GT-Panama Thesis Series

DISCLAIMER

Assessment of Panama as an IFRC Regional Humanitarian Logistics Hub

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EXECUTIVE SUMMARY

This Capstone Project, Assessment of Panama as a Regional Humanitarian Logistics Hub, focused in to help the Humanitarian Organizations with presence in the Panama to understand their operations in the Region.

The first step to accomplish this goal was understand the demand, to achieve this we gather historic data (1900 to 2010) for the Latin America and Caribbean Region from the Centre for Research on the Epidemiology of Disasters Database, data collected included the number of events and affected people for natural disasters such as Volcanoes, Earthquakes, Mass Movements, Droughts and Storms. After analyzing the data, we concluded that only data from 1966 to 2010 would be considered, due to the fact of low event registration in the beginning of the twenty century and a notable increase trend after 1965. Subsequently, we analyzed the data from 1966 to 2010, evaluating several forecasting models; double exponential smoothing was selected as our model and was applied to the data. Prior to this, the data was divided in sub-regions to evaluate the demand in a scenario that will lead to better response time. Our forecast predict that the designated regions, The Caribbean, Central America, South America and Southern Cone, will handle 26%, 26%, 37% and 11% respectively of the demand for 2011.

Our next step consisted on design a network for the four sub-regions. This was done applying the Factor Rating Method; several factors were considered on this phase, such as the Logistics Performance Index, the Lead Time to resupply those countries, the Enabling Trade Index and the World Risk Index of Vulnerability. After applying this technique to all the countries in the Sub Regions, the results were as follows, for Central America, the warehouse should be located in Panama; for the Caribbean, should be located on Dominican Republic; for South America, Ecuador and for the Southern Cone, Chile.

Afterwards, we decided to evaluate the Regional division, this was done compiling the transit time and air freight cost of from the each warehouse to the Southern Cone, South America and Central America Cities. Subsequently, we decided to change some

countries of their assigned regions, testing a three warehouse scenario. Colombia was moved to Central America, Venezuela was moved to the Caribbean and the remaining countries in South America were merged with the Southern Cone. The outcome was evaluated in Demand and Network Configuration; the results of the one region of the forecast were more variable that in the previous setting, the network show two warehouses overcharged, due to this, we decided to maintain the four warehouse strategy over the one with three warehouses.

The last part of the project was to conduct an analysis of Panama as a Humanitarian Hub, where we evaluated Panama versus Costa Rica from the Factor Rating results, for Central America. In that analysis Panama and Costa Rica where tied, so we used the Global Competiveness Report for 2010-2011 as well as the Logistics Performance Index for 2010 to make a comparison among this two countries. Despite they are neighboring countries Costa Rica in the future could become a rival for Panama as a Hub. Therefore Panama has been making strong investments to assure and strengthen their position as the Hub for the Americas.

ACKNOWLEDGMENT

This Capstone project would not have been possible without the sponsorship of SENACYT, the National Secretariat of Science and Innovation of the Republic of Panama, who deposited their faith in logistics as an area that would help transform the country.

It is a pleasure to thank those who made this project possible such as our families who gave us the moral support we needed during the research. We want to make a special recognition to our project advisor Dr. Ozlem Ergum from GT, who guided us through this exiting journey of Humanitarian Logistics, even though been overseas dedicated time to visit Panama.

We also would like to make a special reference to the International Federation of the Red Cross and their Pan-American Response Unit located in Panama for all their support, since without them we could not have gotten such relevant data.

Lastly, we offer regards and blessings to all of those who supported the completion of the project in the Georgia Tech Research and Innovation Center in Panama.

INTRODUCTION SECTION

BACKGROUND

Region: Latin America and the Caribbean (LAC)

The region consists of 44 countries and approximately 580 million people. Even though the region is widely known for its richness in culture and resources, unfortunately it is the worst region in the world in terms of wealth distribution inequity and has the highest homicide rate. Currently, about 50% of the wealth is controlled by 10% of the population and 38% of the population has experienced crime-related violence.

The LAC region is the second most prone region in the world to extreme flooding, landslides, earthquakes and droughts. About 30% of the population lives in disaster prone areas. On average, the natural-disaster occurrence rate in the region has grown 5% annually over the last three decades, and climate-related risks will continue increasing the impact of natural disasters on the most vulnerable populations. While Caribbean nations such as Dominican Republic and Haiti are susceptible to flooding and hurricanes, one third of Latin America faces increasing desertification and potential drought. More than 70% of the land in Argentina and Mexico is dry-land, and in Bolivia and Peru, the majority of the population lives in dry-lands. (UNDP, May 2008)

Approximately, 90 to 100 natural disasters occur in LAC per year and a majority of them are small to mid-scale and are caused by heavy rain and subsequent floods and landslides. Of these, 80% are weather related. Six significant hurricanes and three major earthquakes have occurred in the region in the last three years.[1] In LAC the main natural hazards are droughts, hurricanes, cyclones, tropical storms, floods, tidal waves, avalanches, landslides and mudslides, earthquakes and volcanoes. Mining and oil spill represent the main human-caused disasters in the region. Problems of drought and food insecurity affected both Central and South America; national

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[1] http://ochaonline.un.org/ocha2011/field/field/field/rolac.html

emergencies of this nature were declared in Guatemala, Honduras, Ecuador, Argentina, Bolivia, Uruguay and Venezuela in 2009.
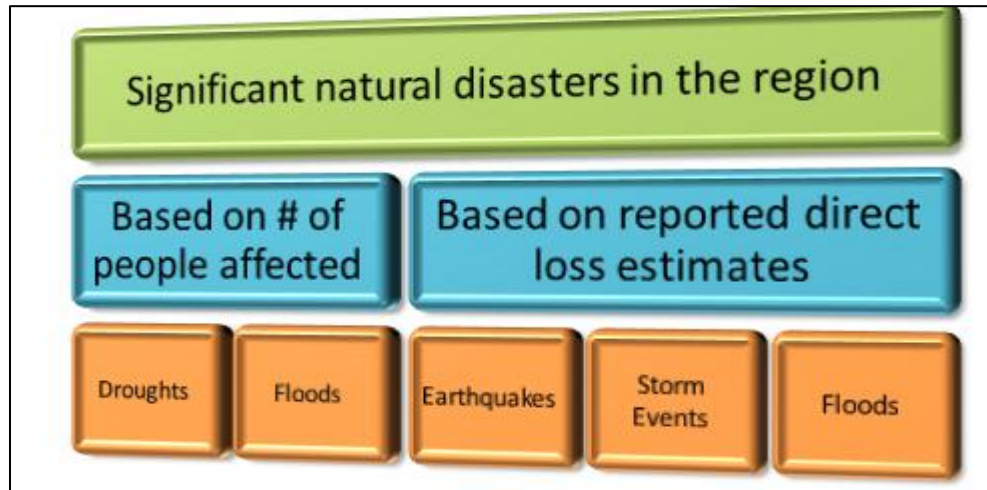
Figure 1: Natural Disasters in the region. (Andersen 2007)

Earthquakes are among the most costly natural hazards. In the past the region has suffered major earthquakes such as:

- Mexico 1985: $4 billion lost
- Colombia 1999: $2.9 billion lost
- El Salvador 2001: $2.8 billion lost
- Haiti 2010: $8 billion lost
- Chile 2010: $30 billion lost

From this list, two are considered mega-disasters due to their impact. On January 12, 2010, an earthquake with magnitude 7.0 struck southern Haiti, killing an estimated 230,000 people and affecting approximately 3 million others. Less than a month later, On February 27, 2010, an earthquake with magnitude 8.0 (the 5th largest ever recorded by the U.S. Geological Survey) occurred off the coast of Chile, affecting approximately 2 million people.

Storm events represent some of the largest reported natural catastrophe losses. The Caribbean is highly susceptible to hurricanes and tropical storms.

Central America and Mexico	Andean Region	Caribbean
• Floods • Earthquake • Volcanic eruptions	• Volcanic activities • Floods • Earthquake • Droughts	• Hurricanes • Floods

Figure 2: Most Common Disaster per Sub Region (Andersen, 2007)

In 2009, LAC registered 59 disasters, 53% relating to hydro-meteorological events such as storms, floods and landslides, much lower than in 2008 when 102 disasters were registered. In 2010, LAC registered 98 disasters, 81% related to hydro-meteorological events and the rest where volcanoes, earthquakes and tsunamis which caused the higher deaths based on a report of CEPAL (Economic Committee for Latin America and the Caribbean). For the first quarter of 2011, 4 of the 32 global natural disasters occurred in LAC. These four events affected some 318,000 people and generated economic losses of at least USD $500 million.
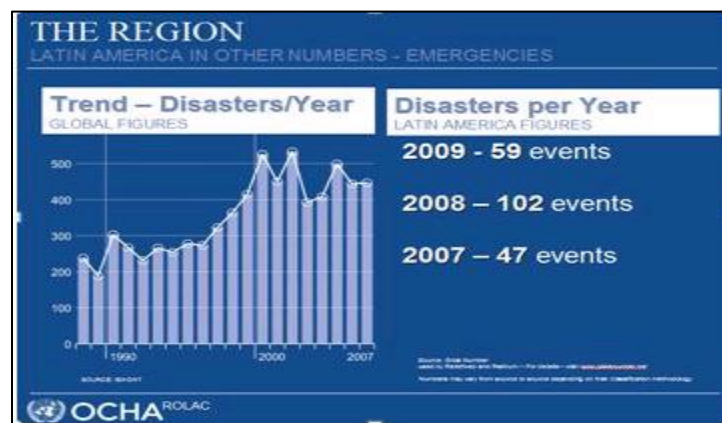
Figure 3: Number of disasters per year in LAC region taken from the OCHA-ROLAC website.

