GT-Panama Thesis Series

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GEORGIA INSTITUTE OF TECHNOLOGY

GEORGIA TECH INNOVATION AND RESEARCH CENTER IN PANAMA

DUAL MASTER OF SCIENCE IN SUPPLY CHAIN ENGINEERING

CAPSTONE PROJECT

URBAN FREIGHT LOGISTICS IN PANAMA CITY

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CONTENT

I. EXECUTIVE SUMMARY

Urban freight is the study of the flow of all goods within a specific urban area destined to satisfy its demands. This field is important because it contributes to the economic growth and development of a region. Because, an efficient urban freight system, contributes to the economic delivery of goods and improves business services.

Over the last ten years, private and government institutions have performed studies to address road congestion for urban passenger transport in Panama City. However, freight transportation has not been considered within these projects and has played the role of an observer that should adapt to the existing infrastructure. This project considers "Panama City" as the region formed by the districts of Panama and San Miguelito.

The general objective of this research is to estimate urban freight behavior in Panama City, in order to provide the first comprehensive study on urban freight logistics and identify the trend of freight vehicle growth for future research on infrastructure needs.

This project is divided in two main deliverables: the Descriptive Assessment and the Urban Freight Network. The descriptive assessment evaluates urban freight characteristics by using four aspects: commodities, infrastructure, transport and traffic services.

Commodities describe the type of freight moving in and out of the city. In order, to analyze their movement, this will be divided in: sources, sinks and paths. Sources are points of entry or exit of freight in Panama City (these are bridges, industrial parks, airports and ports). In 2010, Cristobal Port had the largest volume of truck trips for imported freight, while the Tocumen International Airport had the largest volume for exported freight. Sinks are freight consumption points; these represent the counties within the districts of Panama and San Miguelito. In 2008, the largest expenditure of the population in Panama City was food and beverages. Paths are the types of freight that move in the commodity network. Freight was divided in: national produce, imports and exports.

Panama City road infrastructure is composed of three roadways: longitudinal roads, transverse streets and corridors (tolled highways). These infrastructures are the main traffic paths and connect the suburbs (San Miguelito) with the commercial areas in the district of Panama. Given that this road infrastructure is limited, this network is the primary means of transport for private, public and commercial vehicles.

Panama City has 77% of the country's total vehicle count; this vehicle proportion is related to the high concentration of population and businesses in this area. The 19% of the total country's vehicle count is represented by urban freight vehicle population (fleet size). In 2010, trucks and delivery vans were the preferred urban freight vehicles in Panama City.

At present there are no established regulations for the control of urban movements in the city or the country. Currently, urban movements are delimited by the combination of three main regulations: freight vehicle permitted tonnage and dimensions, general transit regulations for all types of vehicles that include cargo handling measures, and security procedures at weight control stations.

The deliverable Urban Freight Network is composed of the fleet size forecast model, and the Tactical and Strategic Analysis. The tactical and strategic analyses are based on a network representation of Panama City's road infrastructure. Nodes represent main intersections, and paths are the distances between one intersection and the other.

The fleet size forecast model consists of evaluating economic variables that affect fleet size. For fleet size, is understood as total number of freight vehicles registered in Panama City by the Vehicle Registration Office (which belongs to the Ground Transit and Traffic Authority). The model was defined with the equation generated by the regression analysis between population and fleet size. Other variables were also evaluated, but it was found that they hardly had any effect on freight vehicle population. The forecast estimations served as input for the tactical analysis.

The tactical analysis used the Shortest Path Problem (SPP) approach to establish the most frequently visited nodes for a freight vehicle moving from a distributor to a supermarket. A node is visited if a vehicle passes through that node along its path from origin to destination. Nodes with the largest number of visits concentrated in the center of the City.

The strategic analysis is based on the forecast model results. The fleet size per county was estimated an assigned to each node. In this analysis, fleet size is been used as a proxy for the number of trips moving in or near the area where the node is, but it does not infer on the number of truck trips (the number of times each truck moves through the node). It is assumed that a node with a large volume of fleet size has a large volume of truck moving near that zone. A Pareto analysis allowed identifying the nodes with the largest fleet size. These nodes were plotted in a map to show where most of them were concentrated.

The comparison shows that urban freight vehicles movements are going from the center to the outsides of the city, following the same pattern of growth as the population, but not responding at the same pace. This analysis will allow the government to identify areas with potential freight flows and use this trend as input for urban planning decisions.

II. INTRODUCTION

The study of urban freight is of great importance because it contributes to the economic growth and development of a region. An efficient urban freight analysis promotes a timely delivery of goods, improves business services and reduces their transportation costs and lead times[1].

At present there have been several theses, projects and research held by private and government institutions to address road congestion for urban passenger transport in Panama City. Nevertheless, freight transportation has not been considered within these analyses and has played the role of an observer that should adapt to the existing infrastructure.

The general objective of this research is to estimate urban freight behavior in Panama City, in order to provide the first official study on urban freight logistics and identify the trend of freight vehicle growth for future research on infrastructure needs.

This project also will provide characteristics of freight movements in Panama City; identify main sources and destinations (consumption points), and recommend a method for analyzing urban freight movements for long term government decisions.

This paper will begin with the presentation of the methodology on how data was collected. It will also present the assumptions considered for each of the deliverables in the project and their limitations. This project is divided in two main deliverables: the Descriptive Assessment and the Urban Freight Network.

The Descriptive Assessment will provide information on urban freight characteristics in Panama City by evaluating four aspects: commodities, infrastructure, transport and traffic services. This descriptive assessment will also consist of an urban freight survey methodology for comparing freight characteristics between different urban areas or industries, at a national or local level.

The Urban Freight Network will be composed by the fleet size forecast model for Panama City and the Tactical & Strategic Analysis. The forecast model will present the fleet size estimations and analyze its trend of growth. The tactical and strategic analysis will provide insights on what areas have the largest movement of freight vehicles and how it will behave in the future.

Finally, the Conclusions and Recommendations section will be presented, followed by the References considered for this research.

[1] Pendyala, Ram M. (2002). "Final Report: Urban Highway Freight Modeling Including Intermodal Connectors for Florida".

III. PROJECT METHODOLOGY

The study was divided in two main sections: the descriptive assessment and urban freight network both have the purpose of analyzing urban freight logistics in Panama City. For this project, Panama City is considered to be formed by the districts of Panama and San Miguelito, which are the two most populated districts in the entire country. The district of Panama is the main economic zone in the republic, while San Miguelito functions as a dormitory city for all its residents that work in the district of Panama.

The descriptive assessment was divided in two parts: The data review on urban freight, and the urban freight survey. The urban freight network is also divided in two sections: the fleet size forecast model and strategic & tactical analysis on urban freight.

This methodology shows how both deliverables were developed, the process of collecting data, the general analysis and most importantly the limitations presented during the development of each phase.

The project had a timeline of 2 months and approximately 15 days, officially it begun on May 15, 2011 and finished on August 3, 2011. The project was divided in two sections: the Proposal phase which ended at June 17, and the Final Project which ended on July 30.

The Proposal phase consisted on meeting with contacts and do research in order to define the problem and provide the objective of the final project. The final project consisted on research towards the completion of the two main deliverables: the Descriptive Assessment and the Urban Freight Network. Each deliverable was reduced into tasks to be completed weekly or bi-weekly depending on the length of research and work required for each (Figure 1).

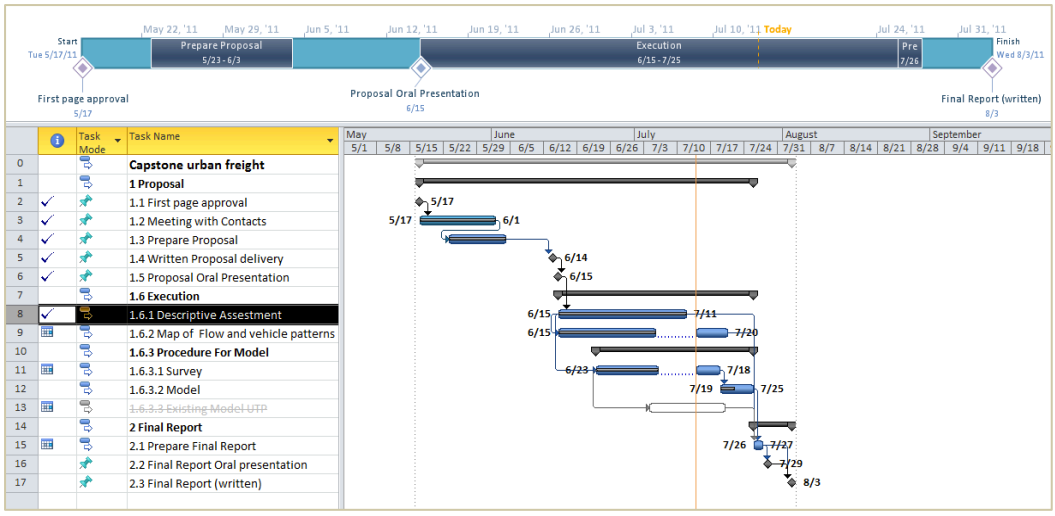

Figure 1 - Capstone Project Timeline

Descriptive Assessment

The descriptive assessment presents a literature review on data available related to urban freight and an urban freight survey. Both deliverables had the objective to infer on urban freight characteristics in Panama City.

Urban Freight Data Review

The data review on urban freight was divided into four sections: commodities, infrastructure, transport services and traffic services. This allowed exploring each of the aspects and providing insights on freight movements by showing how each aspect interacts with each other. The four aspects were inspired by the Good Trip Model, which is a quantitative urban freight model that considers these aspects as variables.

The type of information collected depended on the aspect being researched. For example: if the aspect was Commodities, imports and exports data was requested to Customs. The information for the data review was collected primarily by data requests and interviews to government institutions. All other information not collected by any of these methods was collected online at the government data bases and reports, and by complementing with newspaper articles (See Table 1).

Table 1: Data sources for urban freight data review

Section	Data Source
Commodities	Accountability Office Ministry of Commerce and Industry Georgia Tech Logistics Center Newspaper Articles
Infrastructure	World Bank Interview: Angelino Harris (Former Ground Transit and Traffic Chief) Interview: Ricardo Chavez (Truckers Association in Panama) Newspaper Articles Online Governments
Transport Services	Accountability Office Chorrera Weight Control Station (Ground Transit and Transportation Authority) Newspaper articles Online government reports
Traffic Services	Ground Transit and Transportation Service Website Official Gazzete online database National Assembly online database Interview: Arturo Gonzalez (Former Ministry of Public Works analyst)

The limitations of the data review was the data collection process, though there were institutions willing to provide reports on several types of information such as the Accountability Office and the Ministry of Commerce and Finance. There were institutions that contact was not possible, even with the intervention of the Center, such as the Ground Transit and Transport Authority, which was one of the primary sources for information to obtain more detail on vehicle counts, fleet size information, regulations, etc. Also, another limitation was the extensive process of requesting reports from other government institutions, it was necessary to submit a petition letter which ultimately resulted in postponement or lack of response

After collecting the data, several assumptions were necessary so as to provide insights on how the information was related to urban freight logistics in Panama City (See Table 2). These assumptions establish the connections between sections and determine the initial steps for the forecast model.

Table 2: Assumptions for the urban freight data review

Section	*Assumptions*
Commodities	1. Panama City is formed by the Districts of Panama and San Miguelito.
	2. Sources are ports, industrial parks or airports were freight is generated.
	3. Sinks are population zones were goods are consumed.
	4. The study only considers sources surrounding the districts of Panama and San Miguelito.
	5. Freight is divided in: imports, exports and national produce.
	6. Imports, exports and national produce move through the city.
	7. Trips per year for imports and exports can only be quantified for sources that are registered as entry/exit points of the country by Customs Authority
	8. Trips per year per source are the import or export tonnage of each source (registered by Customs) divided by the average weight capacity of an average freight vehicle.
	9. Fleet size of the districts or an area is all freight vehicles registered in the Municipality of the district of Panama and San Miguelito.
	10. The average haul capacity of a freight vehicle is equal to fleet size the districts of Panama and San Miguelito divided by their total haul capacity (registered by Accountability Office)
	11. The provincial GDP provides data on national produce. Estimations on value ($) or weight of goods generated within the City will not be provided due to limited data.
	12. The total expenditure of the population is equal to the amount consumed in imports and national produce.
Infrastructure	12. Urban freight uses the same road network as passenger transport.
	13. Sources enter the city through Panama City main roads.
Transport Services	14. Urban freight vehicle fleet size is equal to the total number of freight vehicles registered in the Municipality of Panama and San Miguelito

Traffic Services	15. Regulations that apply to hauling cargo are considered as regulations for urban freight vehicles.

Urban Freight Survey

The urban freight survey was generated to propose a methodology for modeling truck trips for industries. Due to time limitations, the study would consider a very small sample and use the results to generate a truck trip generation model through TSP heuristics. The deliverable would consist of a methodology for applying the survey and generating a model.

The survey was formulated and was applied to a small non-probabilistic sample size of companies. The selected sample size was 4 companies belonging to the food and beverages industry, which is the largest expenditure incurred by the total population in Panama City. These companies were among the largest supermarkets and distributors located in Panama City.

The small sample size was selected to present an idea on how apply the survey and model to the collected data. The survey process consisted on contacting the companies, sending the survey by e-mail, follow up survey by phone and then, visit the company to clarify any questions.

Nevertheless, after initiating the survey process, two out of four companies completed the survey and only one provided valid results. Though the second company responded the survey, it did not provide information on their deliveries due to confidentiality issues. The data collected from the only completed survey will not be presented because it cannot be aggregated.

Surveyed distributors mentioned that the greatest amount of freight was managed through full truck loads; therefore a TSP model would no longer be applicable for the survey.

It was then decided that the survey would be a database for urban freight characteristics as European countries use. The survey could be used as tool for estimating freight transport indicators and comparing industries or urban areas.

The urban freight survey was limited due to the difficulty in contacting and collecting available data from private companies.

Urban Freight Network

As mentioned previously, the urban freight network consists of two sections: Fleet size Forecast Model and Tactical & Strategic Analysis. The objective of this section is to provide an analysis on the flow of vehicles within city, that the descriptive assessment due to the unavailability of data could not.

Fleet Size Forecast Model

This model was developed in order to provide a formal view on what it presented in the data review. This model was formulated by using the concept of the Truck Trips of Goods (TTG). This model is based on the idea that truck trips are strongly related to business or economic activities[2]. Due to data unavailability this model was based on fleet size, rather than truck trips.

Considering the limitations on time, it was decided to approach the concept by a statistical tool, Pearson's Correlation Coefficient Analysis. The dependent variable was fleet size and the independent variables were the economic activities. All variables were based on Panama City data.

The economic variables were: the consumer price index (CPI), the Gross Domestic Product (GDP), population and square meters built. The purpose of the correlation analysis was to determine if any of the economic variables had a significant effect on fleet size. Table 3 presents the assumptions considered for each of the relationships.

Table 3: Assumption for Fleet size forecast model

Dependent Variable	Economic Variable	Assumption
Freight Vehicles	*Population*	As population grows, the consumption of goods will also increase, and then a higher volume of freight vehicles will be needed to supply the demand.
	GDP	As industries produce a greater volume of goods, it will be necessary a larger number of vehicles to transport the products to their final destinations.
	Consumer price index	As the value of goods increase, the demand for less expensive products will increase, and businesses will use economies of scale to purchase a higher volume of products in order to lower their prices. This will cause an increase in the number of freight vehicles needed to transport more products to their destinations.
	Meter square built	As the number of buildings grows, the delivery per area will increase and the number of freight vehicles will grow to meet the demand.

[2] Shin, H. et al. (2005). *Background.* Business and Site Specific Trip Generation Model for truck trips. Madison: University of Winsconsin. Retrieved from: http://www.metrans.org/nuf/documents/Shin.pdf

The tool used for the correlation analysis was Excel, and the output was through XY (scatter) plots, which show the equation of the relationship and their Pearson correlation coefficient. In this study, the regression results were analyzed using the following criteria:

- Coefficients greater than 0.90: strong correlation
- Coefficients between 0.89 and 0.75: Modest correlation
- Coefficients lower than 0.75: Weak correlation

The relationships with a strong and modest correlation were considered for a multi-regression analysis. Each variable was evaluated by its statistical parameters to determine the significance of the entire multi-regression equation.

Both methods were evaluated, the Regression and Multi-Regression, and the method with the highest statistical significance was chosen. Then the forecast model was defined, and it was used to estimate fleet size for future years. Fleet size per county was also calculated in order to identify the areas with the largest movement of trucks.

This study assumes that fleet size represents the number of trucks coming in and out of an area, destined to supply the demand of goods.

Tactical and Strategic Analysis

This section was based on a network diagram that represented Panama City Road Network. Nodes were represented by main intersections in the city and paths, where the distances from one intersection to the other.

The tactical analysis used this road network to determine the shortest path between distributors and supermarkets. Then, a Pareto analysis allowed identifying the nodes with the largest amount of visits. A visit is each time a node is included in a shortest path (in another words, a vehicle visits a node, each time it crosses the node to get closer to its destination). These nodes were plotted to observe the areas where most nodes were located.

