common organizational characteristics among transportation related institutions at different normalized transit ridership and/or modal split levels.</p> <p>Your feedback is important. Please click the link below for more information and to answer the survey. The survey would take around 40 minutes to answer if information asked is on hand. You will also receive a Spanish version of this Survey; you could choose to respond to either of them. <i>(También recibirá una versión en español de esta Encuesta; puede elegir responder cualquiera de las versiones.)</i></p> <p>Thank you,</p> <p>Zaida E. Rico, P.E., M.S.C.E., Ph.D. Candidate Advisor: Prof. Didier Valdés, Ph.D. [didier.valdes@upr.edu]</p>	
<p>Survey Link Placeholder</p>	
<p>OPT OUT Learn More</p>	
<p>If you do not wish to receive further surveys from this sender, click the link below Zoomerang will permanently remove you from this sender's mailing list.</p> <p><u>I do not want to receive any more surveys and emails from this sender.</u></p>	

Appendix C Survey (Text - English Version)

Transportation Organization Survey
Encuesta sobre Organizaciones de Transportación
English Version

You are currently previewing this survey. No responses will be recorded.

Transportation Organization Survey
Encuesta sobre Organizaciones de Transportación
English Version

University of Puerto Rico - Mayagüez Campus
College of Engineering - Department of Civil Engineering and Land Surveying

Transportation Organization Survey
Encuesta sobre Organizaciones de Transportación
Informed Consent Statement
English Version

Thank you for your interest in participating on this study. Please read carefully this statement before the completion of the online survey.

Acknowledgement

By answering to the survey, you are acknowledging that you read, understood and accepted the statements included in this document.

Objective

The objective of this survey is to obtain information in order to find out if there are common organizational characteristics among transportation related institutions at different normalized transit ridership and/or modal split levels. This exercise is part of a doctoral dissertation in the Transportation Program of the Civil Engineering and Land Surveying Department.

Voluntary Participation

Please be advised that your participation is voluntary. You may or may not participate in this study, although your participation is greatly appreciated. If you participate, you will not receive any kind of remuneration. However, if you participate, you will have the benefit of receiving an advanced copy of the results of this survey.

Anonymity and Confidentiality

Please be advised that your participation is anonymous. The name of the person answering and the name of the institution represented will remain confidential. Your name and/or the name of the institution may be mentioned on the Acknowledgement section of the final document to express our gratitude for your participation.

Your authorization for this acknowledgement will be asked in the last question of this survey.

IMPACT OF TRANSIT ORGANIZATION IN RIDERSHIP

Instructions

1. Please mark the response that best describes the answer for each question or item.
2. Please feel free to use the space provided for the description of the selection "Other" to add comments considered appropriate. Also, you can include comments at a question included at the end of the survey for that purpose.
3. For your convenience, you will be able to read and/or print the first page of the questionnaire before answering it. The second page only asks for comments regarding the questionnaire and for contact information. Do not press the "submit" button until you are sure you included all your answers, as you won't be able to go back after that.
4. Although you will be able to leave answers non-responded, we greatly appreciate your completion of each item.
5. The survey has 31 questions. It should take you close to 20 minutes to answer the survey, if you have the information on hand.
6. Please complete the survey by 11:59 PM Atlantic Standard Time, Monday, January 31, 2011

Questions and Contact Information

If you have any question or comment, please feel free to contact the researcher, Zaida Rico, through the following e-mail:
zaida.rico@upr.edu.

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

1 Please indicate the mode and or modes that your institution/company covers within the service area you work for. Please indicate all that apply.

- metro heavy rail
- light rail
- commuter rail
- regular bus service
- paratransit
- express bus service
- bus rapid transit
- trolley bus
- electric trolley / streetcar
- monorail
- funicular
- people mover
- bike trails
- pedestrian corridors
- highways (roads, express ways, toll lanes)
- Other, please specify

2 Please indicate the option/s that best describe the relation between your institution/company and the transit system. Please indicate all that apply.

- Owner of a system / mode / line (possesses all or most stock and establishes policy)
- Operator (operates one or more systems / modes / lines, following established policies)
- Contractor (performs works for a transit system, contracted by an owner/operator/administrator)
- Administrator (manages one or more systems / components and/or their integration)
- Monitor (in charge of oversight/monitor that the system / mode / line operates as per goals / standards and policies established)
- Other, please specify

3 What is the extent of your service area?

- Local (smaller than a town or city)
- Municipal (single town or city)
- Regional (more than one town or city)
- State (whole state or province)
- Interstate (more than one state or province)
- Federal (entire country)
- International (more than one country)
- Other, please specify

IMPACT OF TRANSIT ORGANIZATION IN RIDERSHIP

4 Please indicate the most recent year you have ridership (unlinked passenger trips) information of your transit system (sum of all the modes in your system). The ridership will be asked in the following question.