This demonstrates the vulnerability and the variability of disasters striking the region. One thing is very clear LAC needs to be prepared for future climatological changes. In

the 4th Evaluation Report 2007 of IPCC (Intergovernmental panel on climate change)was announced the following future climate changes: higher frequency of hot days and nights, more frequent heavy rains in the majority of regions, higher number of regions affected by the droughts, more intense tropical storms, and an increase in sea level. This means that more people will be affected by disasters in LAC.

MOTIVATION

This project aims to help Humanitarian Organizations to plan their procurement strategies, so they can be more efficient in their timeliness and cost, resulting on more people aided through the years. There are a large number of factors that can influence the number of affected people by a disaster such as the increase of events per year and poverty. For these reasons is very important to try to understand the demand of humanitarian assistance in the region.

This project will also help one of the Humanitarian Organization established in the country (IFRC) to expand their network through the LAC region, resulting on an increased timeliness of the operations.

PROJECT DESCRIPTION AND OBJECTIVES

This project aims to make an assessment of Panama as a humanitarian hub, creating visibility of the humanitarian world in the country. Visibility will be achieved through identifying the organizations already established in the country and how they operate here and from other countries in the word. This will allow us to identify areas of opportunities in services, compared to the Abu Dhabi International Humanitarian City which serves as a Hub for Europe, Africa and the Middle East.

A demand analysis will be conducted, resulting on a tool that will help create a forecast of affected people in the different regions of Latin America and the Caribbean. This would help any organization that operates in the Americas or wish to do so in the future, plan their prepositioned supplies for their warehouses.

Finally, our project will suggest the locations for the prepositioned network that the IFRC is trying to establish in the Americas, based on Sub-Regional Warehouses to accomplish their Logistics 2015 strategic plan to fulfill their Vision 2020.

Objectives
- Make an assessment of Panama as a Humanitarian Logistics Hub enumerating and analyzing the advantages and disadvantages of the country and what would be needed to pursue the goal of been recognized as the Regional Hub for the Americas.
- Propose new locations for the Sub-Regional and Local Warehouses of the IFRC to accomplish their Strategy 2020.
- Create an Excel Tool to help on the forecast and planning of prepositioned items.

Barriers and Challenges

To address the objectives successfully the team had overcome barriers such as:

- Limited time to conduct the investigation: Just 11 weeks were granted to complete this investigation; this type of research usually requires an extensive and specialized study. In order to overcome the disadvantage of time limitation a Project Schedule was developed with realistic deadlines, allowing us to distribute and organize the work fairly.
- Availability of Information: Despite the organizations involved in this investigation are NGO's sometimes the information is restricted or requires authorization in order to release it.
- Schedule of people involved: the persons in charge of the humanitarian operations in Panama have many commitments and setting up meeting with them had been a challenge.

METHODOLOGY

Criteria for sub-regions

To make more manageable the data, sub-regions were created for the region of LAC , as shown below in Table 1.

Central America	South Cone	South America
Costa Rica El Salvador Guatemala Honduras Mexico Nicaragua Panama	Argentina Brazil Chile Paraguay Uruguay	Bolivia Colombia Ecuador Venezuela Peru
Caribbean		
Antigua & Barbuda	Guadeloupe	Trinidad & Tobago
Bahamas	Haiti	Turks & Caicos Island
Barbados	Jamaica	Virgin Islands USA
Cayman Island Cuba	Martinique Puerto Rico	Belice St. Lucia
Dominica	Grenada	St. Vincent & the Grenadines
Dominican Republic	Suriname	Guyana

Table 1: LAC sub-divisions based on geography and political criteria.

Some of the reasons why the classification was made like this were:

The sub-continent of South America was divided in the Southern Cone and South America.

The Southern Cone geographically includes part of Southern and Southeast (São Paulo) of Brazil, in terms of political geography the Southern cone has traditionally been comprised by Argentina, Chile, Paraguay and Uruguay. In the narrowest sense, it only covers Argentina, Chile and Uruguay, bounded on the north by the states of Brazil, Paraguay, Bolivia and Peru. (WIKIPEDIA, 2011) . Brazil, Argentina, Paraguay

and Uruguay form an economic-political trade bloc called the MERCOSUR that is the Southern Common Market. (MERCOSUR) A blend from the geographical and political divisions was taken into account to create the sub-region of the Southern Cone which includes in the study the following countries: Brazil, Chile, Argentina, Uruguay and Paraguay.

The remaining countries in the sub-continent belong to the Andean Community a economic trade bloc formed by Colombia, Ecuador, Bolivia and Peru. They also count with associate countries which are Chile, Argentina, Brazil, Paraguay and Uruguay. Venezuela used to be part of the trade bloc but know its undergoing negotiations with the MERCOSUR. (Andeen Community). Therefore, Venezuela was considered in the study as an ex-affiliate to the trade bloc. These countries are denoted as the sub-region of South America in this study.

For Central America we followed the division of the Economic, Cultural and Political organization called the Central American Integration System (Sistema de Integración Centroamericana, SICA). This organization is formed by 7 members Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and Belize. Nonetheless, Belize was considered as a part of the Caribbean, given the fact that had a better connectivity with this region. This was suggested by the IFRC in our meetings.

For the Caribbean Region, we grouped all the islands of the Caribbean, plus Belize, Guyana, French Guyana and Suriname. The last three were also added by suggestion of the IFRC; given these countries have more relationship with the islands in the Caribbean than with the continental countries. An economic reason to follow this division is the Caribbean Community (CARICOM); most of the countries assigned to this region are members, associate or observers.

DEMAND ESTIMATION

Problem Description

The Humanitarian Organizations are concerned about demand estimation, since they do not have unlimited resources, their procurement planning has to be accurate. With the interesting of help this planning, a tool was develop to estimate the number of affected people in disasters such as earthquakes, floods, storms, mass movements (wet and dry), volcanoes and drought which are the most common in Latin America and the Caribbean (Andersen, 2007).

The demand estimation will help in planning contracts with vendors; determine the appropriate level of prepositioned items on each warehouse, and may also be used in appealing to donors for funding.

After several meetings with the humanitarian organizations present in the country, we determine that the most important item stored here are the hygiene kits, this can be used almost in every type of disaster and do not require any special conditions for its storage. Based on this the tool will provide an estimate of the quantity of hygiene kits that should be purchased in order to satisfy a given percentage of the affected population.

Data Collection

The raw data for the tool was obtained from the Emergency Events Database (EM-DAT) created for The Centre for Research on the Epidemiology of Disasters (CRED). The database is a comprehensive database carrying data for various types of natural disasters by both country and date (year and month) going back to 1900.

For a disaster to be entered into the database at least one of the following criteria must be fulfilled: ten or more people reported killed; 100 people reported affected; declaration of a state of emergency; or a call for international assistance. The classification of Natural Disasters in accordance to EM-DAT could be observed on (Figure 5).
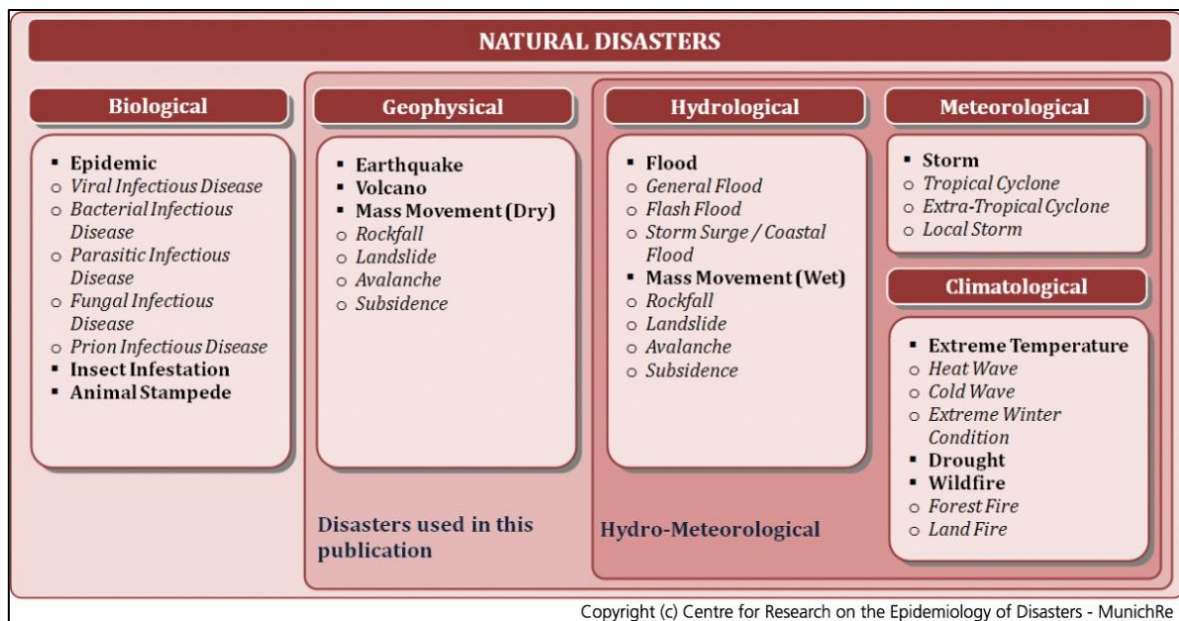
Figure 4: Classification of Natural Disasters (EMDAT)