The strategic analysis is based on the forecast model results. The fleet size per county was estimated an assigned to each node. In this analysis, fleet size is been used as a proxy for the number of trips moving in or near the area where the node is, but it does not infer on the number of truck trips (the number of times each truck moves through the node). It is assumed that a node with a large volume of fleet size has a large volume of truck moving near that zone. A Pareto analysis

allowed identifying the nodes with the largest fleet size. These nodes were plotted in a map to show where most of them were concentrated.

Finally the results of both analysis were compared to show the behavior of the growth trend of fleet size in Panama City.

IV. DESCRIPTIVE ASSESMENT FOR URBAN FREIGHT IN PANAMA CITY

The purpose of this assessment is to present the characteristics of urban freight movements in Panama City, and evaluate its behavior. This assessment is divided in two sections: an urban freight data review and a statistical model.

The data review describes urban freight in several aspects (such as transportation services, infrastructure, etc.) providing a scenario on freight movements.

The purpose of the survey is to provide a methodology on how to collect urban freight characteristics in Panama City or other urban areas in the country.

A. PANAMA CITY URBAN FREIGHT DATA REVIEW

This review describes urban freight in four sections: commodities, infrastructure, transport services and traffic services.

1. COMMODITY

The commodity section shows the sources, sinks and freight triggered by demand in Panama City. Sources are freight origin points. These will be the entry points of goods to the city (ports, bridges, airports, industrial parks). Sinks (destinations) are considered to be the counties within Panama and San Miguelito, where population is located and products (freight) are consumed.

Sources in Panama City

Sources allow the movement of freight, whether for inner consumption or for export. This study identifies ten sources surrounding Panama City, under the assumption that freight moves into or through the City, in order to arrive to their destination. This study divides freight three types: imports, exports and national produce.

Ports and airports are considered sources for export and import. Bridges enable the entrance of national produce to Panama City. Industrial areas generate goods for import, national consumption or export (See Table 4).

Table 4: Sources surrounding Panama City by Province and Type

Sources	Location	Source Type	Freight Type
Cristobal Port	Connects to the City through Colon highway or Interamerican road	Port	Imports & Exports
Manzanillo International Terminal		Port	Imports & Exports
Colon Container Terminal		Port	Imports & Exports
Balboa Port	Panama	Port	Imports & Exports
Centennial Bridge	Panama	Bridge	National Produce
Bridge of the Americas	Panama	Bridge	National Produce
Tocumen Airport	Panama	Airport	Imports & Exports
Industrial Zones in Panama Areas	Panama	Industrial Areas	National Produce
Colon Free Zone	Colon	Industrial Areas	Imports & Exports
Export Trade Processing Zones	Panama	Industrial Areas	Exports

A brief description of each source is presented below:

a. Cristobal Port

This source is located at the Eastern Atlantic end of the Panama Canal[3]. In 2010, this port had a container movement of 689,058 TEU's (twenty equivalent units)[4].

The port of Cristobal has an area of 1,430 thousand square meters. It has four container berths and seven multi-purpose berths. The combined length of all berths is 3750 meters with alongside depths from 12 to 14 meters.

b. Manzanillo International Terminal (MIT)

This port is located on Manzanillo Bay at the eastern entrance of the Panama Canal adjacent to the Colon Container Terminal in Colon. Last year, this port registered a container movement of 1,599,676 TEU's[2].

Manzanillo International Terminal has an area of 520 thousand square meters. It has a storage capacity for 37 thousand TEU's. This port has 1,240 meters of continuous container berth with an alongside depth of 13 meters, and 400 meters of container berth with 14 meters of alongside depth[5].

c. Colon Container Terminal

This source is located at the Atlantic entrance of the Panama Canal. The total container movement for this port in 2010 was 519,770 TEU's[2]. The Colon Container Terminal has an area of

[3] World Port Source (2011). *Port of Cristobal.* Retrieved from http://www.worldportsource.com/ports/PAN_Port_ of_Cristobal_1603.php
[4] Georgia Tech Panama Logistic Innovation and Research Center (2011). *Container Movements in TEU's for Ports in Panama*. Panama City: Panama Maritime Authority.
[5]World Port Source (2011). *Manzanillo International Terminal*. Retrieved from: http://www.worldportsource.com/ports/PAN_ Manzanillo _International_Terminal_1599.php

740 thousand square meters. It has an access channel with a 600-meter radius turning basin, a draft of 14 meters, and a 200 meter wide breakwater[6].

d. Balboa Port

This port is located at the Pacific end of the Panama Canal. It is is located ten kilometers southwest of Panama City. The container movement for this port in 2010 was 2,758,506 TEU's[2], indicating that Balboa has the highest container movement of all ports here presented.

The Balboa port has an area of 1,820 thousand square meters. It has four container berths and two multi-purpose berths. The berths are over 2.4 thousand meters long with alongside depth of 15 meters. It also has 2.1 thousand square meters available for warehouse space[7].

e. Tocumen International Airport

This airport is located 24 km from Panama City. The airport's operations are focused on passenger transport rather than cargo. Nevertheless, the airport's location is still an important quality for companies in the cargo movement industry. An example is the establishment of DHL's logistic hub in this airport.

In 2010, the Tocumen airport had a total throughput of more than 5 million passengers and approximately 98,000 transactions (entry and exit movements) for cargo and mail[8].

f. Bridge of the Americas

This bridge was built in 1962, and it was the first road connection of Panama City with the rest of the country[9], until the opening of the Centennial Bridge in 2004.

The bridge of the Americas has increased road traffic across the canal. The bridge has a capacity for 30 thousand vehicles per day, with an actual movement of 45 thousand vehicles per day[10].

g. Centennial Bridge

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[6]World Port Source (2011). *Colon Container Terminal*. Retrieved from: http://www.worldportsource.com/ports/PAN_Colon_Container_Terminal_1600.php

[7] World Port Source (2005-2011). *Port of Balboa*. Retrieved from http://www.worldportsource.com/ ports/PAN_Port_of_Balboa_1602.php

[8] Tocumen International Airport (2010). *Movimiento de Operaciones, Pasajeros y Carga: Enero – Diciembre 2010 [Operations, Passengers and Cargo Movements: January – December 2010*]. Retrieved from: http://www.tocumenpanama.aero/upload/files/Estadistica-Formato-Ene-Dic-2010.pdf

[9] Zarate, A. (2003). *El puente de las Américas irradia colores de patria [The Bridge of the Americas lits up with patriot colors]*. La Prensa Newspaper. Retrieved from: http://mensual.prensa.com/mensual/ contenido/2003/11/26/hoy/ciudad.shtml

[10] Castillo & Gonzalez, (2010). *Puente Centenario Subutilizado [Centennial Bridge is underused]*. La Prensa Newspaper. Retrieved from: http://mensual. prensa.com/mensual/Contenido/2010 /11/17/hoy/pdf/Portada.pdf

The Centennial Bridge is located 15 km north of the Bridge of the Americas, and crosses Gaillard Cut near the Pedro Miguel locks. It was built to reduce the large traffic flow on the bridge of the Americas, and it was forecasted to carry approximately 40% of the Americas' vehicle movements.

The bridge has a daily vehicle capacity of 45 thousand, but an actual movement of 15 thousand vehicles per day[11]. It is believed that the preference for the Americas' route over the Centennial is due to distance, 53 versus 61 kilometers respectively.

h. Colon Free Zone

The Colon Free Zone is located a few kilometers from the Panama Canal in the Province of Colon. It is the second largest free zone in the world and the first to be established in the western hemisphere[11].

The Colon Free Zone has an area of 7,000 thousand square meters with approximately 2,500 established companies. It is divided in two commercial areas: galleries and warehouses. Galleries are small or medium size showrooms for product exhibition, while warehouses are larger in size for storing, packaging and shipping goods[12].

i. Export Trade Processing Zones

These zones are defined by law as Duty Free Zones of Free Enterprise. These companies produce good and offer services for exportation.

The law promotes the establishment of processing zones by providing fiscal, labor, as well as migratory incentives. These zones can be established in any region within the republic.

Table 5: Processing Zones located in Panama City[13]

Processing Zone	Location
Panexport / Ojo de Agua	Belisario Porras, San Miguelito
Proexport International Development, Inc	Tocumen, Panama
Proinexport, S.A.	Las Mañanitas, Pedregal
Albrook Processing Export zone. S.A.	Albrook, Ancon
Marpesca Processing Zone, S.A.	Corozal, Ancon
Espanam Iberoamerica, S.A.	Pedro Miguel, Ancon
Rail Road Export Processing Zone	Corozal, Ancon
Chilibre Processing Zone	Chilibre, Panama

[11] Colon Free Zone (2008). *Profiles*. Retrieved from: http://www.zonalibredecolon.com.pa/page/show/colon-free-zon-profiles
[12] Marthe, J. (2010). *Mejorará flujo vehicular a la entrada de la Ciudad de Colón [Traffic flow will improve at the entrance of the City of Colon]*. Retrieved from: http://www.asamblea.gob.pa/main/ComunicacionesyPrensa/tabid/84/articleType/ArticleView/articleId/1010/Mejoraran-flujo-vehicular-a-la-entrada -de-la-ciudad-de-Colon.aspx
[13] Proinvex (2010). *Processing Zones in the Republic of Panama*. Panama City: Ministry of Commerce and Industry

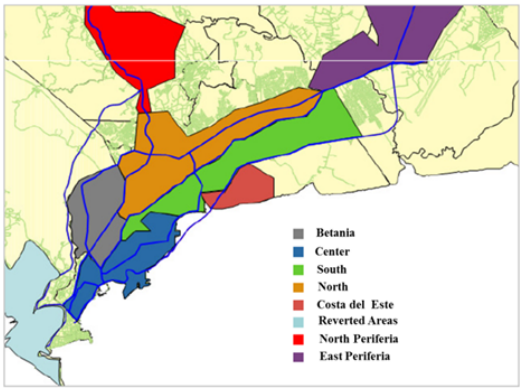


Figure-2: Map of Industrial Areas in Panama City

j. Industrial Zones in Panama City

According to CB-Richard Ellis the industrial zones are divided in seven areas: Betania, South, Center, North, Reverted Areas, North peripheral zone and East peripheral zone (Figure-1).

These zones are composed of two types of projects. Type A refers to industrial parks, and type B to individual warehouses.

Type A buildings are generally 15 thousand square meters or larger. Type B projects are generally "built to suit"; therefore their sizes may vary between 1,800 and 3,200 square feet depending on the client's requirements[14].

Table 6: Industrial Areas in Panama City

Industrial Area	Zones
Betania	Los Angeles, La Locera, El Dorado, Vista Hermosa
South	La Exposición, Bella Vista to Ernesto T. Lefevre Avenue
Center	Parque Lefevre, Juan Diaz, Rio Abajo, Via Jose Agustin Arango
North	North of Via España and Via Jose Agustin Arango, North side of Transistmica, San Miguelito, Ricardo J. Alfaro road and surroundings
Reverted Areas	Albrook, Clayton, Corozal and Howard
North Periferia	Las Cumbres, Milla 8, through Transistmica to the north of the East peripheral zone
East Periferia	Pedregal, Tocumen, through Tocumen and to the east of the road Panamericana

Generation and Consumption of Urban Freight

As it was presented on Table 4 (Sources in Panama City), it is assumed that freight will be generated by: national produce, imports or exports. National produce are all goods produce in the country, imports are goods supplied by other countries for Panama's consumption, and exports are goods destined to supply the demand in other countries.

National Produce

This study considers national produce as all goods produced in the countryside of the Republic. It is assumed that all national produce enters Panama City through the Centennial and the

[14] CB Richard Ellis (2010). *Mercado Industrial en Panamá [Industrial Market in Panama]*. Panama City: Market View. Retrieved from: http://www.cbre.com.pa/bienes-raices-panama/ reportes /panamacity2q10indusE2.pdf

Americas Bridge. These are the only two sources that connect the city with west side of the county (air or water transportation from the countryside to the City will not be considered within this assumption).

The Provincial GDP (Gross Domestic Product) is an estimation generated by the Accountability Office to infer on the value each province contributes to the country's GDP. The estimated GDP generated by province for the year 2004 (which is the most recent estimation) is presented in Table 7.

Table 7: Gross Domestic Product according to consumer price and Province (in millions of dollars)[15]

Province	2004	GDP (%)
Panama	8,786.3	67.1%
Colon	1,916.6	14.6%
Chiriqui	992.7	7.6%
Cocle	355.0	2.7%
Veraguas	341.0	2.6%
Herrera	261.2	2.0%
Los Santos	211.9	1.6%
Bocas del Toro	172.9	1.3%
Darien	66.2	0.5%
Gross Domestic Product based on consumer's price	**$ 13,103.8**	**100%**

As the table shows, the province of Panama has the greatest GDP percentage (67.1%), followed by the province of Colon (14.6%) and by Chiriqui (7.6%). The contribution of the province of Panama to the economic development of the Country is noticeable.

The district of Panama Municipality estimates that 55% of the province of Panama's GDP is generated in the district of Panama[16].Therefore, analyzing GDP by value ($) shows that the province and district of Panama are main contributors to the country's economy. Nevertheless, the GDP should also be evaluated by industry to determine if the contribution per province differs significantly (See Table E).

Table 8 presents the industries not generated in the Province of Panama. These are: the [1] agriculture, livestock and forestry industry produced in Chiriqui, and [2] wholesale and retail

[15] Accountability Office (2006). *Estimación del PIB Provincial según categoría de actividad económica a precios de 1996 [Estimation of the GDP by industry and province according to 1996 prices]*. Retrieved from: http://www.contraloria.gob.pa/dec/Publicaciones/16-14/PIB.pdf

[16] Panama Municipality (2010*). La Ciudad [The City]*. Retrieved from: http://www.municipio.gob.pa/es/laciudad.html

trading industry generated in Colon. Consequently, it can be assumed that freight from these industries will enter the city for local consumption or move through the city for export. All other industries are primarily produced in Panama with a 55% contribution or greater.

Table 8: Percentage composition of the Gross Domestic Product by province and by industry section. At 1996 prices- year 2004

Description	Total	B. del Toro	Cocle	Colon	Chiriqui	Darien	Herrera	Los Santos	Panama	Veraguas
Agriculture, Livestock, Hunting and Forestry	100	10.1	6.1	2.2	30.1	2.6	8.0	12.9	16.9	11.1
Fishing	100	1.0	11.7	1.8	11.2	2.3	9.4	2.4	56.0	4.2
Mine and Quarry Explotation	100	1.2	2.2	4.1	4.7	0.0	1.3	1.0	83.7	1.8
Manufacturing Industries	100	0.8	2.9	2.8	6.4	0.0	1.2	0.2	82.0	3.7
Electricity, Gas and Water Supply	100	0.1	2.1	7.0	31.3	0.2	1.5	0.8	55.3	1.7
Construction	100	1.2	2.1	4.1	4.7	0.0	1.2	0.4	84.5	1.8
Wholesale and Retail Trade; Vehicle reparation; Motorcycles, Personal Effects and Household Equipment	100	0.6	1.8	50.5	5.0	0.0	1.3	0.6	39.0	1.2
Hotels and Restaurants	100	1.4	12.1	6.4	4.4	0.3	1.6	1.0	69.2	3.6
Transporation, Warehousing and Communications	100	0.8	1.5	23.6	4.8	0.0	1.5	1.1	65.1	1.6
Financial Intermediation	100	0.4	1.5	4.9	5.0	0.1	1.5	1.1	83.4	2.1
Real State, Entrepeurnership and Rental Activities	100	0.3	0.2	2.5	3.0	0.0	0.3	0.2	93.2	0.3
Private Education	100	1.6	2.1	4.9	9.7	0.0	1.8	0.8	76.7	2.4
Social Services and Private Health Activities	100	0.7	2.0	5.4	3.2	0.0	6.2	1.4	77.6	3.5
Other Social Community Activities and Personal Services	100	0.7	2.9	6.8	5.9	0.2	1.9	2.5	75.5	3.6
Less: Indirectly Measured Intermediate Financial Services, asignned to internal consumption	100	0.6	1.7	5.8	5.3	0.1	1.7	1.1	81.3	2.4
INDUSTRIES SUBTOTAL	**100**	**1.2**	**2.5**	**15.8**	**7.3**	**0.3**	**1.9**	**1.4**	**67.3**	**2.3**

In addition, this chart identifies the different supply chains in the Province of Panama and their level of importance by evaluating their percentages. For example, freight generated in Panama by the manufacturing industry is 82% over all the other provinces.

The value on dollars ($) that each of the supply chains in the Province of Panama contribute to the provincial GDP were not available, therefore National Produce will not be approximated by value ($) or weight of goods generated within this City.

Imports generated by sources in Panama City

Imports can be analyzed in two ways: by the value of goods imported or the total weight of goods imported. The total value of goods imported for 2010 by Panama City's sources was $6,611,125,371[17] (Other sources not considered within this analysis were omitted).

Figure-3 shows that almost all ports are the receivers of the highest value of goods, and that Balboa occupies the first place as the preferred source. Therefore, it can be assumed that most of the

[17] Accountability Office (2010). Importaciones Totales de la República de Panamá para el año 2010 [Total imports of the Republic of Panama for the year 2010]. Retrieved from Centro de Información Estadística [Statistical Information Center]

imported freight exits Balboa and then moves within the city in order to arrive to its destination, given the close proximity of this port to the city.