2004 or previous

2005

2006

2007

2008

2009

2010

System under development, a projection for first service year will be provided (indicate year):

5 Please indicate your total ridership (sum of unlinked passenger trips on all modes you cover) for the most recent year you have data available (same year you indicated on previous question). Example: for 20 million unlinked passenger trips, please write 20000000.

6 Please indicate the average trips per person per day (in all modes, including private auto) at your service area, for the same year of the information asked at previous question. If you only have this information for a different year, please provide it and indicate the year.

7 Please indicate your service area in square kilometers.

8 Please indicate the population of your service area. Example: for 3 million, write 300000.

9 For your service area, please indicate the percentage of trips made by private auto. Please indicate only the number, for example: for 15%, write 15.

10 Please indicate the percentage of trips made in transit in your service area. Please write just the number, for example: for 15%, write 15.

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

11 Who is the owner of your institution/company (set policies and/or owns stock)?

- Private Single Owner
- Private Multiple Owners
- Private and Public (Government) with most of the share being Private
- Public (Government) and Private with most of the share being Public
- Public and Private, equal share
- Local Government Body (smaller than a town or city)
- Municipal Government (town or city)
- Regional Government (more than one town or city)
- State Government (state or province)
- Interstate Government (more than one state or province)
- Federal Government (entire country)
- International Government (more than one country)
- Other (please describe in next field)

12 What is the institution/company/corporate type?

- Government Office (not legal identity by its own)
- Government Agency (has legal identity, depends solely on assigned budget)
- Government Public Corporation (has legal identity, can collect funds from revenue, taxes, bonds, etc.)
- Non Profit Corporation
- Private Corporation
- Limited Liability Company
- Proprietary Limited Company
- Other, please specify

13 Are you a Parent or Subsidiary company?

- Not Applicable
- Parent, I provide transportation services
- Parent, only subsidiaries provide transportation services
- Parent, I and subsidiaries provide transportation services
- Subsidiary, only one providing transportation services
- Subsidiary, I and other subsidiaries provide transportation services
- Subsidiary, my parent company also provides transportation services
- Other (please describe in next field)

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

14 Does your company subcontract services? Please indicate all that apply.

- No
- Yes, including transportation services
- Yes, including major maintenance services (service vehicles, tracks, etc.)
- Yes, only supporting services (security, cleaning, etc.)
- Yes, other (please explain in next field)

15 What portion of your business services, within your service area, are subcontracted?

- No subcontracts (0%)
- Less or Equal to 25%
- More than 25% but less or equal to 50%
- More than 50% but less or equal to 75%
- More than 75% but less than 100%
- 100%

16 Indicate the amount (can be approximate) of employees that your company has.

17 Indicate the approximate amount of your annual budget.

18 Do you have integration among transportation services?

- No
- Yes, among the services I operate/administer
- Yes, also with services operated/administered by other companies within my service area
- Yes, also with services outside my service area

19 What kind of integration you have? Please indicate all that apply.

- None
- Route
- Schedule
- Fare Type
- Fare Collection System
- Marketing Identity
- Incident Management
- Operations and Control Center
- Transfer Terminal
- Park-And-Ride
- Budget
- System Planning
- Other, please specify

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

20 Please indicate the leadership style that best describes your company's top level administration (level where main medium to long term decision making is performed). You can select more than one option if applicable.

Authoritarian (The leader is responsible for and dictates policies and procedures, decides what goals are to be achieved, and directs and controls all activities without meaningful participation by the subordinates on those tasks.)

Dominant (There is a clear line of authority that gives the leader the power of delegation, and the power to control the subordinates' level of participation in decision making process.)

Transformational (The leader identifies the needed change, creates a vision to guide the change through inspiration, and executes the change with the commitment of the members of the group.)

Achievement oriented (Management which sets challenging goals, assists in training, emphasizes improvement, and expects the highest levels of performance.)

Participative (The leader involves subordinates in goal setting, problem solving, team building etc., but retains the final decision making authority.)

Collegiate (Decisions are taken by consensus and responsibility is shared by the group.)

Delegative (The leader transfers decision making power to one or more employees, but remains responsible for their decisions.)

Bureaucratic (Emphasizes procedures and historical methods. Problem solving is made mainly through addition of layers of control, exercised mainly to the flow of information.)