This project will only consider Droughts as well as Hydrological and Meteorological Disasters, leaving us with only 7 types of disasters; this segmentation was made to only consider data relevant to the LAC Region.

Data Cleaning

The data for LAC contains 1782 disasters, a clear increase on disasters per year can be observed from 1960 onwards, for this reason the forecast consider only data from 1966 to 2010. This could be appreciated on Figure 6. The same trend is observed on the number of affected people per year. Figure 7
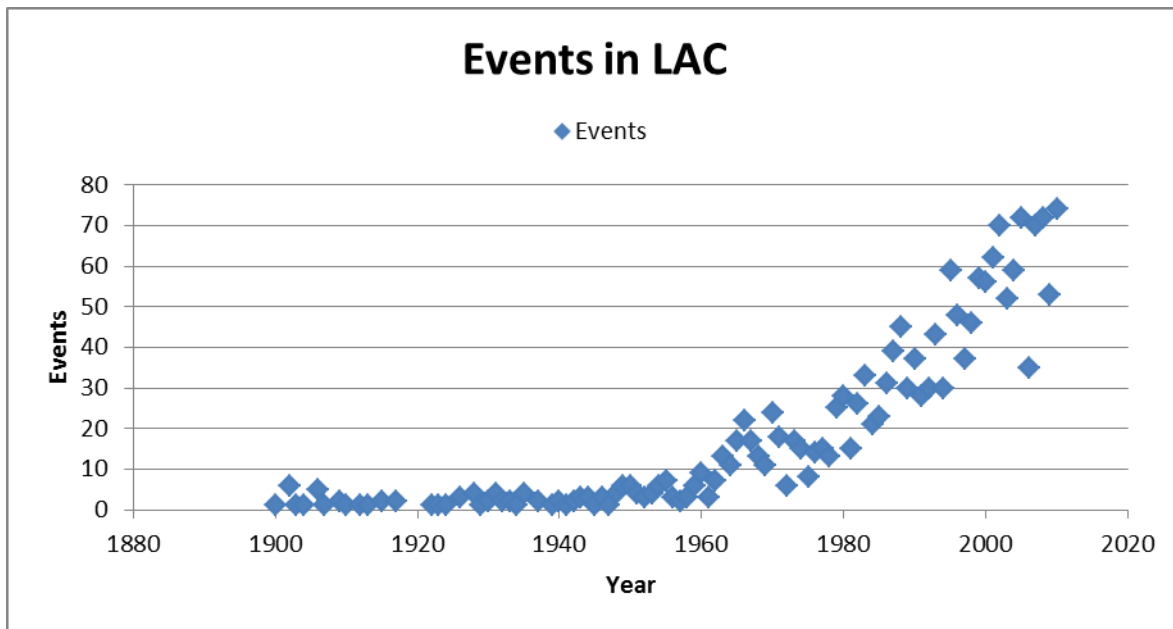
Figure 5: Number of Events in LAC from 1900-2010. (EMDAT)
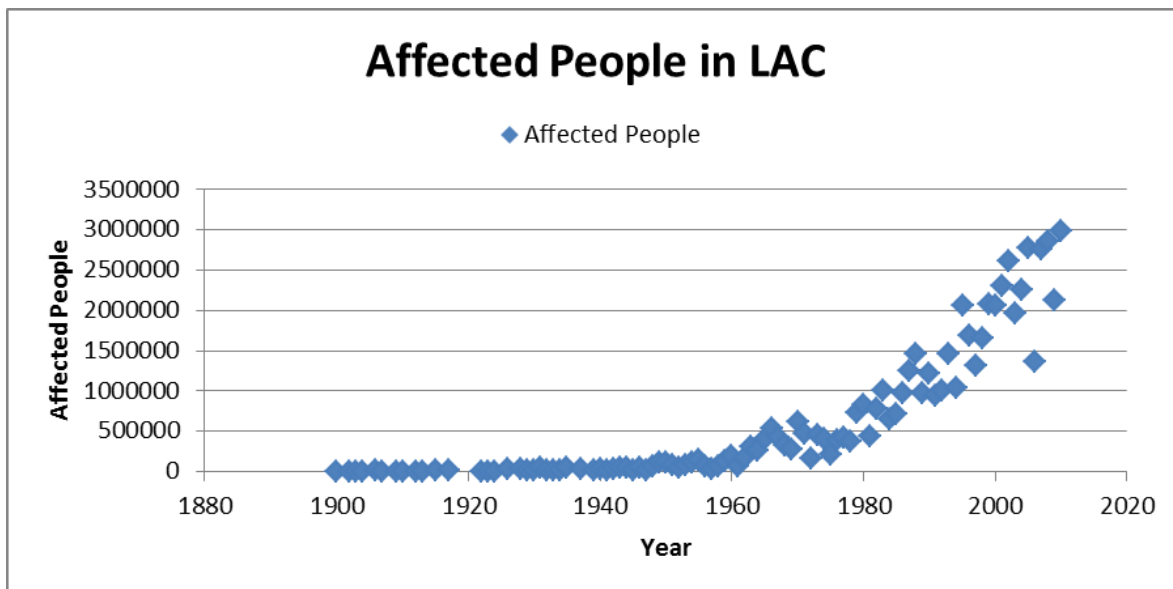
Figure 6: Affected people in LAC from 1900-2010. (EMDAT)

Some peaks were identified in the data, these were provoked by Mega Disasters (more than 1 million affected people) these were removed from the data, in order to have a more steady trend. There were also 40 events from 1900 to 2010 without a start month; these events were also disregarded from the data to forecast.

The Forecasting Model

There are various factors that can affect the number of affected people by a natural disaster through a given year; factors such as, the rising number of disasters themselves, population growth, location and poverty. Consequently, the forecast presented later should be treated accordingly.

As stated before this forecast only uses data from 1966 to 2010, and the Mega Disasters occurred on those years were removed from the data to avoid high peaks that are not relevant to this study, since we are only focused on up to Middle Level Disasters.

Since the data shows a significant variation in the number of affected people from year to year, different forecast techniques could led to different results. Consequently, is improbable that the use of a highly sophisticated model led to a more precise forecast. Based on that, simple techniques such as Exponential Smoothing, Double Exponential Smoothing and Regression were tested. Finally Double Exponential Smoothing (See Technical Annex) was selected as the Forecasting Technique, since was the one that show the minimum error in the Median Average Deviation (MAD).