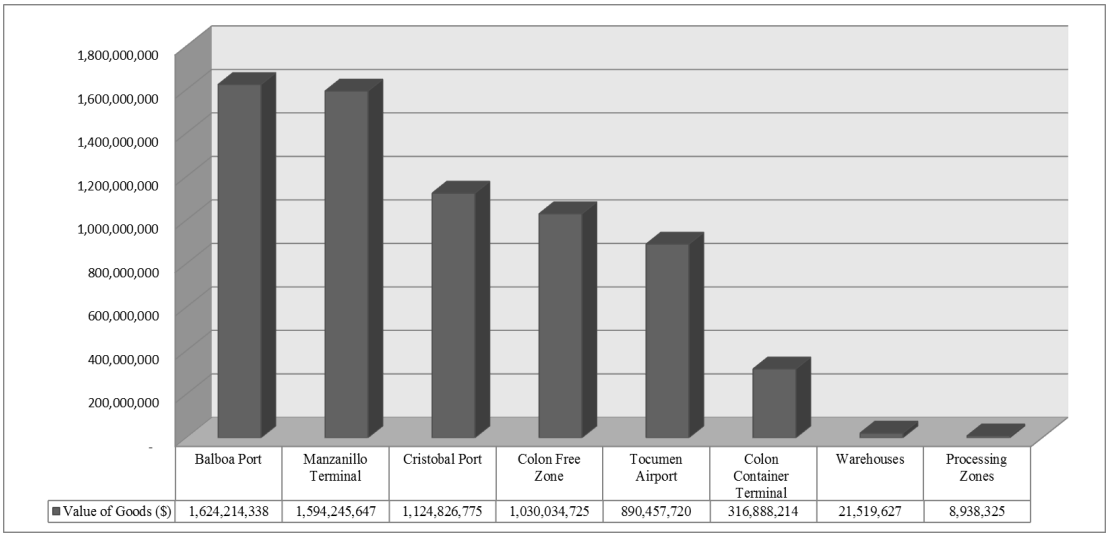


Figure-3: Imports generated by sources in Panama City (in Value of goods) for year 2010

The weight evaluation shown in Figure-4, illustrates sources that possibly generate more truck trips. Though, Balboa port has the greatest volume of imports in value, Cristobal Port has the largest volume of imported weight, which means it would generate more trips than Balboa. Therefore, freight generated by Cristobal could move through the outside roads of the city and not necessarily move within the city's main road network. Still freight generated by Balboa would need to move within Panama City's road network to arrive to its destination.

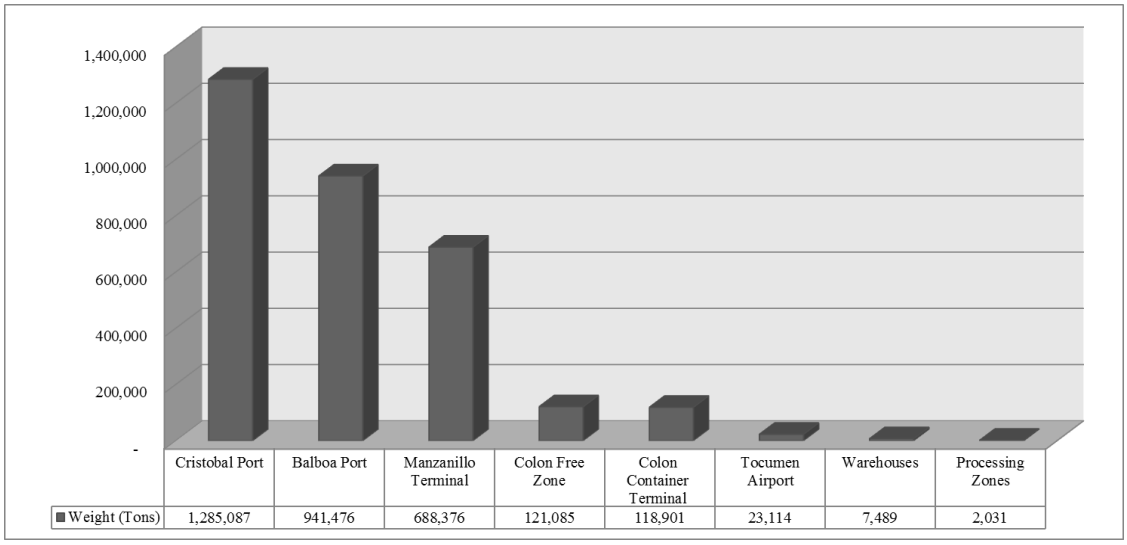


Figure-4: Imports generated by sources in Panama City (in tons) for year 2010

The total number of freight vehicles registered in the districts of Panama and San Miguelito for 2009 (which is the most recent data) was 24,629 units, the sum of all vehicles had a total capacity of 140,670 metric tons. Therefore, dividing the total number of vehicles by the total haul capacity allows estimating that on average each vehicle carries six metric tons. Table 9, presents the estimated number of trips per year generated by each source.

Table 9: Trips per year generated by exports

No.	Source	Trips per year
1	**Cristobal Port**	214,332
2	**Balboa Port**	157,023
3	**Manzanillo Terminal**	114,810
4	**Colon Free Zone**	20,195
5	**Colon Container Terminal**	19,831
6	**Tocumen Airport**	3,855
7	**Warehouses**	1,249
8	**Processing Zones**	339
	Total	**531,632**

Exports generated by sources in Panama City

Exports can also be evaluated by value of goods and tons. The total amount of exports for sources in Panama City for 2010 was of $536,145,718[18]. When comparing the values of imported goods imported to those that are exported, it is noticeable that the value imported is larger. This is mainly due to the fact that Panama City has the tendency of being a service provider rather than an

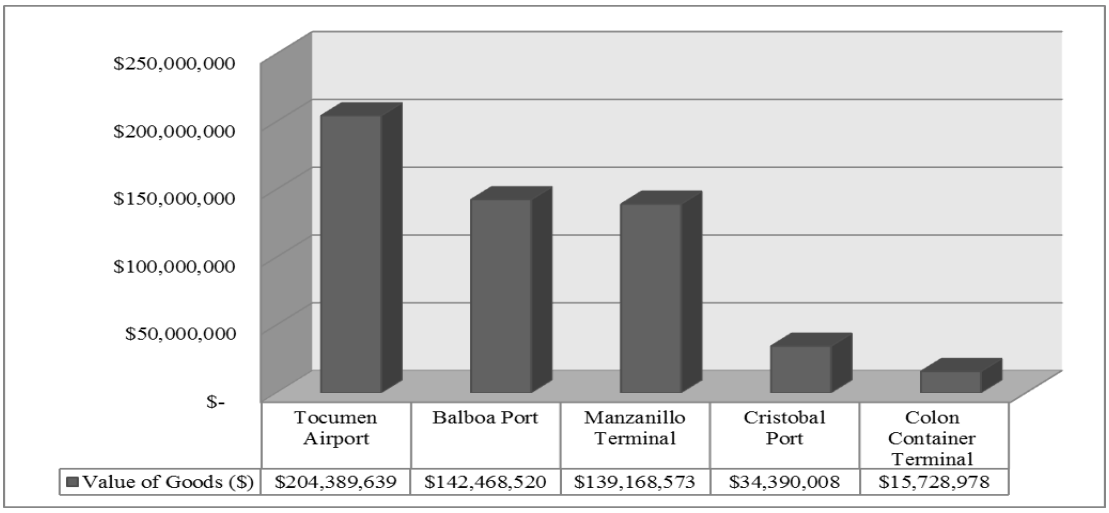


Figure-5: Exports generated by sources in Panama City (in value of goods) for year 2010

[18] Accountability Office (2010). *Exportaciones Totales de la República de Panamá para el año 2010 [Total Exports of the Republic of Panama for the year 2010]*. Panama City: Centro de Información Estadística [Statistical Information Center]

industrial region.

Figure-5 and Figure-6 show that the International Tocumen Airport is the preferred source for exporting products in terms of value of goods as well as for tons of exported products.

The Tocumen Airport is located at the farthest east side of the City, which means that all freight destined for exportation to Tocumen indeed moves through the city.

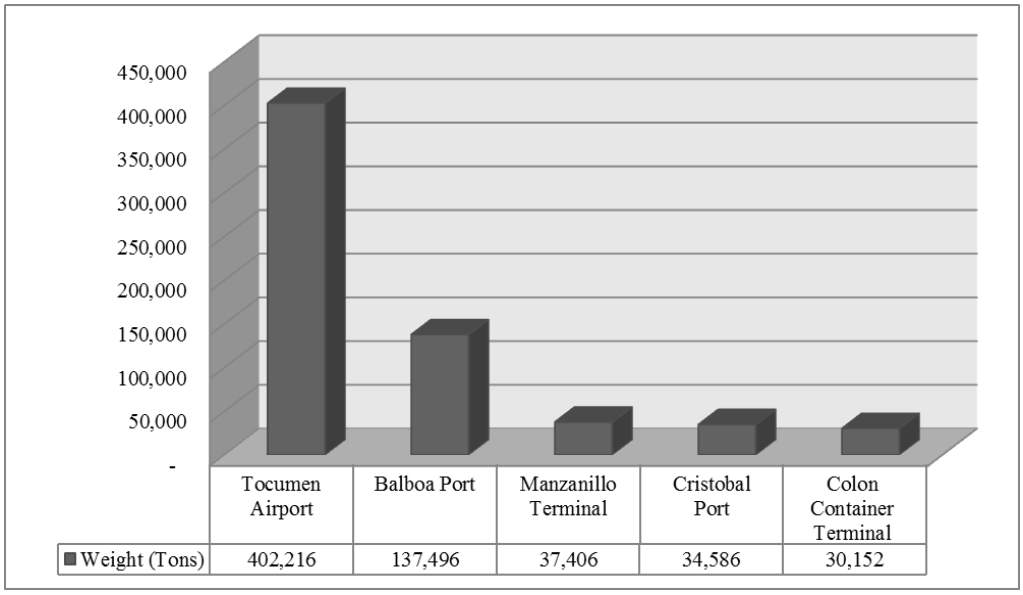


Figure-6: Exports generated by sources in Panama City (in tons) for year 2010

All sources follow the same order for the value of goods as well as for tonnage analysis. First, Tocumen Airport, followed by the Balboa Port, then the Manzanillo International Terminal, Cristobal Port and lastly, the Colon Container Terminal.

Trips per year will be equal to the total tonnage exported by each source divided by the tonnage per vehicle as it was calculated on Table 9. See Table 10, for the trips per year generated by the exports of each source:

Table 10: Trips per year generated by exports

No.	Source	Trips per year
1	**Tocumen Airport**	67,083
2	**Balboa Port**	22,932
3	**Manzanillo Terminal**	6,239
4	**Cristobal Port**	5,768
5	**Colon Container Terminal**	5,029
	Total	**107,051**

Sinks in Panama City

Urban freight is generated by the level of consumption of the population which live in the urban area. For this analysis, sinks will be considered as demand points of freight. Demand is assumed to be any location where population is located and products are consumed. Sinks will be the 30 counties within the districts of Panama and San Miguelito (Table 11).

Table 11: District of Panama and San Miguelito Counties[19]

District of Panama – Counties*		District of San Miguelito - Counties	
1	24 de Diciembre	22	Amelia Denis de Icaza
2	Ancon	23	Belisario Porras
3	Bella Vista	24	José Domingo Espinar
4	Betania	25	Mateo Iturralde
5	Calidonia	26	Victoriano Lorenzo
6	Curundu	27	Arnulfo Arias
7	Chilibre	28	Belisario Frias
8	El Chorrillo	29	Omar Torrijos
9	Juan Diaz	30	Rufina Alfaro
10	Las Cumbres (Alcalde Diaz)		
11	Las Mañanitas		
12	Pacora		
13	Parque Lefevre		
14	Pedregal		
15	Pueblo Nuevo		
16	Rio Abajo		
17	San Felipe		
18	San Francisco		
19	San Martin		
20	Santa Ana		
21	Tocumen		

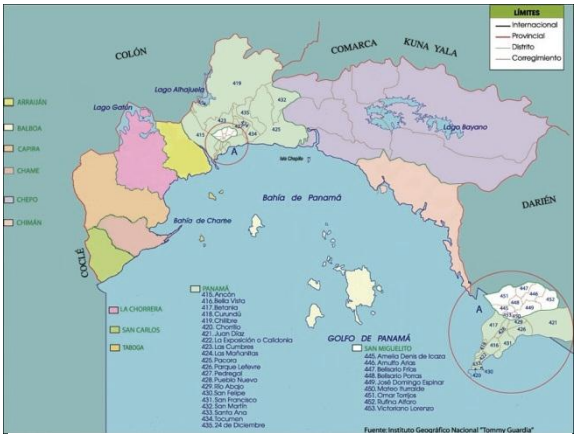


Figure-7: Map of Districts of Panama and San Miguelito

**The Ernesto Córdoba Campos and Alcalde Diaz Counties were not considered within this study because they were founded in 2009[20], and estimations for this data will not be available. Therefore, it will be assumed that the county of Las Cumbres includes these two counties.*

[19] Tommy Guardia National Geographic Institute (n.d.). *Map of the Province of Panama*. Retrieved from: http://www.somospanama.com/informacion/geografia/panama/administrativo.php

[20] Gobierno Nacional (2009). *Presidente Martinelli sanciona su primera ley [President Martinelli sanctions his first law]*. Retrieved from: http://www.presidencia.gob.pa/ver_nodo.php?cod=38

Consumption by sinks

The consumption of freight will be given by the total expenditure level of the population in the districts of Panama and San Miguelito. This will identify the counties with highest level of expense, and so those which consume larger volumes of freight (The estimations will be presented in the descriptive assessment model section.

Reports provided by the Accountability Office estimate that the total population in the districts of Panama and San Miguelito spend a total of $367,715,185 per month. Table I presents the types of expenditure which move the most amount of freight. The most incurred category is food and beverages category which represent 28.2% of a total household expenditures.

Table 12: Monthly Consumption Expenditure for households in the Districts of Panama and San Miguelito per Category
Constant values from July 2008, according to expense type
Year 2007/2008

Description	Total Population Monthly Spend ($)[21]	Average Spend per Home ($)[22]	Percentage
Food and Beverages	103,810,878.92	321.56	28.2%
Transportation	66,035,390.63	204.55	18.0%
Entertainment	33,933,287.60	105.11	9.2%
Housing	33,219,069.90	102.90	9.0%
Clothing and Shoes	26,555,376.53	82.26	7.2%
Personal care and effects	23,636,624.17	73.22	6.4%
Home Maintenances and Services	17,249,380.54	53.43	4.7%
Communications	16,272,748.60	50.41	4.4%
Education	14,398,332.82	44.60	3.9%
Health Care	13,566,390.42	42.02	3.7%
Furniture, Accessories and domestic equipment	13,297,856.79	41.19	3.6%
Other Expenses	5,739,848.29	17.78	1.6%
Total	**$ 367,715,185.22**	**$ 1,139.01**	**100.0%**

This study assumes that the expenditures that drive the most number of truck trips: food and beverages, clothing, personal care, and furniture. The sum of the monthly value of all these

[21] Accountability Office (2008). *Cuadro 114: Gasto monetario promedio mensual de los hogares en Panamá y San Miguelito [Table 114: Average of monthly consumption expenditure in Panama and San Miguelito households]*. Retrieved from: http://www.contraloria.gob.pa/inec/Aplicaciones/EIGH2008/gastos.htm

[22] Accountability Office (2008). *Cuadro 123: Total de gasto monetario mensual de los hogares en Panamá y San Miguelito [Table 123: Total monthly consumption expenditure of all households in Panama and San Miguelito]*. Retrieved from: http://www.contraloria.gob.pa/inec/Aplicaciones/EIGH2008/gastos.htm

expenditures is $167,300,736, and so with an annual value of $2,007,608,837. Therefore, it can be assumed that the population in Panama City consumes this same amount of value in imports and national produce. Areas with the largest number of commercial areas such as supermarkets, distributors and malls, will be likely to have the highest movements of trucks.

1. INFRASTRUCTURE

According to the World Bank (2007)[23], the road infrastructure in Panama City is formed by three road streams: longitudinal roadways, transverse streets and corridors (tolled highways). These infrastructures are the main traffic paths and connect the suburbs (San Miguelito) with the commercial areas in the district of Panama. Given that this road infrastructure is limited, this network is the primarily means of transport for private, public and commercial vehicles.

The road network in the city of Panama is composed of:

- Four main **longitudinal roadways** with an east to west orientation.
- **Transverse roads** which travel north to south and complement the longitudinal streets.
- **Two tolled highways** that run parallel to the main longitudinal roads.