Laissez-faire ([French for "allow to pass" or "let go"]
Non-authoritarian leadership style where leaders try to give least possible guidance to subordinates, and try to achieve control through not-so obvious means, believing that people excel when they are left alone to respond to their responsibilities and obligations in their own ways.)

Other, please specify

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

21 Please indicate the leadership style that best describes your company's mid level management (level where most day-to-day decision making is performed). You can select more than one option if applicable.

Authoritarian (The leader is responsible for and dictates policies and procedures, decides what goals are to be achieved, and directs and controls all activities without meaningful participation by the subordinates on those tasks.)

Dominant (There is a clear line of authority that gives the leader the power of delegation, and the power to control the subordinates' level of participation in decision making process.)

Transformational (The leader identifies the needed change, creates a vision to guide the change through inspiration, and executes the change with the commitment of the members of the group.)

Achievement oriented (Management which sets challenging goals, assists in training, emphasizes improvement, and expects the highest levels of performance.)

Participative (The leader involves subordinates in goal setting, problem solving, team building etc., but retains the final decision making authority.)

Collegiate (Decisions are taken by consensus and responsibility is shared by the group.)

Delegative (The leader transfers decision making power to one or more employees, but remains responsible for their decisions.)

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Laissez-faire ([French for "allow to pass" or "let go"]
Non-authoritarian leadership style where leaders try to give least possible guidance to subordinates, and try to achieve control through not-so obvious means, believing that people excel when they are left alone to respond to their responsibilities and obligations in their own ways.)

Other, please specify

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

22 Please select the option that best matches each statement.

- Strongly Agree
- Agree
- Partially Agree
- Disagree
- Strongly Disagree

Employees of my company have a strong sense of belonging to it.

Employees of my company have a strong sense of pride over their job.

My company has and promotes clearly a vision, mission and/or objectives among all employees.

Changes in the people at the top management level generally does not imply significant changes on the vision, mission and/or objectives of the company.

Changes in the leading political party at the government section in charge of transportation policy generally does not imply significant changes on the vision, mission and/or objectives of the company.

23 With what frequency does the mission, vision or objectives typically change?

- Less or equal to two years
- More than two years but less or equal to five
- More than five years but less or equal to ten
- More than ten years

24 In my company, recruiting and promotion is mostly based on:
(Please read all alternatives before answering. You are able to mark more than one option if is applicable. You can see the Others space to include comments.)

- Specific policy and procedures
- Merit (experience, academic achievements, examination)
- Through apprenticeship or mentorship programs
- Sympathy with the policies established by the administration and/or political ideals
- Trust / Friendship
- Other, please specify

IMPACT OF TRANSIT ORGANIZATION IN RIDERSIP

25 Please select the option that best matches with each statement.

- Strongly Agree
- Agree
- Partially Agree
- Disagree
- Strongly Disagree

My company has a clear and specific policy for recruiting and promoting employees.

My company puts effort on advertise itself as an employer.

My company has an employee retention policy and/or program.

My company has promotions opportunities for employees.

My company provides for employees to participate on decision making process.

My company promotes that employees provide ideas and take them into consideration.

My company provides side benefits such as insurance, vacation and/or other.

My company provides employment stability.

26 My company provides the following benefits to deserving employees as mean for retention: (please select all that apply)

- Not applicable
- Bonuses and monetary incentives
- Promotion opportunities
- Preferred office space
- Preferred parking
- Transit pass
- Other, please specify

27 What is the typical time a particular administration lasts?
(Administration meaning either of the board / party / executive management / president / CEO / Secretary or similar.)

- Less or equal to two years
- More than two years but less or equal to five
- More than five years but less or equal to ten
- More than ten years

28 Use this area to for Comments regarding any of the questions of the Survey.

IMPACT OF TRANSIT ORGANIZATION IN RIDERSHIP

29 Please indicate the employment status that best describes your position.

- Top Management (President/CEO/General Manager/ or similar)
- Mid-level Management (Area/Department/Section Director/ or similar)
- Professional (Engineer/Planner/Architect/ or similar)
- Administration (Administrative Assistant/ or similar)
- Skilled (Mechanic/Operator/Electrician/ or similar)
- Unskilled (other field employees not required to have a particular license/permit to perform their job)
- Other, please specify

30 Please provide your contact information.

- Name
- Company
- Address 1
- Address 2
- City/Town
- State/Province
- Zip/Postal Code
- Country
- Email Address

31 * Can your name or the name of your institution be included in the Acknowledgement section of the final dissertation document?

- No
- Yes, both my institution's and my name
- Yes, my institution's name only
- Yes, my name only

Questions marked with an asterisk (*) are mandatory.

THANK YOU FOR ANSWERING OUR SURVEY!

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