Interface of Demand Estimation Tool
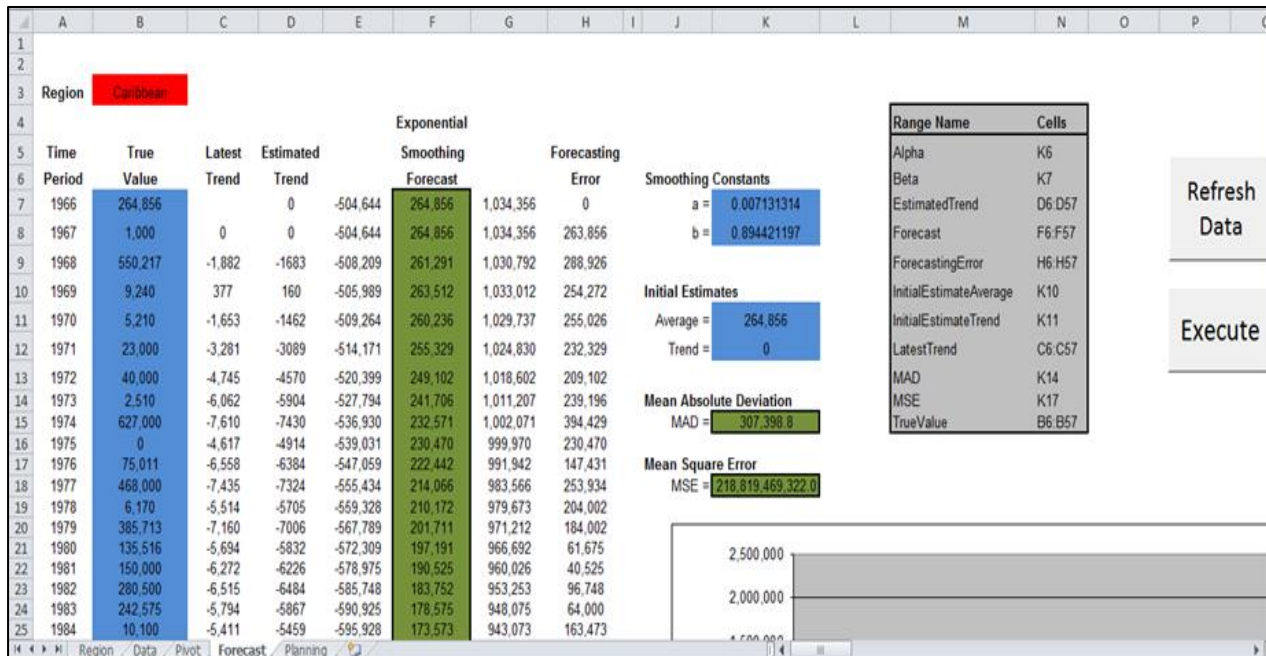
Figure 7: Demand Estimation Preview

There are 5 main tabs in the Demand Estimation Tool:

- Region: This tab contains the Countries of the LAC Region classified in Sub Regions; each country can be reclassified to another region if desired. This can be done by changing the region on column B.

- Data: This tab contains the main data extracted from EM-DAT. When an event is added, columns A, B, E, G and H should be filled.

- Pivot: Is not necessary to change any value in this tab.

- Forecast: This is the main tab of the tool; it generates the forecast of affected people for the regions.
    - Steps to run the forecast with given data:
        - Select the desired region from the drop down menu on the red cell (B3)
        - Hit Execute Button
        - Result will be the on cell F52
    - Steps to add data to the tool and run the forecast:

- In the Data tab, columns A, B, E, G and H should be filled with the statistics for the year that is being added.

- In the Forecast tab, hit the Refresh Data button.

- Add the new years to be included in the forecast at the end of column A. For example, at current status year 2011 should be copied on cell A52. Remember to keep the sequence of the years.

- Hit the Execute Button.

- The Result will be the last numeric value of column F (green).

- Planning: this tab contains a tool that provides an example of how much will cost to preposition a determined amount of items in the Sub Regional Warehouses. The item selected was the Hygiene Kit. To use the tool the amount of affected people should be imputed on the column B, column C will provide a percentage of the population that is targeted to be helped then the shipping cost per FEU should be inputted on column F. This would provide us an estimate cost of prepositioned item for a Sub Region in a determined year.

	A	B	C	D	E	F	G
3	Region	Affected People	Target	Required Hygiene Kits	40 ft. Containers	Shipping Cost	Cost of Prepositioning
4	Caribbean	672,094	1	134,419	67	$ 150.00	$ 10,050.00
5	Central America	662,772	1	132,554	66	$ 150.00	$ 9,900.00
6	South America	946,030	1	189,206	94	$ 150.00	$ 14,100.00
7	Southern Cone	295,487	1	59,097	30	$ 150.00	$ 4,500.00
9	This cells should not be changed						
10	This cells are subject to change						

Figure 8: Demand Estimation Tool, Planning Tool

The shipping cost were obtained from www.globalshippingcosts.com, they are an independent group of consultants with expertise in transportation, trade, Internet technologies, international law, banking, insurance, marketing and regulatory

compliance. Their web site is designed to provide carriers and shippers with optimized efficiencies for application to the supply chain.

The calculation is based on a weight average of a group of rates on a given route which makes it a unique marketing and planning tool for obtaining generic shipping costs and shipping time.

Results: Demand Estimation

The results obtained from the forecast are shown below:

Region	Lower: 5%	Forecast	Upper: 95%
Caribbean	-97,883	672,094	1,442,070
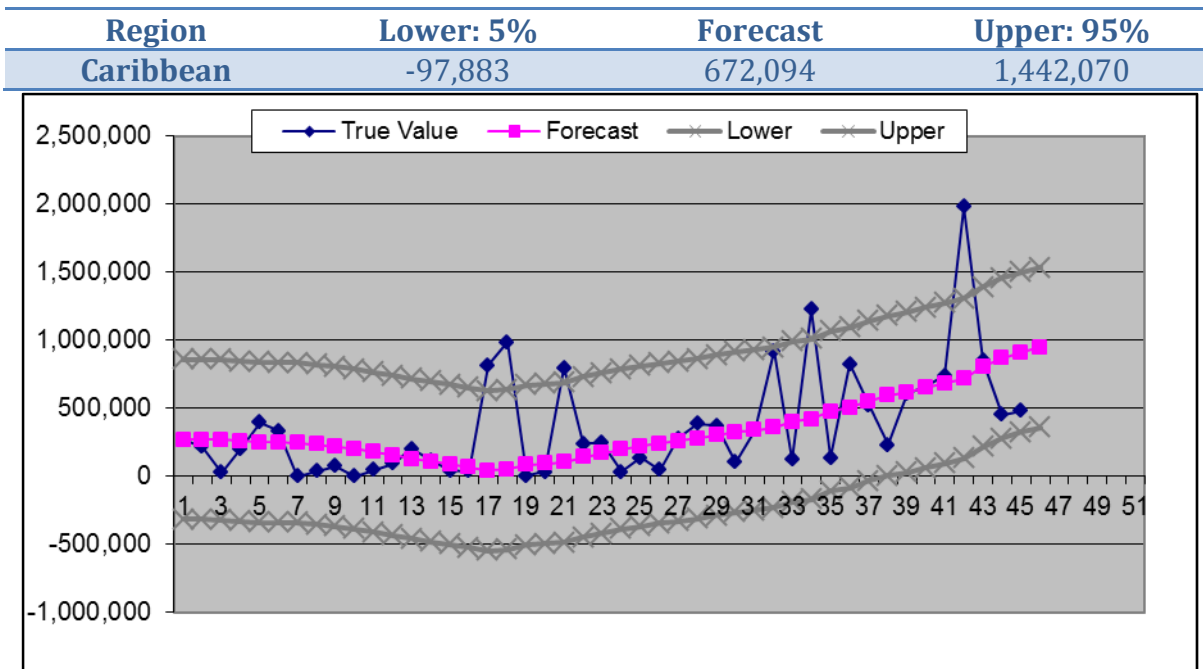
Figure 9: Forecast for the sub-region of the Caribbean

Region	Lower: 5%	Forecast	Upper: 95%
Central America	57,575	662,772	1,267,968
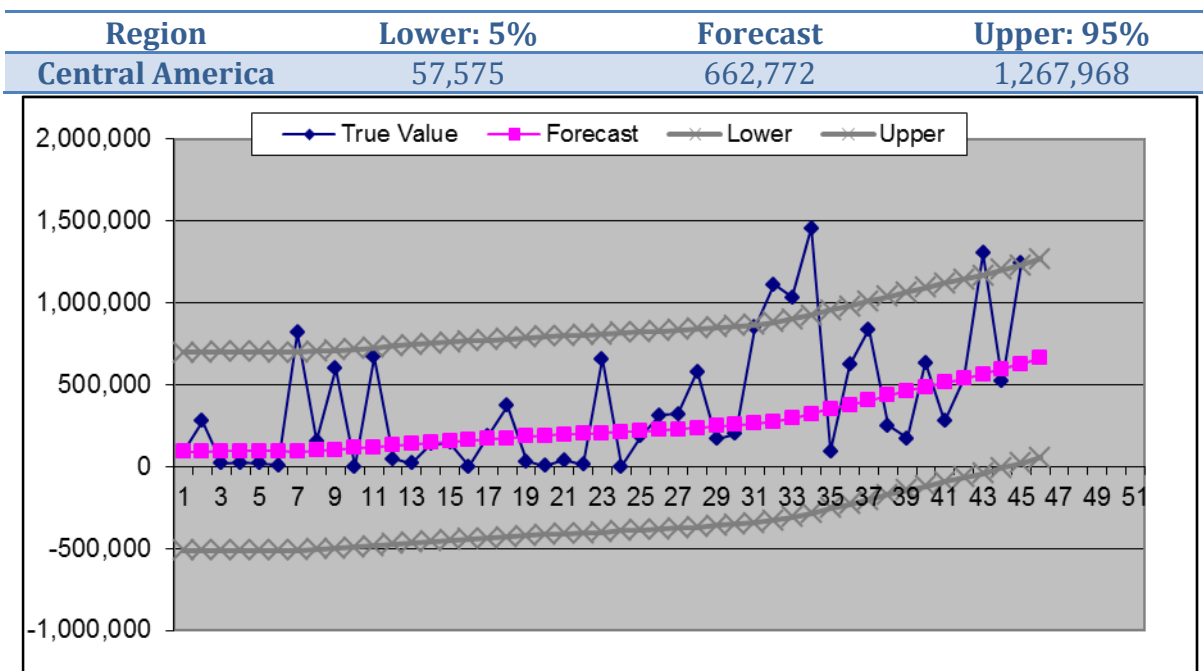
Figure 10: Forecast results for the sub-region of Central America