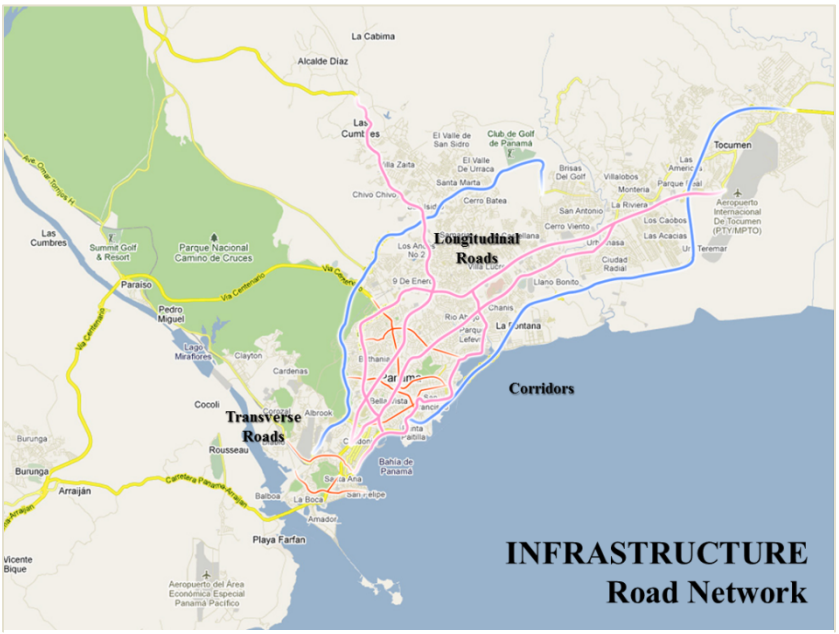


Figure-8: Road infrastructure in Panama City

[23] World Bank (2007). *La movilidad urbana en el área metropolitana de Panamá [Urban Mobility in Panama's Metropolitan Area]*. Panama City: World Bank Office

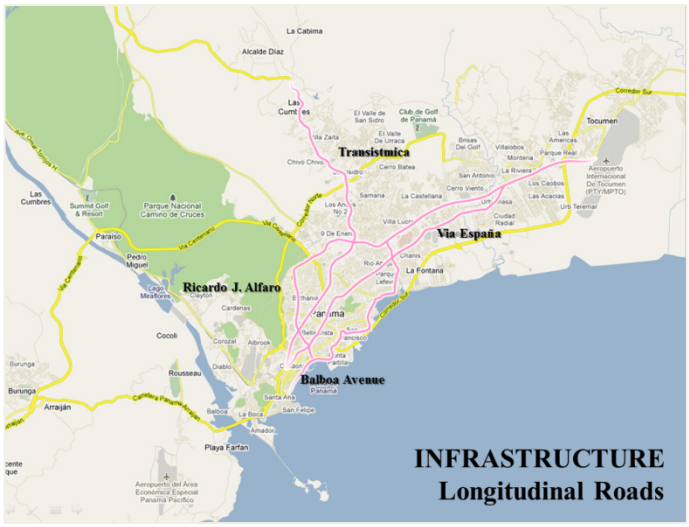


Figure-9: Longitudinal Roads

The longitudinal roads are parallel to the coast, and to the transverse roads. It is believed that this distribution is due to the existence of the former Panama Canal Zone, which until 1999 was a restricted urban area, causing an urban linear growth towards the interior of the city.

The limited number of roads in the network causes a high level of vehicles flow producing traffic conflicts and congestion. The city is considered to be linearly designed with a greater number of vehicles moving through the longitudinal roads rather than the transverse.

The **longitudinal east-west roadways** are:

1. Avenida Central, Via España, Via Jose Agustin Arango.
2. Avenida Nacional, Via Simon Bolivar, Via Transistmica.
3. Avenida Federico Boyd, Avenida Manuel Espinosa Batista, Avenida Ricardo J. Alfaro, Avenida Domingo Diaz.
4. Avenida Balboa, Via Israel, Avenida Cincuentenario.

According to the WB (2007), the average speed for three of the four longitudinal roads is:

Table 13: Average speed on longitudinal roads

Road	Average Speed (Km/h)
Transistmica	**20.8**
Ricardo J. Alfaro	**27.0**
Via España	**18.9**

This data was collected throughout different hours of the day. The average value suggests that these roads are in fact congested due to the high number of vehicles in the network.

The **North – South transverse roadways**, which are considered streets for traveling between longitudinal roads, can be identified as the following:

1. Avenida A, Avenida Arnulfo Arias (Balboa).
2. Avenida 3 de noviembre (Calle 23 Este), Calle 9 de enero, Ave. Omar Torrijos (Gaillard).
3. Avenida Brasil, Avenida Ramon Arias, Via el Paical.

4. Belisario Porras, Avenida Fernandez de Cordoba, Avenida La Paz, Via Patacon.
5. Avenida Ernesto T. Lefevre, Avenida 12 de octubre, Calle D. Diaz, Ave. 14C Norte / Calle 74 Oeste.
6. Calle Martín Sosa, Avenida de los Martires, Avenida Nicanor Obarrio / Calle 50

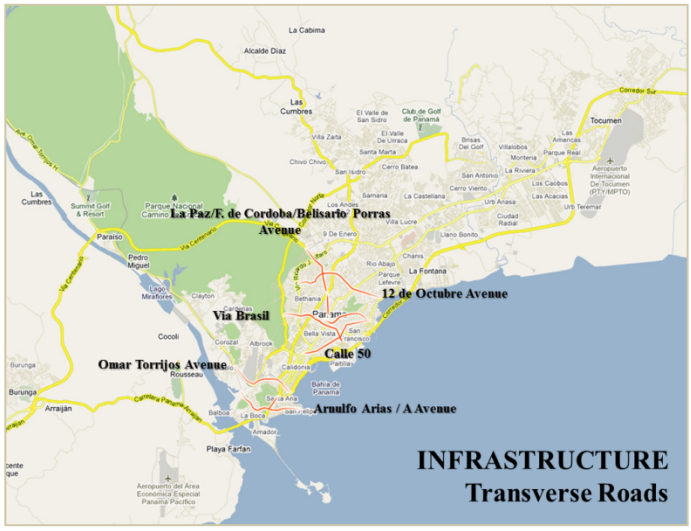


Figure-10: Longitudinal Roads

Also, the following average speed was evaluated by the WB (2007) speed:

Table 14: Average speed on transverse roads

Road	Average Speed (Km/h)
Brasil Avenue	**17.5**
12 de Octubre	**22.3**
Calle 50	**20.3**

Though these streets have a lower traffic than longitudinal roadways, speed on both roadways is similar and it is evidence that congestion affects the whole network.

The **tolled highways** are called: the Corredor Norte and Corredor Sur. These were built to reduce the traffic of vehicles in the longitudinal and transverse roadways. Still, the increase of vehicle flow per year has caused these roads to suffer from congestion, especially during rush hours.

The Corredor Sur is designed for speeds between 80 to 110 km/hr[24]. It has controlled accesses and exits

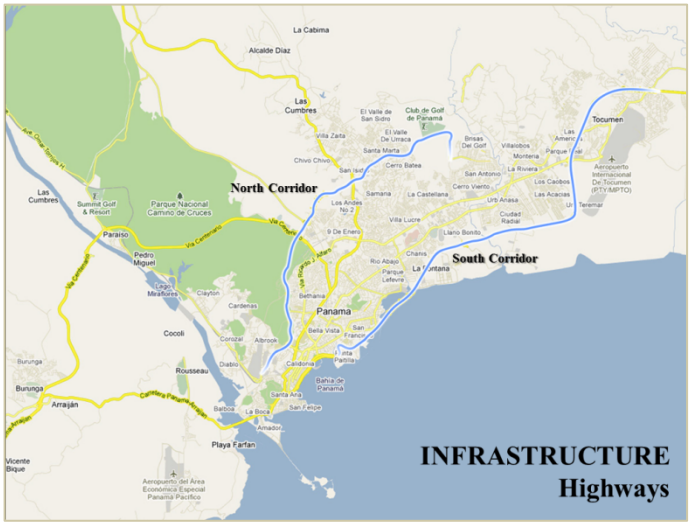


Figure-11: Tolled Highways

[24] ICA Panama, S.A. (2008). *Technical Data*. http://www.ica.com.pa/eng/sitio/corredor.aspx#b

through toll booths, which are located within the perimeter of the urban zones at the south side of the city. The total length of the highway is 18.8 km (11.7mi). It is estimated to have an average traffic of approximately 100,000 vehicles per day[25].

The Corredor Norte connects the center of the City with the reverted areas and with the main suburbs located at the north of Panama City. This highway has 9 transport interchanges and 16 paytoll booths.

In 2009, the Company Consul-Tech was hired by the government to evaluate the performance of the Corredor Norte. The consulting company estimated that traffic per day is approximately of 54,000 vehicles[26].

At present, the vehicle flows for both highways are greater than the values forecasted. Currently, the Corredor Sur has a traffic flow which was estimated for 2025. Together both highways have a flow of 154 thousand vehicles per day[27].

Roads that connect sources to the City

Urban freight vehicles have a total of 12 roads to move goods within city. Due to the limited size of the network, there are sources that communicate with the city by using, in some cases the same roadways. Table 15, shows the source and the possible routes a vehicle would take to enter or exit the city. Sources that present the same route allow recognizing the possible level of congestion affecting urban freight.

Table 15: Roads connecting Sources with Panama City

Sources	Possible Routes
Cristobal Port	Longitudinal (Transistmica-Interamerican) and Highway (Corredor Norte)
Manzanillo International Terminal	Longitudinal (Transistmica-Interamerican) and Highway (Corredor Norte)
Colon Container Terminal	Longitudinal (Transistmica-Interamerican) and Highway (Corredor Norte)
Balboa Port	Longitudinal (Transistmica) and Highway (Corredor Norte)
Centennial Bridge	Transverse (Avenida La Paz) and Highway Corredor Norte
Bridge of the Americas	Transverse (Avenida Roosvelt)
Tocumen Airport	Longitudinal (Avenida Domingo Diaz) and Corredor Sur
Industrial Zones in Panama Areas	Longitudinal, transverse and highways
Colon Free Zone	Longitudinal (Transistmica) and Highway (Corredor Norte)
Manufacturing Zones	Longitudinals, transverse and highways

[25] Proyeco (2010). *Informe final de la auditoría contable financiera y de bienes raíces del Corredor Sur [Final audit report of the financial accounting and real state of the Corredor sur]*. Retrieved from: http://www.mef.gob.pa/DocumentosInteres/Informe_ ejecutivo_corredor _sur.pdf

[26] Consul-Tech (2009). Informe de la auditoría del Corredor Norte [Audit report of the Corredor Norte]. Retrieved from: http://www.mef. gob.pa/Documentos-Interes/Informe%20de%20 auditor%C3%ADa%20corredor%20Norte.pdf

[27] Ministry of Economy and Finance (2010). *Empresa Nacional de Autopistas – Adquisición de los corredores [National Company of Highway: Corridors Acquisition]*. Retrieved from: http://www.panabolsa. com/sys/upload/files/PPTs/XI_Foro_de_ Inversionistas___ENA_1_08_2010.pdf

Figure-12 presents the sources that surround the city and the road infrastructure that allows freight to exit or enter the city. As the figure shows, in order to move freight from one source to the other it is necessary for it to move within Panama City's road network.

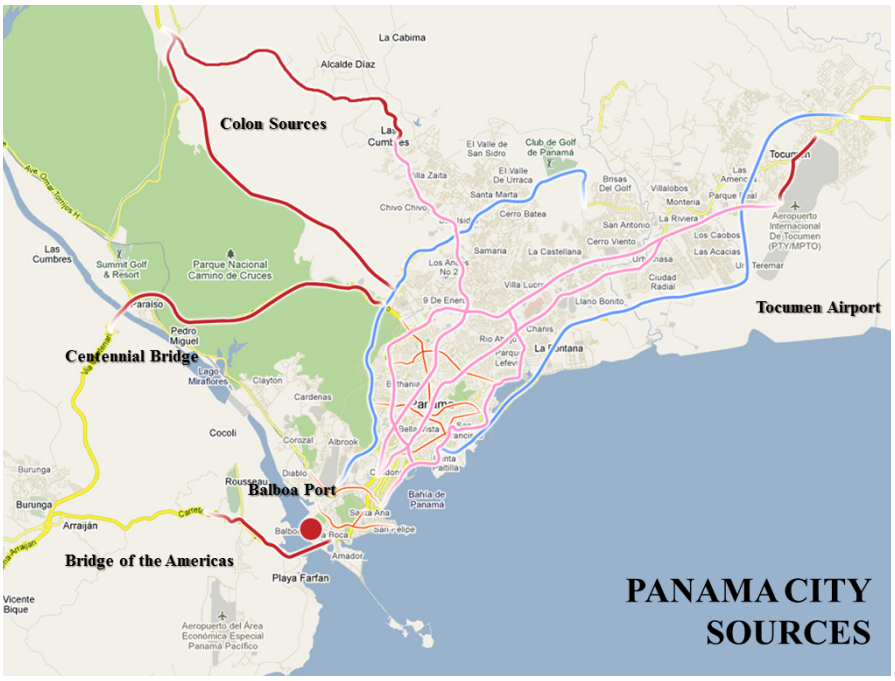


Figure-12: Longitudinal Roads

New Infrastructure Projects Proposed by the Government to reduce congestion

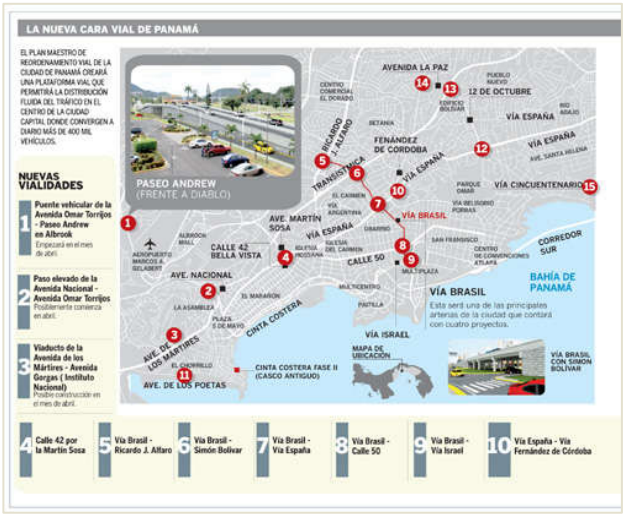


Figure-13: Infrastructure Projects in Panama City

The Ministry of Public Works has developed a new infrastructure project, Road Reordering for Panama City and the Metropolitan Area, will serve to reduce the overcapacity of the road network in Panama City.

This project is composed of 15 new road infrastructures (Figure-13). The objective is to create a better connectivity between industrial zones- ports and urban - commercial areas, reduce the number of

accidents, congestion and lead times in the City[28].

These projects are being built in parallel to the construction of the first lane of the subway.

It is believed that 21 streets, intersections and pedestrian bridges will be built simultaneously, and will be completed by 2014. These infrastructures will focus on the four longitudinal roads previously described. Other measures will be: the prohibition of left turns, the reduction in number of traffic lights, and construction of two or three level roundabouts.[29]

Interviews with former chiefs in the Government and contacts in the current administration, commented that urban freight was not considered within the feasibility studies for this project (A. Gonzalez, personal interview, June 21, 2011), urban freight vehicles just adapt to the current and proposed infrastructure without playing any active role. There are approximately a total of 8 official government studies[30] for passenger transport and non for urban freight (R. Chavez, personal interview, June 14, 2011).

2. TRANSPORT SERVICE

This section describes the freight vehicle characteristics in Panama City, and its classifications.

Vehicle Population in the Republic of Panama

The vehicle population in the Republic of Panama (Figure-14) is distributed as follows: 77% of vehicles are located in Panama City, followed by the Province of Chiriqui with 8.6%. This vehicle proportion is related to high concentration of population and business in these two urban areas. The combined population of these two regions represents 70.6% of the total population in the country.

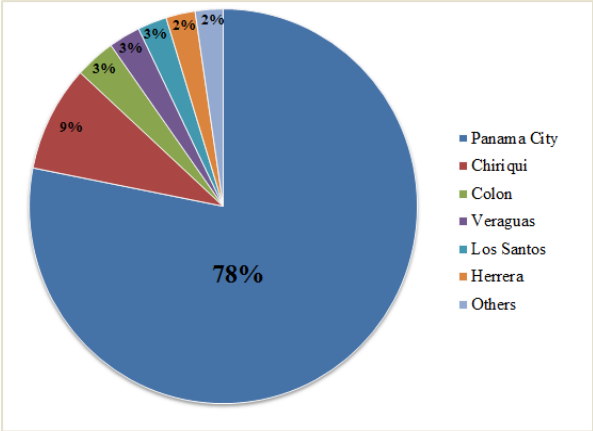


Figure-14: Vehicle Population in the Republic of Panama

[28] Ministry of Public Works (2010). Plan Vial 2010 [Road Plan 2010]. Panama City: Georgia Tech Logistics and Innovation Center.
[29] Ortega, E. (2011). Reordenamiento Vial: Dos años de congestionamiento [Road reordering: two years of traffic congestion]. Panama America Newspaper. Retrieved from: http://www.padigital.com.pa/periodico/edicion-anterior/nacion-interna.php?story_id= 1016313
[30] Metro (2011). *Resumen no técnico: Impacto ambiental Línea 1 del Metro [Non-Technical Summary: Environmental Impact of Subway Line 1]*. Retrieved from: http://www.bei.org/attachments/pipeline/20100202_nts_es.pdf

The country's vehicle population can also be classified according to the vehicle purpose: official (1%), private (19%) and commercial (80%). Subsequently, commercial vehicles are divided in three sub-categories: urban freight vehicles (60%), buses (14%) and company cars (19%).[31]

Panama City Urban Freight Vehicle Distribution

The Accountability Office classifies urban freight vehicles as trucks, truck (chassis), trailers and delivery vans.

Trucks are defined as motor vehicle with a body built, used for the transportation of heavy merchandise. Trucks (chassis) are motor vehicle designed for drawing trailers. Trailers are vehicles designed to be drawn by other motor vehicles. And delivery vans are automobiles used for distributing small quantities of merchandise (these are also called panels)[32].