Region	Lower: 5%	Forecast	Upper: 95%
South America	357,163	946,030	1,534,897
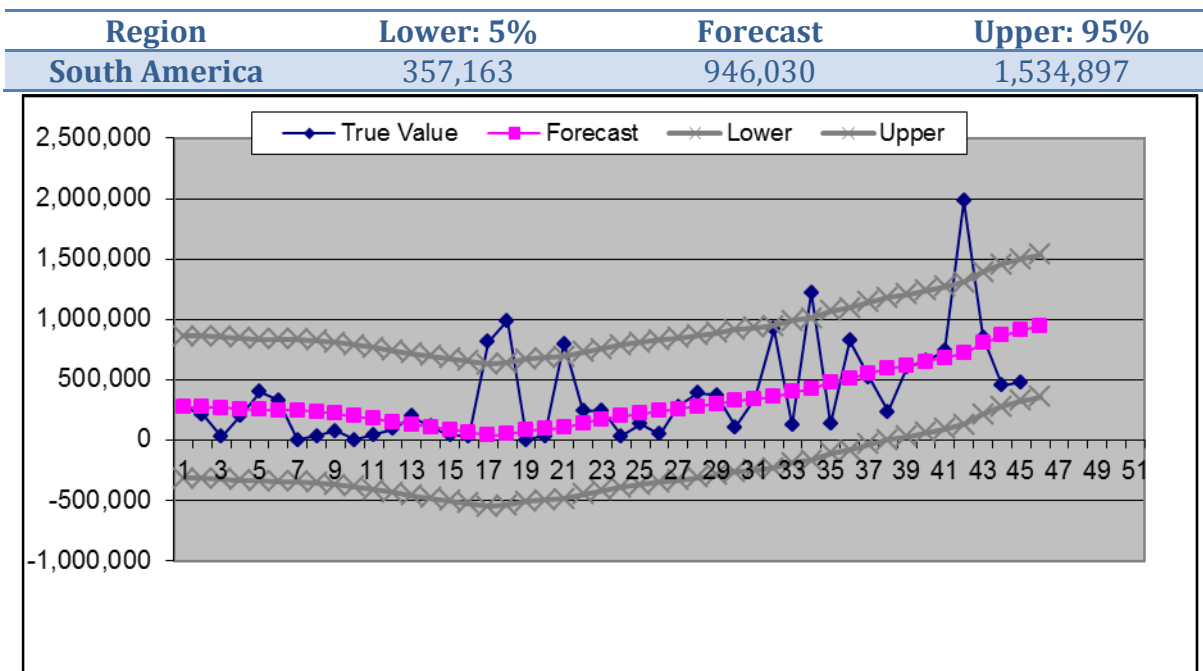
Figure 11: Forecast for the sub-region of South America

Region	Lower: 5%	Forecast	Upper: 95%
Southern Cone	-204,063	295,487	795,036
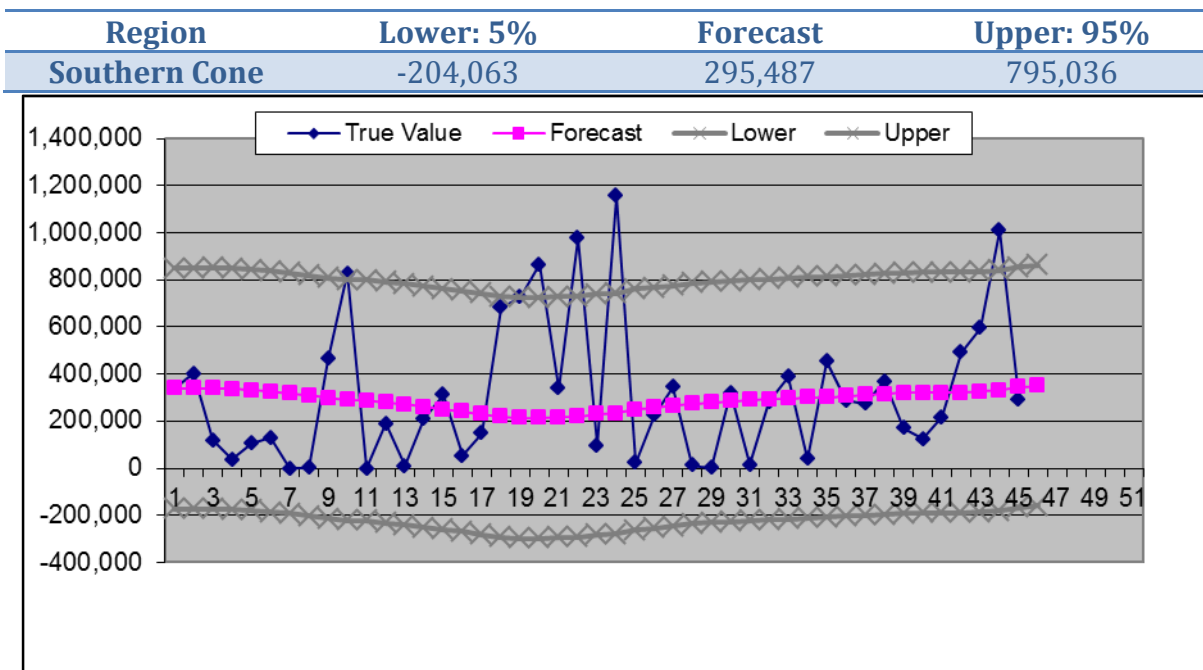
Figure 12: Forecast for the Sub-Region of the Southern Cone

The forecast model revealed an increasing trend in the Caribbean, Central America and South America. Nonetheless, a steadier trend was shown in the Southern Cone region. From this we can expect increasing numbers in the expected affected people

for those Regions in the future, while the Southern Cone will present a similar number through the near years.

Region	Forecast Affected People
Caribbean	26%
Central America	26%
South America	37%
Southern Cone	11%

Table 2 Forecasted Percentage Affected People

On table 2, we can appreciate the distribution of affected people suggested by the forecast model. As we can see is nearly balanced between all the warehouses, just the South America warehouse is a bit more charged than the Caribbean and Central American, aiding the Southern Cone Warehouse to maintain less storage.

Region	Historic Affected People
Caribbean	23.41%
Central America	29.20%
South America	25.62%
Southern Cone	21.76%

Table 3 Historic Percentage of Affected People

This goes in accordance with the values seen on table 3 and 4, the historic ones, in which Southern Cone is the one with the lowest percentage of affected people and events in the LAC region.

Region	Historic Events
Caribbean	26.25%
Central America	29.92%
South America	24.58%
Southern Cone	19.24%

Table 4 Historic Percentage of Events Occurrence in LAC

NETWORK DESIGN

Client Description

The IFRC is the world's largest humanitarian organization and its mission is to improve the lives of vulnerable people by mobilizing the power of humanity. The Federation coordinates and directs international assistance to victims of natural and technological disasters, to refugees and in health emergencies.

This project focused in the IFRC Global Logistics Service (GLS): Logistics 2015, a five year strategic plan designed to support the delivery of Strategy 2020 and set the framework for continuing improvement and development of the GLS. The main objective of Logistics 2015 is to ensure that National Societies individually, and the IFRC as a network have competent, efficient and effective logistics capacity in preparing for disasters and crisis, and in managing relief and recovery assistance to vulnerable and affected communities. (IFRC-Global Logistics Service, 2011).

Regional logistics units

The three regional logistics units were established in 2006 in Panama, Dubai and Kuala Lumpur. The key objective of each unit is to deliver specified relief items globally to 5,000 families within 48 hours of a request and to a further 15,000 families within two weeks. The three units contain stockpiles sufficient to meet the needs of 300,000 people (100,000 per unit).

The structure and mandate of the regional units is identical. However, there are differences in the regions in terms of exposure to disasters and scale of needs.

Figure 13: International Federation of the Red Cross Regional Logistics Units.

The regional logistics units cover regional needs according to the following geographical divisions:

- Panama (Americas)

- Dubai (Europe, Africa, Middle East and North Africa)

- Kuala Lumpur (Asia and the Pacific)

Regional logistics units deliver mobilization, procurement, stock, warehousing and fleet services as well as general logistics support to operations. (IFRC, 2011)

Problem Description

In order to help IFRC achieve their goals for Logistics 2015, we decided to focus on the Region of the Americas throughout their Pan American Regional Unit located in Panama (PADRU).

We evaluated the locations in the Latin America and the Caribbean to suggest potential sub regional units to support PADRU in reducing lead time enabling them to be closer to disaster prone areas in the Americas.

The inventory prepositioned in PADRU consists primarily of donations of National Societies such as American Red Cross, Canadian Red Cross and the British Red Cross, and disaster relief inventory purchased in advance to respond to a disaster

(prepositioning) as well as emergency items purchased immediately after a decision is made to respond to a disaster.

Evaluating Location Alternative through Factor Analysis

The procedure we follow in order to develop a factor rating analysis was:

1. Determine which factors are relevant
2. Assign a weight to each factor that indicates its relative importance concerned with all other factor. The weight sum has to be equal to 1.
3. Decide a common scale for all factors and set the minimum acceptable score if necessary.
4. Score each location alternative.
5. Multiply the factor weight by the score for each factor m, and sum the results for each location alternative.
6. Choose the alternative that has the highest score as per acceptable score.

Location decision Factors

Lead Time Index

The nature of location decisions for the humanitarian world sometimes follows the pattern of profit organizations and other times they differ. The strategic importance of location decisions are closely tied to organizations strategies. For the humanitarian organizations, their goal is to be where they are needed in the shortest time possible and been able to help those in need faster, no matter the cost. Therefore, lead time and frequency of transportation modes are a crucial factor to be considered. For this we created a Lead Time index and weighted it with 30%.

Country	Lead Time	LT Index	Country	Lead Time	LT Index
Belice	11	3.43	Dominica	9	3.71
Costa Rica	1	4.86	Dominican Republic	4	4.43
El Salvador	5	4.29	Grenada	5	4.29
Guatemala	4	4.43	Guadeloupe	12	3.29
Honduras	4	4.43	Haiti	4	4.43
Mexico	10	3.57	Jamaica	6	4.14
Nicaragua	2	4.71	Martinique	6	4.14
Panama	0	5.00	Puerto Rico	4	4.43
Argentina	23	1.71	St. Lucia	10	3.57
Brasil	25	1.43	St. Vincent & the Grenadines	10	3.57
Chile	9	3.71	Trinidad & Tobago	7	4.00
Paraguay	32	0.43	Turks & Caicos Island		1.00
Uruguay	20	2.14	Virgin Islands USA	9	3.71
Bolivia	NA	1.00	Antigua & Barbuda	12	3.29
Colombia	2	4.71	Bahamas	16	2.71
Ecuador	7	4.00	Barbados	6	4.14
Guyana	14	3.00	Cayman Island	2	4.71
Peru	6	4.14	Cuba	17	2.57
Suriname	9	3.71	Dominica	9	3.71
Venezuela	6	4.14			

Table 5: Lead Time Index for LAC

Another important factor to be analyzed is the regional factors. In the regional factors we can evaluate climate, trade, logistics, lead time, land transportation and legal and environmental concerns. To cover this area we decided to use several indexes from the World Economic Forum and the World Bank.

The Logistics Performance Indicator (LPI)

The LPI helps us evaluate the performance of LAC countries in terms of logistics. Since logistics is an important component in the Humanitarian world this Factor was assigned a weight of 30%.
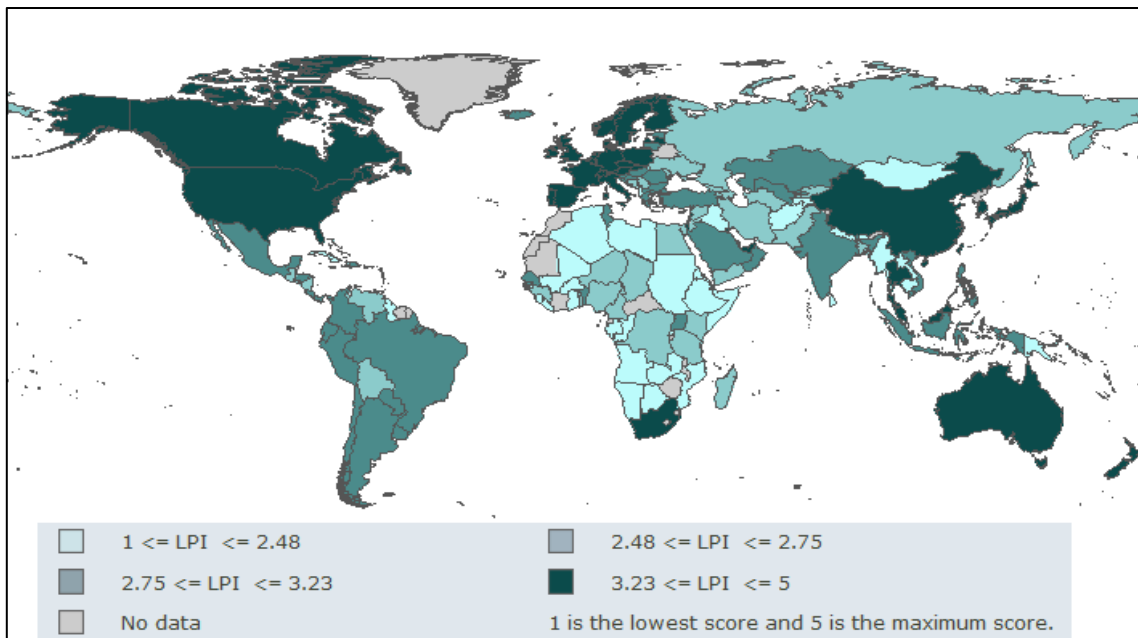
Figure 14: LPI world map 2010.

The Enabling Trade Index (ETI)

The ETI measures institutions, policies and services facilitating the free flow of goods over borders and to destination. It breaks the enablers into four issue areas: market access, border administration, transport and communications infrastructure, and business environment.

The Index uses a combination of data from publicly available sources, as well as the results of the Executive Opinion Survey, a comprehensive annual survey conducted by the World Economic Forum with its network of partner institutes (leading research institutes and business organizations) in the countries included in the report. The survey provides unique data on many qualitative institutional and business environment issues, as well as some indicators related to international trade. (World Economic Forum).

As countries enable trade, they also provide benefits to their trade partners, thereby supporting economic growth.We weighted this factor with 20%.

The Global Risk Index of Vulnerability (GRIV)

Since the nature of the humanitarian prepositioned network is to be able to prepared for disasters, we based the assumption collaborated with the IFRC that they preferred to be closer to disaster prone areas.

The Global Risk Index of Vulnerability is developed between the Alliance Development Works and the University of the UN in Bonn, Germany. It classifies 193 countries worldwide based on data from EMDAT, and scales the countries based on the historical and forecasted disasters. The scale goes from 5-1 (Very High to Very Low See Figure 11). We weighted this factor with 20%.
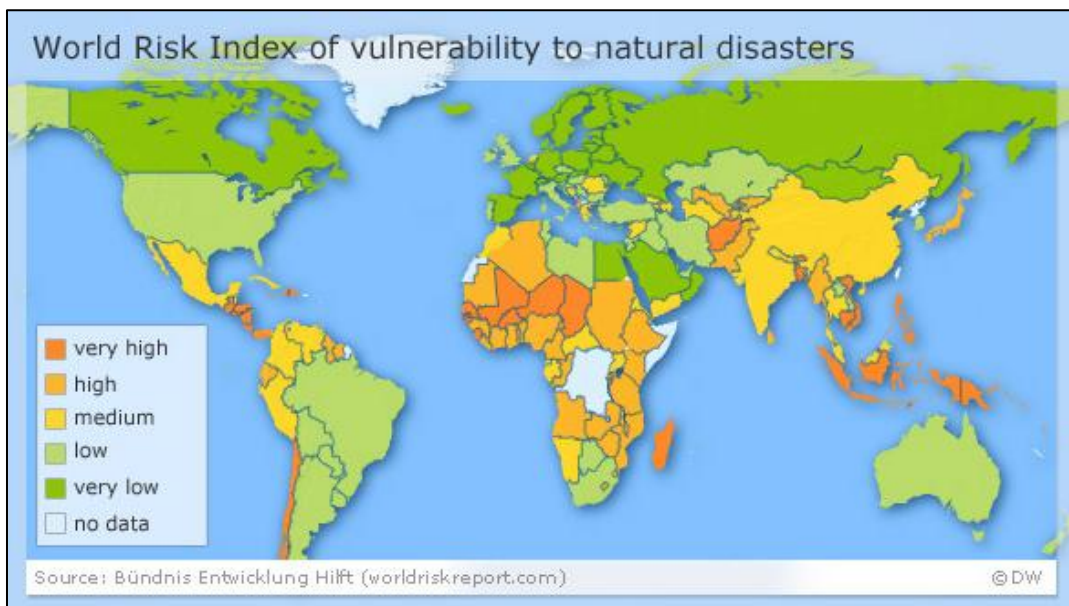
Figure 15: World Risk Index of Vulnerability (worldriskreport.com)

The map above (Figure 11) reflects that the highest peril is to developing countries. The greatest danger for natural disasters exists in Asia and Latin America. There are hardly any, or very few, state-sponsored preparations to combat the effects of natural disasters. The global risk index reaffirms the importance of crisis prevention, but it also highlights something else - when it comes to disasters, it's poverty that kills. (Deutsche Welle).