The table below presents the total fleet size for Panama City from the year 2002 to 2009:

Table 15: Total amount of registered commercial vehicles Districts of Panama and San Miguelito[33]

Year*	Trucks	Trucks (chassis)	Trailers	Delivery Vans	Total
2002	7,993	882	2,133	4,526	15,534
2003	8,570	965	2,223	4,618	16,376
2004	9,029	977	3,017	5,009	18,032
2005	8,794	997	2,979	5,642	18,412
2006	8,767	865	2,063	6,056	17,751
2007	10,617	809	2,822	6,021	20,269
2008	10,954	824	2,868	6,279	20,925
2009	11,741	1,036	3,166	7,435	23,378

****Data for 2010 was not available. This estimation has yet to be published by the Ground Transit and Traffic Authority.***

In seven years, the total urban freight population has increased in 34%. Delivery had the highest increase in population with 39%, followed by trailers (33%), trucks (32%) and, trucks – chassis (15%).

[31] BBVA. (2011). Situación Automotriz [Automobile Market in Panama]. Retrieved from: http://www.bbvaresearch.com/KETD/fbin/mult/1104 _ SitAutomotrizPanama_tcm346-256026.pdf?ts=472011

[32] Accountability Office (2008). Situación Económica de Transporte [Economic Situation of Transport]. Retrieved from: http://www.contraloria.gob.pa/inec/Publicaciones/11-06-05/Notas.pdf

[33] Accountability Office (2002-2009). Registro de vehículos en los distritos de Panamá y San Miguelito [Vehicle registration for the districts of Panama and San Miguelito]. Retrieved from Centro de Información Estadística [Statistical Information Center]

In 2009, trucks and delivery vans were the preferred freight vehicles, probably due to the limited road space in Panama City (where small or medium size freight vehicles are recommended to avoid loading, unloading or parking issues).

According to the Ground Transit and Transportation Authority (ATTT for its initials in Spanish), there are approximately 30,000 trucks traveling per day through Panama City[34].

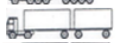
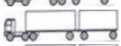
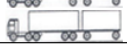
Freight Vehicle Classification by Law

The ATTT classifies urban freight vehicles by their weight and dimensions. This classification was established by Law No. 10 of January 24, 1989.

This regulation classifies freight vehicle considering several features (See Table 16):

- By type of vehicle: C (Trucks), T (Tractors), S (Semi-trailers) and A (trailers).
- By number of axles: C-2 (Two axle trucks), D-3 (Three axle trucks), and C-4 (Four axle trucks).
- For articulated vehicles: T2 (Truck tractor with two axles), T3 (Truck tractor with three axles), S1 (Single axle semitrailer), S2 (Two axle semitrailer), and S3 (Three axle semitrailer).
- For trailers: R2 (Two axle trailer), R3 (Three axle trailer).

Table 16: Permitted weight and dimensions for freight vehicles

Type	Reference	Maximum Weight (tonns)	Maximum Dimensions (meters)			Type	Reference	Maximum Weight (tonns)	Maximum Dimensions (meters)		
			Lenght	Height	Width				Lenght	Height	Width
C-2		14.0	11.00	4.15	2.50	T3-S1		31.9	16.70	4.15	2.50
C-3		21.9	12.00	4.15	2.50	T3-S2		38.3	16.70	4.15	2.50
C-4		27.5	12.00	4.15	2.50	T3-S3		43.9	16.70	4.15	2.50
C-4-E		31.9	12.00	4.15	2.50	T3-S4		51.1	16.70	4.15	2.50
C-5		37.5	16.70	4.15	2.50	T4-S1		37.5	16.70	4.15	2.50
C2-R2		30.0	16.70	4.15	2.50	T4-S2		43.9	16.70	4.15	2.50
C2-R3		36.5	16.70	4.15	2.50	T4-S3		49.5	16.70	4.15	2.50
C3-R2		37.9	16.70	4.15	2.50	T4-S4		56.7	16.70	4.15	2.50
C3-R3		44.4	16.70	4.15	2.50	T2-S1-R2		41.5	16.70	4.15	2.50
T2-S1		25.5	16.70	4.15	2.50	T2-S2-R2		47.9	20.00	4.15	2.50
T2-S2		31.9	16.70	4.15	2.50	T3-S1-R2		47.9	20.00	4.15	2.50
T2-S3		37.5	16.70	4.15	2.50	T3-S2-R2		53.4	20.00	4.15	2.50

[34] Malema, M. (2010). Treinta mil camiones circulan por la capital [Thirty thousand truck move through the city]. La Prensa Newspaper. Retrieved from: http://www.prensa.com/hoy/panorama/2230256.asp

Every freight vehicle must abide to weight and dimensions described by the law. Therefore, there are several control points in the country which verify that vehicles are following the established weight limitations.

For instance, every truck traveling to or from Panama City must stop at the Chorrera Control Station, 40 km from Panama City. In this control station, trucks are weighed to verify their tonnage. If a truck is over the permitted capacity, the driver must transfer the excess tonnage to another truck or all excess weight will be confiscated. In the case of encountering excess weight on dry or liquid bulk freight, a penalty for over tonnage will be applied[35].

3. TRAFFIC SERVICE

At present, there are no established regulations for the specific control of urban movements in the city or the country.

Currently, urban movements are delimited by the combination of three main regulations: one law which establishes the permitted vehicle tonnage and dimensions, one general decree for urban freight handling measures and procedures, and one last decree for controlling procedures at weight control stations (See Table 17).

Table 17: Regulations for Urban Freight in the Republic of Panama[36]

Law	Description
Law 10 of January 24, 1989[37]	Subrogates Law No. 11 of September 13, 1985 and adopts new measurements of weight and dimensions for freight vehicles which circulate on public roadways
Executive Decree 160 of June 7, 1993[38] (Revoked)	Issues Transit Regulations for the Republic of Panama
Executive Decree 270 of August 13, 1993[39]	Takes measures for the transit control of freight vehicles on public roadways

[35] Ground Transit and Transport Authority (2010). Tabla de límites de pesos y medidas para vehículos de carga [Weight and dimension limits for freight vehicles]. Province of Panama: Chorrera Weight Control Station.
[36] Ground Transit and Transportation Authority (2008). *Estructura Organizativa [Organization Structure]*. Retrieved from: http://190.34.149.228/transparencia /manual%20proc.pdf
[37] National Assembly (n.d.). *Gaceta Oficial 21222 del 27 de enero de 1989 [Official Gazette 21222 of January 27, 1989]*. Retrieved from: http://www.asamblea.gob.pa/APPS/LEGISPAN/PDF_GACETAS/1980/1989/21222_1989.PDF
[38] National Assembly (n.d.). *Gaceta Oficial 22305 del 11 de junio de 1993 [Official Gazette 22305 of June 11, 1993]*. Retrieved from: http://www.asamblea.gob.pa/APPS/LEGISPAN/PDF_GACETAS/1990/1993/22305_1993.PDF
[39] National Assembly (n.d.). *Gaceta Oficial 22360 del 27 de agosto de 1993 [Official Gazette 22360 of August 27, 1993]*. Retrieved from: http://www.asamblea.gob.pa/APPS/LEGISPAN/PDF_GACETAS/1990/1993/22360_1993.PDF

Decree 640 of December 27, 2006[40]	Revokes Executive Decree No. 160. Provides the Vehicle Transit Regulations for the Republic of Panama

Review of the content of each regulation

Law 10 of January 24, 1989

This law has been previously described in the transportation service section. As mentioned earlier, this regulation presents the allowed tonnage and dimensions for freight vehicles in the Republic of Panama.

Executive Decree 270 of August 13, 1993

This decree establishes that a representative from the National Police will need to be at each Weight Control Station, to assure that weight and dimensions limitations are carried out.

Decree 640 of December 27, 2006

It presents the regulations for all types of vehicles: private, commercial and public, on how to obtain a license, road hierarchy and signs, general security measures when driving, etc.

Articles 57 to 60 describe general procedures for freight transportation. These articles provide regulations on how to carry freight, security measures (such as reflective bands, materials for protecting merchandise in cases of carrying dry bulk commodities, etc.).

Another group of articles related to freight transportation are the articles 70 to 92, which describe the procedures for carrying hazardous commodities. It provides information on required permits, security measures on how to handle cargo, accidents and, also penalties for violations committed.

Freight Cargo Law Proposal

A meeting with a formal ATTT chief (Angelino Harris) lead to an interview with another former government analyst (Arturo Gonzalez) who now works independently, but actively in government infrastructure projects. During the interview with Mr. Gonzalez, he mentioned that currently the company where he is employed, ALCONSUL, has recently presented a proposal to the ATTT for the establishment of a Law for freight cargo in the Republic of Panama.

The information provided was rather vague, probably because the document was generated and issued by a privately held company. He did mention that his company had already studied the

[40] National Assembly (n.d.). *Gaceta Oficial 25701 del 29 de diciembre de 2006 [Official Gazette 25701 of December 29, 2006]*. Retrieved from: http://www.gacetaoficial.gob. pa/pdfTemp/25701/2318.pdf

freight movements in Panama City, especially because of his previous work experience in the Ministry of Public Works. He also commented that his company performed other analyses, such as vehicle counts in the road network to provide freight estimations, and to complement their proposal.

Coincidentally, his description was similar to the recommendations provided by the WB (2007) study where it proposed the evaluation and creation of a Law for Freight Movements.

These recommendations consisted of: the establishment of road priority to restrict the entry of freight vehicles to streets or avenues according to permitted weight and dimensions; delimit authorized areas for parking, loading or unloading activities; restrict the movement of freight vehicles to certain hours of the day to avoid congestion; among others.

B. URBAN FREIGHT SURVEY FOR PANAMA

The purpose of the urban freight survey is to establish a methodology on how to collect data of urban freight in Panama City, to establish freight transport indicators for comparing the logistic performance between industries or different urban areas nation-wide.

This section will provide the methodology in order to establish a procedure for collecting freight data at government level, such as the population census is performed currently. This will allow entities, such as the Ground Transit and Transport Authority to keep record of urban freight movements and have data available for indicators and future modeling.

Survey Key Performance Indicators

The survey data collected will generate freight transport indicators. The proposed indicators are based on the BESTUFFS (2004)[41] where it details indicators used by different countries in Europe. This study considers that the best freight indicators for expressing the behavior in Panama City are the following:

Table 18: Key Performance Indicator for Urban Freight

No.	Indicator	Units
1	Industry	Industry where the vehicle or the business belongs to
2	Type of vehicle	Vehicle classification by percentages
3	Size of fleet	Average of the total sum of vehicle fleets surveyed

[41] Browne, M. and Allen, J. (2004). BESTUFFS II: Best Urban Solutions II. University of Westminster, London. Retrieved from: http://www.bestufs.net/download/BESTUFS_II/key_issuesII/BESTUFS_II_results_datacollection/BESTUFS_II_data_collection_synthesis_report.pdf

4	Distance per delivery	Average distance per delivery
5	Empty Running	Distance travelled by vehicle from the last delivery to depot / total vehicle kilometers
6	Percentage of Volume delivered across the week	Average of total freight delivered / total days of service in a week
7	Loading factor	Total tons carried / total freight vehicle capacity
8	Shipments per zone	Total shipments / total zones delivered
9	Average delivery per vehicle type (tons)	Total deliveries per vehicle types
10	Average receptions per day	Total receptions / total days of service

Urban freight survey future projections

This urban freight survey could be complemented with other data collection methods such as the establishment of a zoning system for studying several areas, collect data through vehicle counts in main commercial locations to identify main origins and destinations, or roadside interviews to truckers to specify tour trips. The collection of this data with the survey would allow the generation of freight origin-destinations matrix, and enable the modeling and forecast of truck trips behavior in Panama City.

Data Collection Method

The data collection process will be through a personal survey. This study recommends this survey to be performed each year (See Appendix A for survey format).

According to BESTUFFS (2006)[42], this questionnaire is classified as an establishment survey. This type of survey is applied as the name implies to commercial establishments. According to BESTUFF, this tool is useful for analyzing vehicle trips of goods from one establishment to the other, and how those trips vary depending on the time of day, week or month.

This survey could be applied to several urban areas such as Chiriqui, Colon and Panama, and compare their performances. Or be applied solely to Panama City and compare freight behavior among industries. This study will recommend the second option in order to test the study in Panama City and then, move onto comparing other zones.

The survey consists of three sections: General Information, Loading and Unloading activities. It has a total of 22 questions including best answer, fill in the blanks and open questions.

[42] Browne, M. and Julian, A. (2006). BESTUFS WP 3.1. Report on urban freight data collection in the UK. University of Westminster, London. Retrieved from: http://www.bestufs.net/download/BESTUFS_II/key_issuesII/BESTUFS_II_results_datacollection/BESTUFS_II_ data_ collection_report_UK.pdf

The topics[43] include the total amount of collections and deliveries at the address, the variation in deliveries by day of week and time of day, the origin of deliveries, the type of vehicles used for deliveries, the loading/unloading arrangements and facilities, and the number and purpose of service vehicle visits per week.

The results should be published to allow companies to compare their operations with the rest of the industry and determine if their logistic performance needs to improve. The survey report should be published annually and be available for industries, academics and the general public.

Sample Size

The survey would be applied to a random sample of 545[44] commercial vehicles based on the total freight vehicle population of Panama City. Each candidate would be selected randomly from a list with the following information: commercial vehicle identification number, company the vehicle belongs to and the company's location. In case the name of the company is selected twice, this will be discarded and another vehicle must be randomly drawn.

The list of the population of freight vehicles must be obtained from the District of Panama and San Miguelito Municipality or from the Vehicle Registration Office.

In order for the sample to be representative of the freight vehicle population, the total sample size must be stratified. As mentioned in the transport service section, in the republic of Panama there are 24 different vehicle classifications according to their weight haulage capacity. This sample stratification allows understanding how much each vehicle group contributes to the total freight activity in the city and capture data on their individual trip behavior.

The total sample (545 vehicles) would need to be divided between the total numbers of vehicle classifications. This would result in 23 vehicles per group or at the district level, 11 trucks per group per district would need to be surveyed.

For an industry approach (in order to see how each supply chain contributes to freight activity), it would be recommended to select the population of total commercial companies with fleet activitiy, this information could be provided by the Ministry of Industry and Commerce.

[43] Allen, J. and Browne, M. (2008). Review of Survey Techniques used in Urban Freight Studies. Allen, J. and Browne, M. Transport Studies Group. University of Westminster. London. Retrieved from: http://www.greenlogistics.org/SiteResources/16adc811-45bb-42f4-8fe8-39930e2e8a30_Review%20of%20Survey%20Techniques%20_final_%20November%202008.pdf

[44] *Sample size is based on a probability of 50%, a level of confidence of 95% and an error of 3%.*

Another alternative is to use the warehouse data base of warehouse and distribution centers developed by the Georgia Tech Logistics and Innovation Center for the Warehousing Project in 2010. This list contains a total of 113 companies located in Panama City, given the small number of companies as population; it would be advisable to sample all companies in the list.

Survey Sample Application Results

The survey process was applied to a small sample of companies to validate the proposed methodology. The sample for the survey was a non-statistical sample of business in Panama City, specifically supermarkets and distribution centers. The representative sample consisted of four companies to be surveyed, two supermarkets and two distribution centers. Two companies answered the survey and only one provided valid results.

The questionnaire process had an approximate time of completion of 20 to 40 minutes, depending on how available the company has the information. The sample survey had a low response, and in one of the cases, the company was not willing to respond one of the questions, indicating that it would give away their distribution and cargo strategy.

Data unavailability limited the survey process and indicators were not estimated due to the lack of response by private companies.

V. PANAMA CITY URBAN FREIGHT NETWORK

This section is divided in: fleet size forecast model and tactical & strategic analysis. The first presents the fleet size growth for Panama City, and the second shows how that fleet growth has been distributed across the City and its future trend.

A. FLEET SIZE FORECAST MODEL

The model of this assessment is based on the Truck Trip of Goods (TTG) model, which is focused on the relationships between truck trips and economic activities developed in an urban area. Given that this study has limited data, fleet size will be used as reference rather than truck trips.

The economic variables chosen for this analysis were the following: population growth, consumer price index, gross domestic product, and the number of commercial buildings constructed.

These variables were considered given their direct relation to commercial activities, which then drive the increase in the fleet size of Panama City. Each economic variable was paired with fleet size, and analyzed by a regression analysis using Pearson Correlation Coefficient.

Fleet size was considered as the dependent variable, while the economic factors as the independent. All data collected is only related to Panama City.

The analyzed pairings were:

- Fleet size vs. Population
- Fleet size vs. Gross Domestic Product (GDP)
- Fleet size vs. Consumer price index (CPI)
- Fleet size vs. Square meter built

1. Fleet size vs. Population

The objective of this relationship was to analyze if the increase in population, will cause an increase in fleet size. The relationship is based on the assumption that as the population increases, the consumption of goods will also increase, and then a higher volume of freight vehicles will be needed to supply the demand.

Fleet size for Panama City was based on Table L: Transport Services. The data considered for population was the sum of the total inhabitants in the districts of Panama and San Miguelito. The estimation calculated by the Accountability Office[45] because the census is only performed every ten years. This estimation is used by many government institutions to forecast population growth, such as studies for the Corredor Sur, Corredor Norte and the subway.