Results: Network Design

Factor Analysis Results

After using the weighted factor analysis to evaluate the potential locations based on our sub-regional classification, this where the results.

CENTRAL AMERICA								
Data								
	Weight	Costa Rica	Guatemala	El Salvador	Honduras	Nicaragua	**Panama**	MEXICO
Global Logistic Index	30	2.91	2.63	2.67	2.78	2.54	**3.02**	3.05
Lead Time	30	4.86	4.43	4.29	4.43	4.71	**5.00**	3.57
Enabling Trade Index 2010	20	4.45	3.97	4.16	3.98	3.85	**4.12**	4.04
World Risk Index of Vulnerability	20	5.00	5.00	5.00	5.00	5.00	**5.00**	3.00
Results								
Total	100							
Weighted sum		422.01	391.16	391.87	395.86	394.63	423.00	339.44
Weighted average		4.22	3.91	3.92	3.96	3.95	4.23	3.39
	MAX	4.23	PANAMA					

Figure 16: Factor Analysis for the sub-region of Central America.

The result gave us the potential sub-regional location for Central America should be located in Panama. It also shows a technical tie between Panama and Costa Rica. This fill be further explore in the upcoming section of Case Study: Panama vs. Costa Rica. This is located in the Panama Assessment.

Facts about Panama

Based on the Global Index of Competitiveness (GIC) 2010-2011:

- Panama posts one of the largest improvements in the region moving to rank 53rd, thanks to a more positive assessment of infrastructure quality (44th, up 21 places from last year), increased macroeconomic stability (30th, up 16 places) and technological readiness (41st, up 18 places).

- The country benefit from well-developed financial markets (21st). Strengthening the quality of its educational system (ranked 89th and 82nd for primary education and higher education and training, respectively) and

increasing the flexibility of its labor market and the efficient use of talent (107th for the efficiency of the labor market) are crucial to further reinforce Panama's long-term growth potential going into the future.

Fact about Costa Rica

Based on the Global Index of Competitiveness (GIC) 2010-2011:

- Costa Rica lost its top position in Central America to Panama and currently ranks in the 56th position, after having climbed 13 ranks from 2006 to 2009.
- The country's strong position rests on first-class quality education (ranked 23rd and 43rd for education and higher education and training, respectively), fairly transparent institutions (51st), and a sophisticated and innovative business sector (ranked 32nd and 35th, respectively).
- The focus on new technologies (including biotech and aerospace) has been highlighted as a priority of the new Chinchilla administration.
- The soundness of the macroeconomic environment (108th) remains a problematic area amid increasing security concerns in the country (81st). In addition, the quality of the country's infrastructure (78th) and the development of the financial market (85th) may represent potential bottlenecks going forward.

SOUTH AMERICA						
Data						
	Weight	Peru	Ecuador	Bolivia	**Colombia**	Venezuela
Global Logistic Index	30	2.80	2.77	2.51	**2.77**	2.68
Lead Time	30	4.14	4.00	0.00	**4.71**	4.14
Enabling Trade Index 2010	20	4.04	3.74	3.59	**3.72**	3.04
World Risk Index of Vulnerability	20	3.00	4.00	2.00	**3.00**	3.00
Results						
Total	100					
Weighted sum		349.09	357.90	187.10	358.93	325.49
Weighted average		3.49	3.58	1.87	3.59	3.25
	MAX	3.59	ECUADOR			

Figure 17: Factor Analysis for the sub-region of South America.

The result gave us the potential sub-regional location for South America should be located in Ecuador.

Facts about Ecuador

Ecuador adopted the dollar as its national currency in 2000, following a major banking crisis and recession in 1999. Dollarization led to stability, which helped Ecuador achieve solid economic performance through the years. Is one of the laggards of the South America countries. As for ground transportation, Ecuador´s rail was originally a relatively decent network, connecting Quito and some of the southern region to two coastal ports, though there are no international connections and the gauge is entirely unique within South America.

The industrial sector has had enormous difficulty to emerge significantly. The industrial sector's main problem is the deficit of energy (El Universo, 2010), which the current government has tackled with the improvement of performance on existing hydro plants, and the creation of new ones. Such projects currently include negotiation of the Coca-Cola hydroplant. (El Universo, 2010) Incentives of financing, tributary incentives, tariffs, and others will be implemented, that is intended to benefit areas of tourism, foods process, renewable and alternative energies, bio energies, pharmaceutical and chemical products, biochemical and environmental biomedicine, services, automotive metallurgical industry, footwear, and automotive parts and pieces, among others.

SOUTH CONE						
Data						
	Weight	Chile	Brasil	Argentina	Paraguay	Uruguay
Global Logistic Index	30	3.09	3.20	3.10	2.75	2.75
Lead Time	30	3.71	1.43	1.71	0.43	2.14
Enabling Trade Index 2010	20	5.00	3.76	3.64	3.53	4.29
World Risk Index of Vulnerability	20	5.00	2.00	2.00	2.00	2.00
Results						
Total	100					
Weighted sum		404.13	254.06	257.23	205.96	272.59
Weighted average		4.04	2.54	2.57	2.06	2.73
	MAX VALUE	4.04	CHILE			

Figure 18: Factor Analysis for sub-region of the Southern Cone

The result gave us the potential sub-regional location for the Southern Cone should be located in Chile.

Facts about Chile

Chile despite its emerging status, ranks alongside the most developed economies in the world. It has one of the world's most business-friendly environments and has attracted a number of well-known multinational and foreign investors with its open and competitive economy. The reason for this superior performance is due to the success of its reforms and the strength of its institutions, which have allowed Chile to build a robust macroeconomic framework. This situation had been reflected in its rating credit:

- Structural surplus rule, implemented before the three-year commodities super-cycle that ended in mid-2008, allowed Chile to take advantage of those years of windfall copper profits to build its sovereign wealth funds better than any other country in the region. It used the revenues to build a Pension Reserve Fund (PRF) and an Economic and Social Stability Fund (ESSF) with a combined total of over US$16.6 billion as of December 2010. Including cash investment, assets total is over US$20.4 billion.
- Economic framework includes an independent central bank, whose monetary policy is carried out based on inflation targets and a floating exchange rate. Chile's banking system, based on sound regulatory framework, also helps to

reduce domestic economic volatility, with Chilean banks continuing to grow while maintaining asset quality and adequate capitalization levels in spite of the global financial crisis.

- Economic reforms focused on the key areas of the private pension system, free trade, and the liberalization of financial markets.

- Free trade agreements (FTAs): Has signed FTAs than any other nation. It had FTAs with more than 90% of its trade partners in 2008, including Australia, China, India, Japan, Mexico, the US, the EU and South Korea.

- Reduction of poverty since 1990 it has slashed its poverty rate to 13% from over 40 percent in the early 90s. This dramatic improvement is the result of ambitious and effective social policies and economic growth that has averaged 5.5% since 1990.

- Chile is wired, globally connected, and able to offer investors a low-cost business-friendly environment, a high quality of life, and a talented and educated work force.

Chile's advanced communications systems, logistics, and world-class air and sea ports have helped connect it to world markets and bridge distances with other global business centers

The World Competitiveness Report 2010, prepared by the IMD-International Institute for Management Development in Switzerland, measures how an economy operates all of its resources and expertise to increase the welfare of its population, according to four factors: economic performance, government efficiency, business efficiency and infrastructure. In South America, Chile remained the leading country but declined from 25 to 28, Colombia has improved its position considerably, from position 51 to 45, and Brazil jumped from 40 to 38, Peru fell four positions ranking 41.

According to GTI 2010, produced by WEF, Chile is the Latin America's country that provides the best facilities for international trade, surpassing even the United States. Chile is in second place globally in terms of markets access, after Singapore. His

biggest weakness is the transport and communications infrastructure, which ranked 42.