Table 19: Data for Fleet Size vs. Population Relationship

Year	Population	Fleet Size
2002	1,082,540	15,534
2003	1,105,756	16,376
2004	1,128,972	18,032
2005	1,152,187	18,412
2006	1,175,404	17,751
2007	1,198,620	20,269
2008	1,221,836	20,925
2009	1,245,052	23,378

[45] Accountability Office (2000). *Estimación de la Población Total en la República de Panamá [Estimation of the total population in the Republic of Panama]*. Retrieved from: http://www.contraloria.gob.pa/dec/Publicaciones/13-03/Boletin9.pdf

Applying the regressing analysis, the relationship shows a linear tendency with the following result:

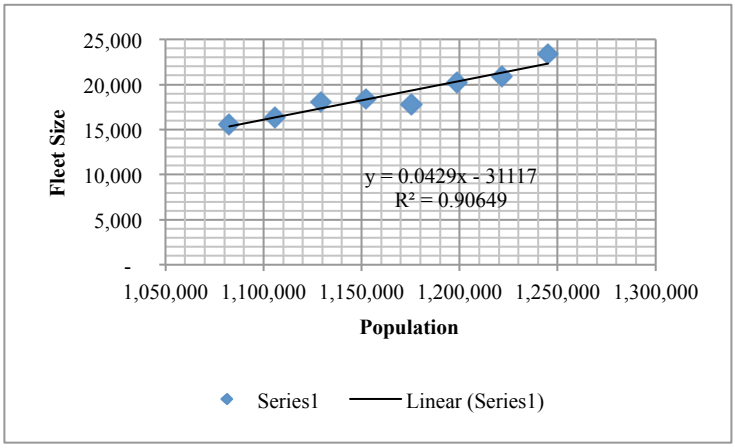


Figure-15: Regression Analysis: Fleet Size vs. Population

Fleet size and population have a positive correlation coefficient of 0.91, which means that the increase of inhabitants will indeed increase the number of freight vehicles in Panama City.

2. Fleet Size vs. GDP

The relationship between fleet size and GDP served to determine if the economic development of Panama City would have a direct impact on the number of freight vehicles. As industries produce a larger volume of goods, it will be necessary a greater number of vehicles to transport the products to their destinations.

The data used for this analysis was the GDP from Panama City and fleet size for the years 2002 – 2009.

The GDP from the district of Panama was estimated by the following assumption: in the commodity section, it was mentioned that the GDP from the district of Panama represented 55% of the total GDP in the country. Therefore, to obtain the GDP generated by this district, the country's GDP entries from 2002 – 2009 were captured, and then multiplied by the 55% generated by the district of Panama.

Table 20: Data for Fleet Size vs. Panama City's GDP

Year	GDP	Fleet Size
2002	4,257,000	15,534
2003	4,506,150	16,376
2004	4,832,465	18,032
2005	7,722,660	18,412
2006	8,381,230	17,751
2007	9,396,420	20,269
2008	10,347,095	20,925
2009	10,677,755	23,378

The regression analysis shows that the GDP and fleet size have a positive correlation with a coefficient of 0.79. Therefore, there is a modest relationship between these two variables.

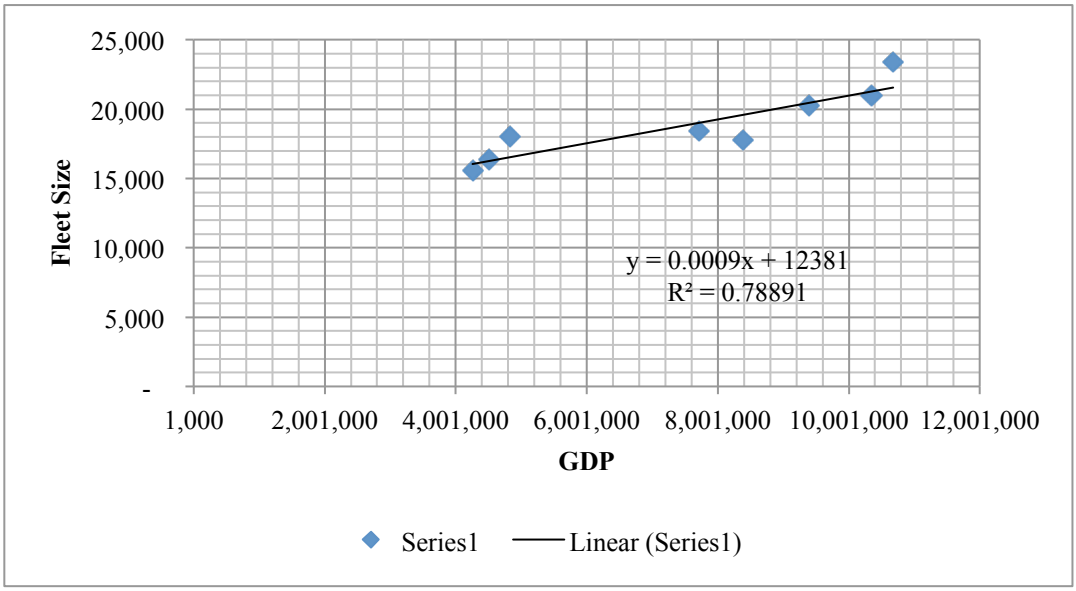


Figure-16: Regression Analysis: Fleet size vs. GDP

3. Fleet Size vs. Consumer Price Index

The relationship between freight vehicle population and consumer price index was considered to determine if the increase in price of the value of goods in the economy, produce a proportional increase in fleet size.

As the value of goods increase, the demand for less expensive products will increase as well, and businesses will use economies of scale to purchase a higher volume of products in order to reduce the price. This will increase the number of freight vehicles needed to transport the increase in goods to their destinations.

The data considered for this comparison was obtained by the Accountability Office, and the years from 2002 to 2009 were analyzed.

Table 21: Data for Fleet Size vs. CPI

Year	Consumer Price Index	Fleet Size
2002	100.00	15,534
2003	100.40	16,376
2004	101.80	18,032
2005	106.70	18,412
2006	108.10	17,751
2007	115.20	20,269
2008	132.00	20,925
2009	139.40	23,378

The relationship has a positive correlation with a coefficient of 0.88, which demonstrates that as freight vehicles increase, the consumer price index increases as well.

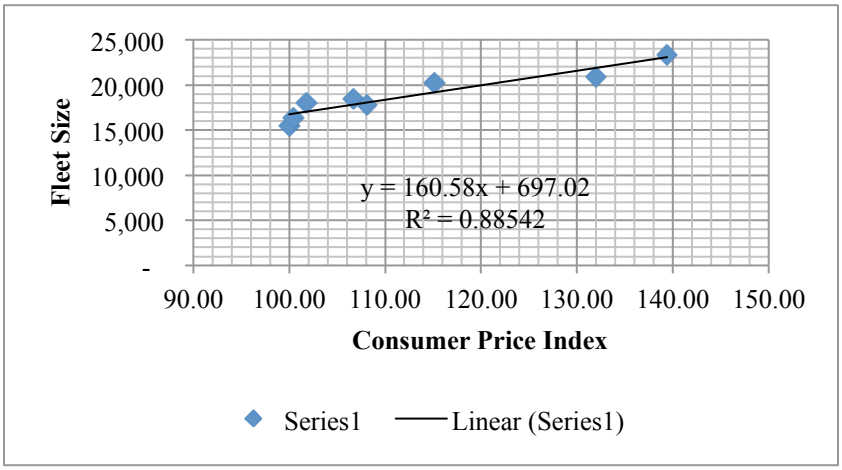


Figure-17: Regression Analysis: Fleet Size vs. GDP

4. Fleet Size vs. Square Meter Built

Square meter built is an indicator estimated by the government to register the increase of commercial constructions in the city. The relationship between fleet size and square meter built was analyzed to identify if the increase in the construction of commercial buildings causes an increase in the number of freight vehicles. It is assumed that as the number of buildings increase, there will be more areas to deliver to and so, the number of freight vehicles will increase.

The variable used to represent the construction of commercial buildings was the number of square meters built for commercial activity. Still, the analysis was limited by the lack of data. The Accountability Office mentioned that the analysis for square meter built was first registered in 2006; therefore data for 2002 to 2005 is not available.

Table 22: Data for Fleet Size vs. Square meter built

Year	Square Meter Built	Fleet Size
2002	Data not Available	15,534
2003	Data not Available	16,376
2004	Data not Available	18,032
2005	Data not Available	18,412
2006	257,981	17,751
2007	407,734	20,269
2008	571,274	20,925
2009	711,935	23,378

Consequently, the regression analysis had to be computed with only five data entries, this resulted in a positive correlation between both variables. Given the limited data available, the result cannot be considered as valid.

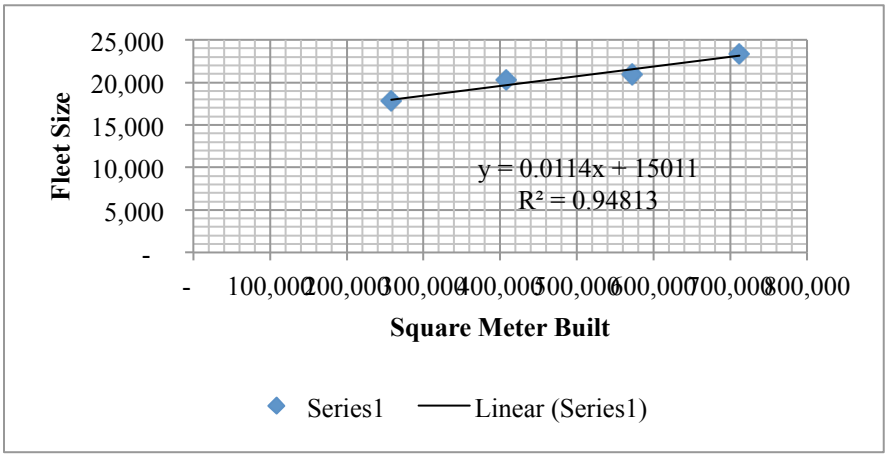


Figure-18: Regression Analysis: Fleet Size vs. GDP

Results for Linear Regression Analysis

Three of the four economic variables are related to fleet size. These are: population, GDP, and CPI (See Table 23).

Table 23: Regression Analysis Results

Dependent Variable	Independent Variable	Correlation Coefficient	Conclusion
Freight vehicle population	Population in Panama City	0.90	Strong Correlation

	GDP	0.79	Modest Correlation
	Consumer Price Index (CPI)	0.88	Modest Correlation
	Square meter built	Not enough data	Results not valid

The variables that could be considered as possible forecast models are all three, due to their acceptable correlation level with fleet size.

Multi-Regression Analysis

After the individual analysis, all variables considered to be acceptable were used in a multi-regression analysis. This would allow creating a correlation analysis of all economic variables versus fleet size. If the value of the correlation resulted to be favorable, then this model could be used as a forecast tool. The software used to compute this analysis was Excel.

Results show that combining all four variables: freight vehicle population vs. (Consumer Price Index, GDP and Population) the correlation coefficient is 0.95 (Table 24), which means that 95% of the variation on fleet size is due to CPI, GDP and population. Nevertheless, in order to validate if this model is applicable it is necessary to evaluate other statistic parameters.

Table 24: Multi-Regression analysis results

y =	**α**	+	**bx_1**	+	**bx_2**	+	**bx_3**
Fleet Size	α	+	b.CPI	+	b.Population	+	b.GDP
y =	-48098.749	+	60.792 CPI	+	0.0555 Population	+	-0.0006 GDP
P-value	--		0.281		**0.103**		0.263
S.E.	--		48.9		**0.026**		0.0004
R_2	**0.953**						

P-value shows how confident a correlation between variables can be. By subtracting the P-value from a 100% it determines how much an economic variable is having an effect over the fleet size. Analyzing all P-values for all three variables, it can be noticed that population has the lowest value, it means there are 90% of possibilities that population has in deed an effect on fleet size. Still, for the other two variables the P-value is larger: CPI has 72%, while GDP has 74%, which is not a very significant effect over fleet size.

S.E. (Standard Error) is the estimate of the variability of data. It is recommendable that S.E. should be no larger than 0.05. Analyzing all variables, population and GPD have the least variability, while the value for CPI is quite large.

If the results of all variables for both parameters (P-value and S.E.) are compared, population results to be the only variable to be significant enough to have more effect on fleet size than the other two. Though the P-value is quite large with 90%, this value can be compensated with the small variability obtained in the analysis (S.E. = 0.03). CPI has high variability and not a significant effect on fleet size. And GDP though its variability is small, its effect on fleet is not significant enough in order to be consider.

It can be concluded that Population is the only variable significant enough for the model. Therefore, the multi-regression analysis was rejected and the forecast model was based solely in the relationship between population and fleet size.

Fleet Size Forecast Model for Panama City

After concluding that population is the variable that has the largest effect on fleet size. The relationship used to establish the model was obtained from the Linear Regression Analysis: Fleet size vs. Population. Therefore, the model to forecast the fleet size of Panama City is:

Fleet Size = (0.0429) Population – 31,117.15

The forecast was computed for the years 2010 - 2015 by using the Excel Business Spreadsheets. The results of this forecast are presented in Table 25. The year 2010 was estimated because this value was not available by the Government.

Table 25: Fleet Size forecast for Panama City (2010-2015)

Year	Population	Fleet Size
2002	1,082,540	15,347
2003	1,105,756	16,343
2004	1,128,972	17,340
2005	1,152,187	18,336
2006	1,175,404	19,333
2007	1,198,620	20,329
2008	1,221,836	21,326
2009	1,245,052	22,322
2010	1,268,268	23,319
2011	1,291,484	24,315
2012	1,314,700	25,312
2013	1,337,916	26,308
2014	1,361,132	27,305
2015	1,384,348	28,301

The forecast shows that by the year 2015, there will be approximately a growth of 27% in the fleet size of Panama City, which represents an increase of approximately 6,000 urban freight vehicles in Panama City. These vehicles represent those which are officially registered in the Districts of Panama and San Miguelito Vehicle Registration Office, therefore vehicles registered in other provinces that still move within the City are not considered within this study.

Another additional analysis is to determine the number of urban freight vehicles per county. This will allow identifying the number of freight vehicles coming in and out of each region and recognize those regions which drive the highest number of vehicles. The primary objective is to recognize the areas where Panama City has the most probability of congestion by urban freight; this analysis will be explained in more detailed in section: Panama Road Network for Urban Freight.

For the allocation of the total number of vehicles per year throughout the counties, this study considered the results obtained by the forecast model. The economic variable population was used to estimate the distribution of vehicles per county.

The distribution of vehicles per county was estimated by multiplying the total fleet size obtained from the forecast with the factor of population distribution. The population factor was defined as the population per county divided by the total population in the country. This vehicle distribution per county was computed from 2010 to 2015 (See Table 26).

Table 26: Forecast of Freight Vehicle Population for years 2010-2015

County / Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
District of Panama	**731,633**	**747,926**	**764,219**	**780,512**	**796,805**	**813,097**	**829,391**	**845,684**	**861,977**	**878,270**	**894,565**	**910,856**	**927,149**	**943,442**	**959,735**	**976,027**
San Felipe	7,139	6,861	6,600	6,366	6,146	5,950	5,768	5,586	5,404	5,222	5,040	4,892	4,744	4,596	4,448	4,300
El Chorrillo	23,414	23,675	23,942	24,214	24,492	24,775	25,079	25,382	25,689	25,991	26,295	26,638	26,981	27,324	27,667	28,010
Santa Ana	21,777	21,605	21,448	21,302	21,169	21,068	20,967	20,866	20,765	20,664	20,563	20,491	20,419	20,346	20,274	20,202
Calidonia	20,313	20,236	20,155	20,071	19,984	19,893	19,826	19,759	19,691	19,624	19,557	19,504	19,451	19,399	19,346	19,293
Curundú	19,722	19,917	20,102	20,281	20,455	20,613	20,863	21,113	21,363	21,613	21,863	22,151	22,440	22,728	23,017	23,305
Betania	45,537	45,594	45,664	45,738	45,817	45,915	46,069	46,223	46,376	46,530	46,684	47,044	47,404	47,765	48,125	48,485
Bella Vista	29,223	29,776	30,287	30,774	31,253	31,726	32,309	32,892	33,475	34,058	34,641	35,356	36,071	36,787	37,502	38,217
Pueblo Nuevo	18,711	18,691	18,672	18,630	18,561	18,484	18,431	18,378	18,324	18,271	18,218	18,152	18,086	18,020	17,954	17,888
San Francisco	36,785	37,098	37,422	37,751	38,092	38,451	38,948	39,444	39,941	40,438	40,935	41,579	42,223	42,867	43,511	44,155
Parque Lefebre	38,230	38,540	38,818	39,092	39,368	39,643	40,251	40,860	41,468	42,077	42,685	43,561	44,437	45,313	46,189	47,065
Rio Abajo	29,577	29,597	29,626	29,657	29,692	29,728	29,853	29,979	30,104	30,230	30,355	30,568	30,781	30,993	31,206	31,419
Juan Diaz	91,111	92,846	94,563	96,285	97,983	99,639	101,354	103,069	104,783	106,498	108,213	110,015	111,817	113,618	115,420	117,222
Pedregal	47,578	48,242	48,883	49,535	50,142	50,689	51,403	52,117	52,831	53,545	54,259	55,109	55,959	56,809	57,659	58,509
Ancón	11,479	11,570	11,668	11,768	11,877	11,993	12,150	12,306	12,463	12,619	12,776	12,968	13,160	13,352	13,544	13,736
Chilibre	41,778	43,733	45,378	46,857	48,234	49,343	50,872	52,401	53,929	55,458	56,987	58,346	59,705	61,063	62,422	63,781
Las Cumbres	95,640	99,029	102,356	105,720	109,180	112,710	116,087	119,463	122,841	126,217	129,595	133,335	137,075	140,820	144,560	148,301
Pacora	21,751	23,334	24,969	26,593	28,160	29,817	31,243	32,668	34,092	35,514	36,933	37,748	38,562	39,373	40,182	40,989
San Martín	3,672	3,793	3,911	4,026	4,142	4,239	4,346	4,454	4,561	4,669	4,776	4,884	4,992	5,099	5,207	5,315
Tocumen	52,269	53,885	55,508	57,146	58,740	60,327	62,088	63,848	65,609	67,369	69,130	70,860	72,590	74,319	76,049	77,779
Las Mañanitas	33,922	35,700	37,738	39,911	42,247	44,767	46,165	47,564	48,962	50,361	51,759	53,225	54,691	56,157	57,623	59,089
24 de Diciembre	42,005	44,204	46,509	48,795	51,071	53,327	55,319	57,312	59,306	61,302	63,301	64,430	65,561	66,694	67,830	68,967
District of San Miguelito	**304,475**	**311,398**	**318,321**	**325,244**	**332,167**	**339,090**	**346,013**	**352,936**	**359,859**	**366,782**	**373,703**	**380,628**	**387,551**	**394,474**	**401,397**	**408,321**
Amelia Denis de Icaza	39,929	40,569	41,211	41,852	42,493	43,133	43,774	44,415	45,055	45,696	46,337	46,978	47,620	48,261	48,902	49,543
Belisario Porras	51,625	51,902	52,175	52,451	52,722	52,998	53,271	53,548	53,824	54,097	54,371	54,646	54,918	55,192	55,465	55,740
José Domingo Espinar	36,587	37,102	37,617	38,132	38,647	39,163	39,678	40,193	40,709	41,223	41,739	42,254	42,771	43,286	43,802	44,318
Mateo Iturralde	13,066	12,936	12,808	12,678	12,548	12,419	12,290	12,160	12,030	11,902	11,772	11,643	11,514	11,384	11,254	11,125
Victoriano Lorenzo	17,961	17,976	17,992	18,006	18,022	18,037	18,053	18,067	18,082	18,098	18,113	18,128	18,143	18,159	18,174	18,189
Arnulfo Arias	31,618	34,169	36,719	39,270	41,822	44,372	46,923	49,474	52,024	54,575	57,125	59,676	62,226	64,777	67,328	69,878
Belisario Frias	48,504	50,880	53,257	55,634	58,011	60,388	62,765	65,141	67,518	69,895	72,271	74,648	77,025	79,402	81,778	84,156
Omar Torrijos	39,026	38,437	37,848	37,259	36,671	36,082	35,493	34,904	34,315	33,726	33,137	32,548	31,959	31,370	30,782	30,192
Rufina Alfaro	26,159	27,427	28,694	29,962	31,231	32,498	33,766	35,034	36,302	37,570	38,838	40,107	41,375	42,643	43,912	45,180

B. URBAN FREIGHT NETWORK

Panama City Urban Freight Road Network was plotted to set the bases for modeling urban freight in Panama City. The network was established by placing nodes on the most important intersections between the longitudinal, transverse and highways (Figure-19).

The objectives of the road network analysis are: to validate the results shown in the forecast model by evaluating the flow of vehicles moving through each node and also, to verify if the nodes with the highest level of fleet size coincide with the areas where supermarkets and distributors are located.

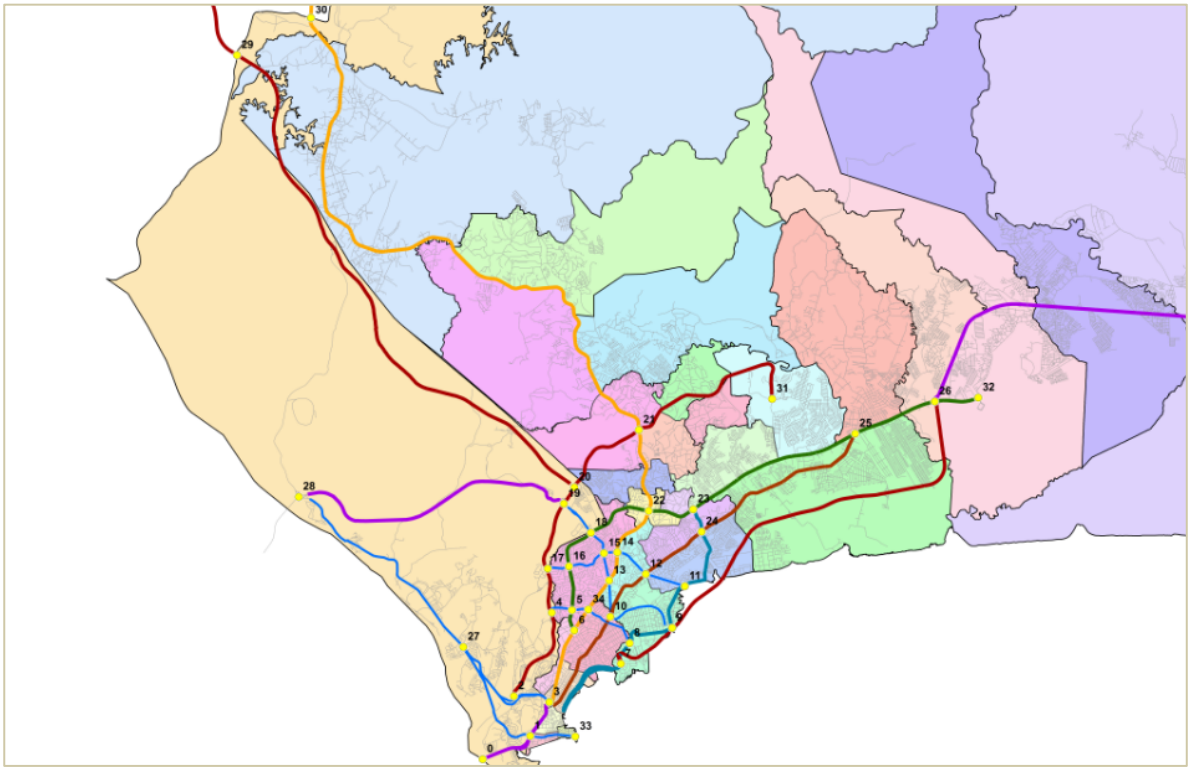


Figure 19: Road Network of Panama City for Urban Freight

Figure-20 presents the Panama City roadway infrastructure in a network diagram. Panama City sources are represented by the yellow nodes. All other nodes colored blue represent the primary intersections, and the links are the distances between intersections and sources. It is important to mention that this network diagram is not based on real road distances or actual node location.

Both networks were used in order to determine the trend of growth of fleet size in Panama City. This trend was obtained by comparing to scenarios: Tactical and Strategic. The growth of fleet size is assumed to be the growth in number of vehicles moving through nodes in the network.

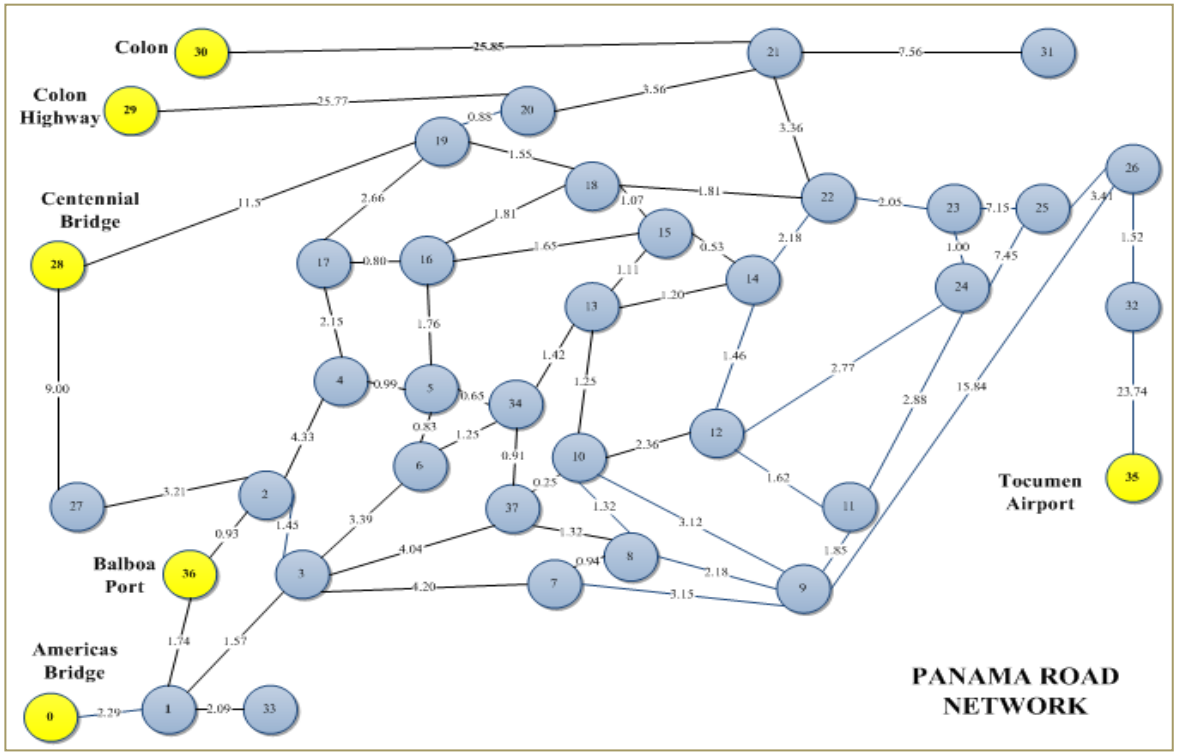


Figure 20: Road Network of Panama City for Urban Freight

C. TACTICAL AND STRATEGIC ANALYSIS

The **Tactical Analysis** objective is to infer on the fleet size moving on Panama City Road Network. This analysis was based on the largest distributors and supermarkets located in Panama City. Distributors were considered to be sources (freight generators) and sinks, supermarkets (freight receivers). It was assumed that all distributors provide products to all supermarkets. There were in total three distributors and 60 supermarkets considered.

The reason why supermarkets and distributors were selected for this analysis is due to the fact that the population in Panama (as it was presented in the Descriptive Assessment, Commodities) has the largest level of expenditure on food and beverages, which are the main products the Distribution & Supermarkets handle.

Previously, a TSP (Traveling salesman problem) was considered, but after the application of the urban freight survey, distributors mentioned that the delivery of products to large customers

is usually done by full truck loads (TL), rather than by less than truck loads (LTL). Therefore, shortest path problem (SPP) is more applicable to TL, where the business looks to deliver their products at the shortest lead time possible and returns to the depot, rather than TSP (Traveling Salesman Problem) where it is used for multi-stop analysis, because the supplier delivers to different customers by using one truck and then goes back to the depot.

The Tactical analysis is oriented towards the frequency of times a truck passes through a node. It assumes that for each delivery, a freight vehicle exits the distribution center, delivers to the supermarket, and returns to the distribution center.

Shortest paths were generated to determine the frequency of visits to each node. A visit is all nodes a vehicle passes in the shortest path in order to arrive to its destination. The SPP was based on the Bellman-Ford Algorithm and generated by the tool WinQSB, There were in total 120 shortest path generated.

A Pareto Analysis allowed identifying which nodes had the most amounts of visits. Figure-21 presents these nodes in blue. The figure shows that nodes with the highest level of visits are those located in the center of the city, primarily in the district of Panama.

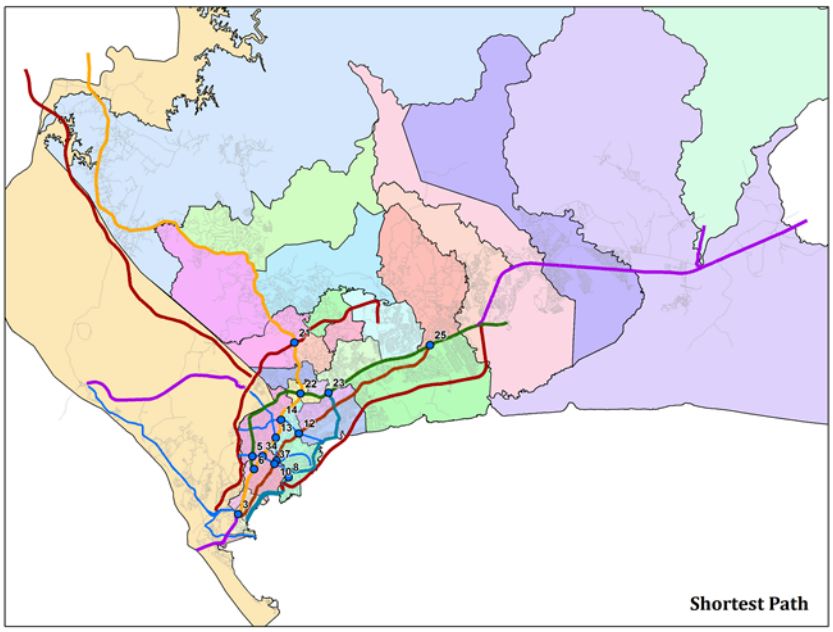


Figure 21: Most visited nodes by commercial business

The **Strategic Analysis** objective provides insights on the fleet size growth. This analysis uses the estimation per county (shown in the Forecast Model Section) as input in order to assign proportionally the amount of vehicles to each of the nodes in the network. This estimation per node was computed from the years 2002 to 2015 (See Table 27).

The estimation per node was estimated by identifying the county where each node was located and assigning the forecasted fleet size. It is assumed that if a county has two or more nodes, the fleet size of the county will be divided equally to all nodes. This is due to the fact that it was difficult to find estimates on vehicle count that could provide an estimated percentage of vehicle passage on each node.

Counties with no nodes assigned, were not considered in the analysis and it is assumed that their assigned fleet size do not move regularly through the main infrastructure network of Panama City.

Table 27: Estimation of freight vehicles per node for the years 2002 - 2015

Nodes/Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0	14	15	16	16	17	18	19	19	20	21	22	22	23	24
1	507	530	556	579	603	626	649	671	694	716	739	761	782	803
2	14	15	16	16	17	18	19	19	20	21	22	22	23	24
3	453	469	486	501	517	531	544	557	570	582	594	605	616	625
4	14	15	16	16	17	18	19	19	20	21	22	22	23	24
5	153	161	169	176	184	191	199	207	214	222	230	239	247	255
6	357	376	396	414	433	452	471	490	509	529	549	568	588	608
7	107	112	118	123	129	134	140	145	151	157	163	169	175	181
8	178	188	198	207	217	227	238	247	257	268	279	290	301	311
9	107	112	118	123	129	134	140	145	151	157	163	169	175	181
10	245	257	269	281	293	305	318	329	341	354	366	379	391	403
11	290	305	319	333	350	365	381	397	413	431	448	466	484	502
12	250	262	274	285	297	309	322	334	346	360	373	387	400	413
13	148	154	160	166	171	176	182	187	192	197	202	207	211	216
14	148	154	160	166	171	176	182	187	192	197	202	207	211	216
15	81	85	88	92	95	98	102	105	108	111	115	118	121	124
16	81	85	88	92	95	98	102	105	108	111	115	118	121	124
17	95	100	104	108	112	116	120	124	127	132	136	140	144	148
18	95	100	104	108	112	116	120	124	127	132	136	140	144	148
19	14	15	16	16	17	18	19	19	20	21	22	22	23	24
20	14	15	16	16	17	18	19	19	20	21	22	22	23	24
21	1293	1374	1455	1537	1617	1697	1778	1859	1939	2019	2099	2179	2259	2339
22	256	267	277	288	297	307	316	325	334	342	350	358	365	372
23	927	972	1016	1059	1102	1144	1184	1225	1265	1304	1343	1381	1418	1457
24	395	413	431	448	467	486	505	523	542	562	582	603	622	643
25	1365	1445	1524	1600	1680	1759	1838	1915	1993	2074	2155	2236	2315	2396
26	799	872	950	1034	1101	1168	1237	1306	1376	1448	1519	1593	1665	1739
27	14	15	16	16	17	18	19	19	20	21	22	22	23	24
28	14	15	16	16	17	18	19	19	20	21	22	22	23	24
31	407	443	480	518	556	595	634	674	715	756	797	839	881	924
32	263	282	301	321	341	361	382	403	424	445	466	488	509	531
33	94	95	95	95	95	95	95	94	93	93	92	91	90	88
34	153	161	169	176	184	191	199	207	214	222	230	239	247	255
35	354	394	433	475	514	555	596	637	680	711	743	775	807	838
36	14	15	16	16	17	18	19	19	20	21	22	22	23	24
37	72	76	81	85	89	93	98	102	107	111	116	121	126	131
38	671	712	753	793	834	875	915	955	995	1036	1077	1118	1158	1199
39	263	282	301	321	341	361	382	403	424	445	466	488	509	531

Nodes with largest fleet size where determined by a Pareto Analysis, it will be assumed that the larger the fleet size, the greater the movement of vehicles through each node. This analysis was only considered for the years 2011 and 2015, in order to compare the present and future, and provide insights on the trends of growth of fleet size in Panama City.

Figure-22 presents the most visited nodes for year 2011. The figure shows that most of the nodes are concentrated on the outsides of the City, rather than the Center.

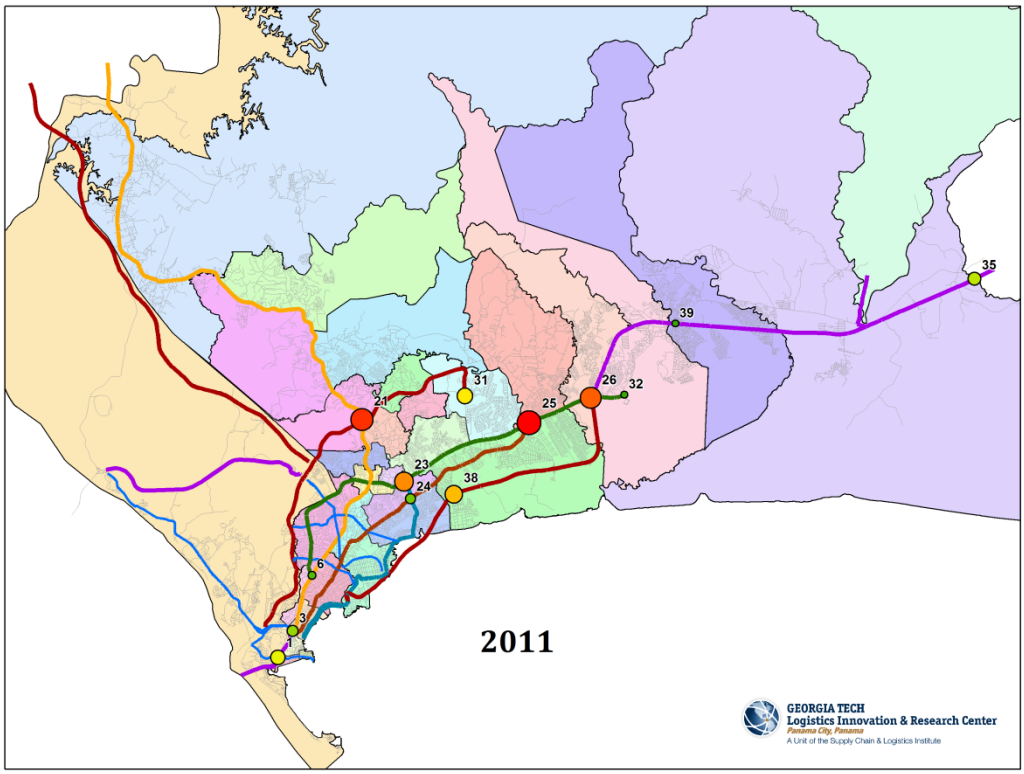


Figure 22: Most visited nodes for year 2011

The comparison between the Tactical and Strategic analysis infer on the current behavior of freight vehicles in the City. The most visited nodes for the Strategic were located in the outsides of the city (towards the East). The Tactical shows that the most visited nodes are located within the center of the center (to the Westside of Panama City).

Both scenarios describe the present; freight vehicles are indeed located into the center because the center is still the primary area of economic activity in Panama City, and also commerce is moving towards the outsides because population is indeed doing so.

An article from the newspaper Capital mentioned that real estate agents are finding more and more difficult to build urban areas in the center of the city due to the lack of available space,

and have decided to build apartment buildings rather than houses. It is believed that population has expanded towards the East of the city looking for a larger residential area and more accessible prices than those offered in the center. For high income population it is believed that there are attracted to the East side due to its close proximity to the Corredor Sur and the Airport of Tocumen[46].

After 2002, ten new supermarkets have opened throughout Panama City: nine of them were in the outsides of the City, while one of them in the Center. The supermarket in the center closed shortly after been opened due to the lack of sales. This allows implying that the commerce is expanding to the East at a slower pace than population, waiting for the market to build itself before establishing their operations in those areas.

The Strategic analysis was complemented by showing the most visited nodes for year 2015 (Figure-23). The figure shows that still the population will continue to grow to the outsides of Panama City. This trend of the fleet size growth to those areas allows creating awareness to the government on the potential areas for urban planning, and identifying infrastructure needs.

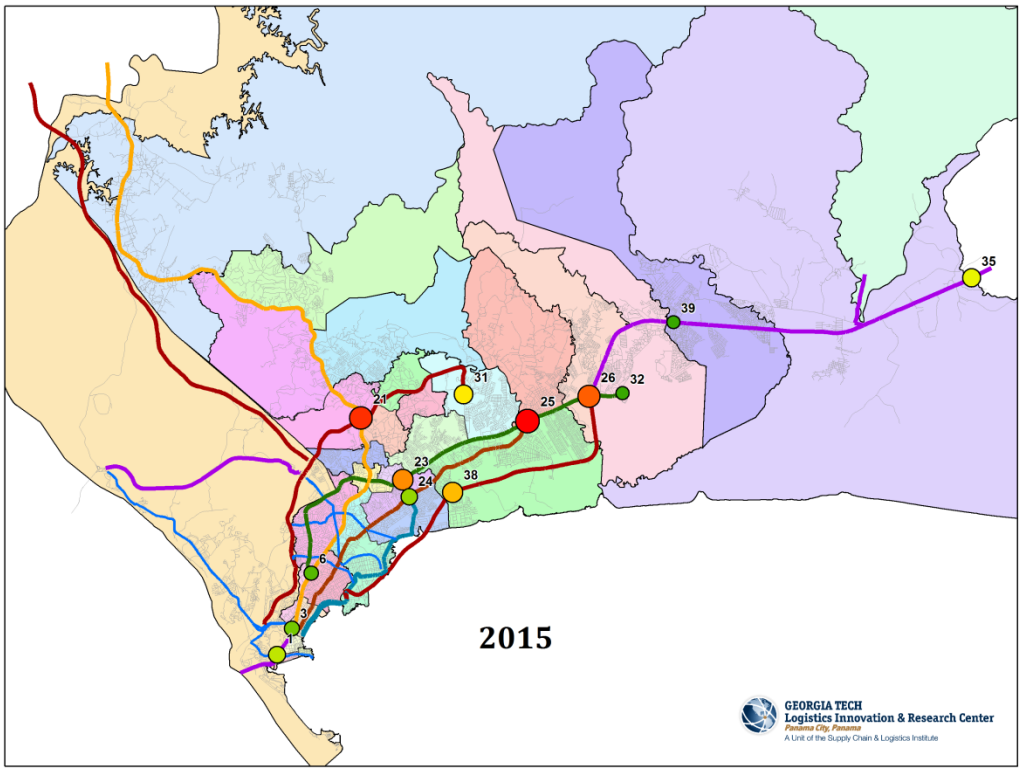


Figure-23: Trend of fleet size growth for year 2015

[46] Gonzalez, Ricardo (2010). *High end houses at the East and West side of Panama City*. Capital Newspaper. Extracted from: http://www.capital.com.pa/?p=825

VI. CONCLUSIONS

As it is mentioned throughout each section, data availability was one of the greatest limitations during the project. Private companies were quite resilient in providing information on their trip information, even though it was requested in a non-specific manner. Government institutions proven to be difficult to contact as well, data availability was scarce and in order to request information, it was necessary to follow a petition process which ultimately resulted in postponement or lack of response. The Georgia Tech Logistic and Innovation Center in Panama informed to this research group that this issue was mentioned at the Logistic Council, and hopefully data availability will be greater for other projects in the future.

This study has allowed demonstrating that fleet size is strongly driven by the population growth in Panama City. This study considers fleet as an indicator of the of freight vehicles moving in and out of a specific area.

As the population spreads to other regions, commercial business will identify a potential market and establish their operations in these zones. A proof of this, is the trend of the population moving from the center to the outside of the City, though commercial activity has yet to be fully developed in those areas, as the population grows and demands more consumption of goods, business activity and so, the number of freight vehicles will increase.

. Currently, the government does not consider urban freight for urban planning projects and there is no official law on urban freight movements. Still, there is a private company in the process of proposing this law to the Ground Transit and Transport Authority, which shows that urban freight is beginning to be considered as a potential important issue for our country.

VII. RECOMMENDATIONS

The Descriptive Assessment would be a valuable reference for a Company that wishes to establish their operations in Panama City. This document provides a general view for the different perspectives of Panama City's Network, allowing the company to access information on: the potential sources for importing or exporting freight into or out the city, the road infrastructure, the laws to which abide to, etc.

As it was mentioned previously, the Urban Freight survey can be used as a tool for collecting urban freight data, in order to compare industries by using freight transport indicators

such as: distance per delivery, empty running, percentage of volume delivered across the week, among others.

The Strategic and Tactical Analysis would enable the government to identify areas with largest freight flows and use this information as input for urban planning decisions. The Strategic Analysis provides insights on the location for potential infrastructure needs, while the Tactical shows the locations where infrastructure should be evaluated for urban freight capacity.

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IX. APPENDIX

Appendix A

METHODOLOGY
URBAN FREIGHT SURVEY

The design of this survey is based on different models published by the Engineering and Physical Science Research Council as part of the University of Westminster's contribution to the Green Logistics project, and by Transport for London as part of the London Freight Data and Knowledge Centre in November 2008.

The purpose of this survey is to provide information about total goods vehicle trips to/from particular establishments, and variation by time, day and month. This survey based on the Establishment Survey, which will provide data on vehicle types, time taken to load and unload cargo, number of stops, origin and destination of vehicle trips. The proposed methods to apply this survey is primarily face to face, then by telephone and lastly, by e-mail.

URBAN FREIGHT SURVEY FORMAT AND OBJECTIVES

SURVEY: URBAN FREIGHT IN DISTRICTS OF PANAMA AND SAN MIGUELITO

1. SECTION I: GENERAL INFORMATION

1.1. How long has your company been in business?
- 1.1.1. 0-5 years
- 1.1.2. 6-10 years
- 1.1.3. 11-15 years
- 1.1.4. 16-20 years
- 1.1.5. > 26 years

1.2. To what sector does your company belong to?
- 1.2.1. Industrial Sector
- 1.2.2. Commercial Sector
- 1.2.3. Agriculture Sector
- 1.2.4. Service Sector

1.3. N How many distribution centers does your company have? _____

1.4. Please provide the location of each your company's distribution centers (DC) within the San Miguelito and Panama Districts:
- 1.4.1. Municipal District:

1.4.2. Street:
1.4.3. Municipal District:
1.4.4. Street:
1.4.5. Municipal District:
1.4.6. Street:
1.4.7. Municipal District:
1.4.8. Street:

1.1 – 1.4. Question Objective:
This section has the purpose of obtaining general information regarding the company's commercial activities and location.

2. SECTION II: OUTBOUND

2.1. How many TRUCK-deliveries are made per day by each DC:
2.1.1. DC _____ : _____
2.1.2. DC _____ : _____
2.1.3. DC _____ : _____
2.1.4. DC _____ : _____

2.2. How long does it take to load a truck at the DC before making a delivery?
2.2.1. 0-10 min
2.2.2. 10-20 min
2.2.3. 20-30 min
2.2.4. 30-40 min
2.2.5. 40-50 min
2.2.6. 50-60 min
2.2.7. >60 min

2.3. How long does a truck take at each stop when delivering?
2.3.1. 0-10 min
2.3.2. 10-20 min
2.3.3. 20-30 min
2.3.4. 30-40 min
2.3.5. 40-50 min
2.3.6. 50-60 min
2.3.7. >60 min

2.4. How much time does it take for truck to travel to each stop when delivering?
2.4.1. 0-10 min
2.4.2. 10-20 min
2.4.3. 20-30 min
2.4.4. 30-40 min
2.4.5. 40-50 min
2.4.6. 50-60 min
2.4.7. >60 min

2.5. What is the total time of a ROUND-TRIP delivery? (In hours)
2.5.1. Minimum
2.5.2. Average
2.5.3. Maximum

2.1 – 2.5. Question Objective:

Questions 2.1, 2.2, 2.3 and 2.4 allow obtaining estimations of load, travel and unload times when delivering to customers. Question 2.5 is a control question in order to verify the given answers from 2.1 to 2.4.

All these questions will provide answers to estimate descriptive patterns of the companies' deliveries. For example, by using the average number of deliveries it will allow to infer on the total time it takes to complete a tour.

2.6. How far away are customers from each other when making deliveries?

2.6.1. <500 m
2.6.2. 500 m – 1 km
2.6.3. 1 – 5 km
2.6.4. 5 – 10 km
2.6.5. >10 km

2.6 Question Objective:

Estimate distances to delivery points. It could be also possible to estimate the total amount of kilometers per tour by using the total number of customers served per trip.

2.7. How many miles, on average, will trucks have by the end of each week?

_____ miles

2.7 Question Objective:

Validate question 2.6 and also estimate the average distance per delivery.

2.8. In a typical week, how many deliveries are made to customers on the following days and times:

Days of the week	00:00 - 05:59	06:00 - 08:59	09:00 - 11:59	12:00 - 17:59	18:00 - 23:59
MONDAY					
TUESDAY					
WEDNESDAY					
THURSDAY					
FRIDAY					
SATURDAY					
SUNDAY					
Deliveries are accepted on all days					

2.8 Question Objective:

Estimate the behavior of deliveries to customers. It will allow the identification of loading and delivery behavior on given days and time periods.

2.9. What impact you believe a proposed restriction of delivering solely at nights and weekends will have on your inbound/outbound operations?

2.9.1. * It will cause serious inconvenience
2.9.2. * It will cause moderate inconvenience
2.9.3. * It will not be a problem
2.9.4. * I do not know

2.9 Question Objective:

Capture the perception of companies regarding their views on new regulations. This regulation has not yet been implemented but has been evaluated by the government.

2.10. Please provide fleet detail

2.10.1. Fleet size:

2.10.1.1. Own fleet

2.10.1.2. Contracted fleet

2.10.2. Maximum Gross Weight Band (type of vehicle and number of trucks)

2.10.2.1. Small Vans

2.10.2.2. 2 axles < 7.5 tonnes

2.10.2.3. 2 axles 7.5 to 17 tonnes

2.10.2.4. 3 axles (rigid) 17 to 25 tonnes

2.10.2.5. 4 axles (rigid) 25 to 33 tonnes

2.10.2.6. 3 or 4 axles (articulated) up to 33 tonnes

2.10.2.7. 5 or more axles (articulated) over 33 tonnes

2.10 Question Objective:

Describe the company's fleet characteristics.

2.11. Do you deliver mainly … Provide Cube (Avg. Cube) and/or Weight (Avg. Weight)

2.11.1. …full vehicle loads

2.11.2. …partial vehicle loads

2.11 Question Objective:

Estimate the cube and/or weight of deliveries.

2.12. Your deliveries are multi-drop or dedicated trip? (In % of deliveries or Avg. of Customers)

2.12.1. Multi-drop _____ %

2.12.2. Dedicated trip _____ %

2.12 Question Objective:

Validate questions 2.1 thru 2.5 and complement question 2.10 by providing delivery characteristics.

2.13. Type of distribution:

2.13.1. Deliveries are made from a single DC to customers

2.13.2. Deliveries are made from several DCs' to customers

2.13.3. One main DC delivers, but also your suppliers deliver direct to customers

2.13 Question Objective:

Validate questions 2.1 through 2.5 and provide delivery characteristics.

2.14. How many deliveries are made to this zones per day:

Sector	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
24 de diciembre							
Las Cumbres							
Parque Lefevre							
Betania							
Pacora							
Juan Díaz							
Bella Vista							
Belisario Frias							
Rufina Alfaro							
Belisario Porras							
José Domingo Espinar							
Please add other areas							

2.14 Question Objective:

This question will provide the distribution patterns of the companies' deliveries in the district of Panama and San Miguelito.

SECTION III: INBOUND

2.15. In a typical week, how many RECEPTIONS are made at the DC on the following days and times:

DAYS	00:00 - 05:59	06:00 - 08:59	09:00 - 11:59	12:00 - 17:59	18:00 - 23:59
MONDAY					
TUESDAY					
WEDNESDAY					
THURSDAY					
FRIDAY					
SATURDAY					
SUNDAY					
Receptions accepted on all days					

3.1 Question Objective:

Understand the behavior of RECEPTIONS to the companies' DCs. It will allow the identification of unloading and receiving behavior on given days and time periods.

2.16. Do you receive mainly … Volume (Avg.) and/or Weight (Avg.)

2.16.1. Full vehicle loads

2.16.2. Partial vehicle loads

3.2 Question Objective:

Estimate the cube and/or weight of receptions.

2.17. Do you receive products from…?

2.17.1. A single supplier's DC
2.17.2. Several DC's from one same supplier
2.17.3. One main DC, but also from other suppliers

3.3 Question Objective:

This question will determine if a company DC's serve each other or if they are served by other suppliers.

2.18. Which of the following factors significantly and ultimately affect deliveries at your customers?

2.18.1. …Some of your suppliers will only deliver on certain days
2.18.2. …Your supplier decides on delivery date, and you have no control on them
2.18.3. …Your supplier will not deliver earlier or later than a certain time of day
2.18.4. …Lack of loading bay space which causes illegal parking
2.18.5. …Other factors you think are important which affect goods reception arrangements, and so affect your customer service
2.18.6. ….Please specify _____

3.4 Question Objective:

This question will allow identifying if companies have any exterior factors that affect their deliveries to customers.