Chile is an extremely competitive location for foreign investors to do business, with low costs, high-quality support services, effective investor protection measures and high standards of corporate governance. (Government of Chile, 2011)

CARIBBEAN											
Data											
	Haiti	Jamaica	Martinique	Puerto Rico	St. Lucia	St. Vincent	Trinidad	Turks	Virgin Islands	Belice	Suriname	Guyana
Global Logistic Index	2.59	2.53	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.27
Lead Time	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	2.00	42.00
Enabling Trade Index 2010	1.00	3.92	1.00	5.00	1.00	1.00	1.00	1.00	5.00	1.00	1.00	3.42
World Risk Index of Vulnerability	5.00	4.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00
Results											
Total											
Weighted sum	197.70	234.30	110.00	190.00	110.00	110.00	110.00	110.00	190.00	110.00	190.00	1476.50
Weighted average	1.98	2.34	1.10	1.90	1.10	1.10	1.10	1.10	1.90	1.10	1.90	14.77

CARIBBEAN										
Data										
	Weight	Antigua	Bahamas	Barbados	Cayman Islands	Cuba	Dominica	**Dominican Rep.**	Grenada	Grenada	Guadalope
Global Logistic Index	30	1.00	1.00	1.00	1.00	2.07	1.00	**2.82**	1.00	1.00	1.00
Lead Time	30	0.00	3.29	2.71	4.14	4.71	2.57	**3.71**	4.43	0.00	0.00
Enabling Trade Index 2010	20	1.00	1.00	1.00	1.00	1.00	1.00	**3.94**	1.00	1.00	1.00
World Risk Index of Vulnerability	20	3.00	3.00	3.00	3.00	3.00	3.00	**4.00**	3.00	3.00	3.00
Results										
Total	100										
Weighted sum		110	208.57	191.43	234.29	283.53	187.14	354.83	242.86	110.00	110.00
Weighted average		1.1	2.09	1.91	2.34	2.84	1.87	3.55	2.43	1.10	1.10

MAX	3.55	DOMINICAN REPUBLIC

Figure 19: Factor Analysis for the sub-region of the Caribbean.

The result gave us the potential sub-regional location for the Caribbean should be located in Dominican Republic.

Facts about Dominican Republic

The Dominican Republic is a country with great opportunities to aspire to higher wealth levels. It is important to establish a clear picture of the future depicting what it wants to be as a nation, so that it will serve as a reference point to guide development efforts by all elements of society. Articulating a vision of the future brings to economic agents and the general population a sense of direction, finality and trust. The Dominican Republic will be the most competitive business, production and tourism center of the Caribbean and Central America, with the greatest regional linkages to the world economy.

Below some competitiveness strategies of the country:

- Market segmentation and changes.

- The fast pace of technology changes.

- The presence of a new global workforce that allows for the efficient production of quality goods and services and rapid delivery throughout the globe.

- Increasing linkages among national and regional production and value chains.

- Significant reduction of economic distances, as a result of advances in transportation and telecommunications.

- A high degree of mobility of goods, services and/or factors of production.

- A higher degree of competition as new entrants come into the market at all levels, from different parts of the globe and at a faster pace.

Dominican Republic has been classified in the third tier among the worst in competitiveness, according to the WEF ranking for the GCI of 2010-2011.

According to the Forum, the country dropped four points compared with last year, and fared better than only five Latin American countries, among them Venezuela, Paraguay, Ecuador, Bolivia, and Nicaragua. (USAID, 2000)

Currently Dominican Rep. is working on several projects to increase its competitive position which are:

- To develop world-class production factors, especially of the country's physical infrastructure, to convert the geographic location of the Dominican Republic into a national competitive advantage.

- To reduce country costs through structural reforms thereby allowing factor costs and economic prices to move closer to international levels. Country costs, comprised of economic prices, factor costs and transactional costs, all of which influence firm costs, are relatively high in the DR.

- To offer higher value-added or new product and service offerings; and to serve more profitable market segments, to help diversify the existing production base and develop competitive advantages.

Potential locations results for sub-regions warehouses.

In the maps below you will be able to see the potential locations that we obtained from the Weighted Factor Rating Analysis.

Figure 20: Map of potential sub-regional locations for the IFRC.

Our suggested sub-regional warehouses should be located in:

- **Central America:** Panama

- **Caribbean**: Dominican Republic

- **South America**: Ecuador

- **Southern Cone***:* Chile

Network Evaluation (WHAT IF)

After obtaining the proposed network, an evaluation was conducted to estimate the average cost of deployment of help from the suggested warehouses, the transit times were also considered. This evaluation considered air deployments; rates and transit times were obtained from www.globalshippingcosts.com calculator. The tariff tier considered was for cargo of more than 1,000 kilos. For the evaluation we considered all the countries in the Region of Central America, South America and Southern Cone. The Caribbean was disregarded of this evaluation given the proximity of Santo Domingo to all the Caribbean Islands.

Country	Region	City	Panama City	Quito	Santiago	Santo Domingo
Costa Rica	Central America	San Jose	$ 0.97	$ 2.42	$ 9.44	$ 3.37
El Salvador	Central America	San Salvador	$ 2.19	$ 3.63	$ 10.50	$ 3.97
Guatemala	Central America	Guatemala City	$ 2.53	$ 3.96	$ 10.77	$ 4.19
Honduras	Central America	Tegucigalpa	$ 1.90	$ 3.47	$ 10.44	$ 3.58
Mexico	Central America	Mexico City	$ 4.51	$ 5.88	$ 12.40	$ 5.75
Nicaragua	Central America	Managua	$ 1.51	$ 3.02	$ 10.00	$ 3.52
Panama	Central America	Panama City				
Bolivia	South America	La Paz	$ 5.82	$ 4.03	$ 3.56	$ 7.32
Colombia	South America	Bogota	$ 1.43	$ 1.36	$ 7.99	$ 3.00
Ecuador	South America	Quito				
Peru	South America	Lima	$ 4.42	$ 2.50	$ 4.63	$ 6.54
Venezuela	South America	Caracas	$ 2.60	$ 5.97	$ 9.22	$ 1.75
Argentina	Southern Cone	Buenos Aires	$ 10.05	$ 8.23	$ 2.14	$ 11.36
Brazil	Southern Cone	Sao Paulo	$ 9.56	$ 8.10	$ 4.88	$ 9.98
Chile	Southern Cone	Santiago				
Paraguay	Southern Cone	Asuncion	$ 8.44	$ 6.74	$ 2.95	$ 9.48
Uruguay	Southern Cone	Montevideo	$ 10.27	$ 8.47	$ 2.57	$ 11.48

Table 6: Transit Time from selected warehouses to cities in LAC.

			Transit Time (hours)			
Country ▼	Region ↓↑	City ↓↑	Panama City ▼	Quito ▼	Santiago ▼	Santo Domingo ▼
Costa Rica	Central America	San Jose	0.7	1.74	6.79	2.43
El Salvador	Central America	San Salvador	1.58	2.61	7.55	2.85
Guatemala	Central America	Guatemala City	1.82	2.85	7.75	3.02
Honduras	Central America	Tegucigalpa	1.36	2.5	7.51	2.57
Mexico	Central America	Mexico City	3.24	4.22	8.91	4.13
Nicaragua	Central America	Managua	1.09	2.17	7.19	2.53
Panama	Central America	Panama City				
Bolivia	South America	La Paz	4.19	2.89	2.56	5.26
Colombia	South America	Bogota	1.03	0.98	5.74	2.16
Ecuador	South America	Quito				
Peru	South America	Lima	3.18	1.8	3.33	4.7
Venezuela	South America	Caracas	1.87	2.35	6.63	1.26
Argentina	Southern Cone	Buenos Aires	7.23	5.92	1.54	8.17
Brazil	Southern Cone	Sao Paulo	6.87	5.82	3.51	7.18
Chile	Southern Cone	Santiago				
Paraguay	Southern Cone	Asuncion	6.07	4.85	2.12	6.82
Uruguay	Southern Cone	Montevideo	7.38	6.09	1.85	8.25

Table 7: Freight rate from Warehouses to Selected Cities in LAC (Rate = More than 1,000 kilos)

From Table 5 we can observed, that Central America and the Southern Cone reaffirmed their selected warehouses. The situation is not so clear for South America; a similar situation can be observed on Table 6.

This situation led us to try a scenario with only three warehouses. The Southern Cone Region was eliminated, reassigning its countries to South America. Colombia was sent to Central America Region, since there was a technical tie between Quito and Panama City to served Colombia. Venezuela was sent to the Caribbean Region, since this evaluation proved that will be faster helping them from Santo Domingo, than from Quito.

New Scenario – Three Warehouse Locations

This lead us to create a new scenario, a three warehouse network was evaluated, dividing the countries as shown on table 8.

Central America	South America	
Costa Rica El Salvador Guatemala Honduras Mexico Nicaragua Panama Colombia	Argentina Brazil Chile Paraguay Uruguay Bolivia Peru Ecuador	
Caribbean		
Antigua & Barbuda	Guadeloupe	Trinidad & Tobago
Bahamas	Haiti	Turks & Caicos Island
Barbados	Jamaica	Virgin Islands USA
Cayman Island	Martinique	Belice
Cuba	Puerto Rico	St. Lucia
Dominica	Grenada	St. Vincent & the Grenadines
Dominican Republic	Suriname	Guyana
Venezuela		

Table 8 LAC Subdivision based on Three Warehouse Scenario

After this new division all previous steps were repeated, recalculating the estimated demand for the new sub regions as well as the network design. Results are shown in the following pages.

Demand estimation for three warehouse scenario

Region	Lower: 5%	Forecast	Upper: 95%
Caribbean	-120,552	628,097	1,376,747
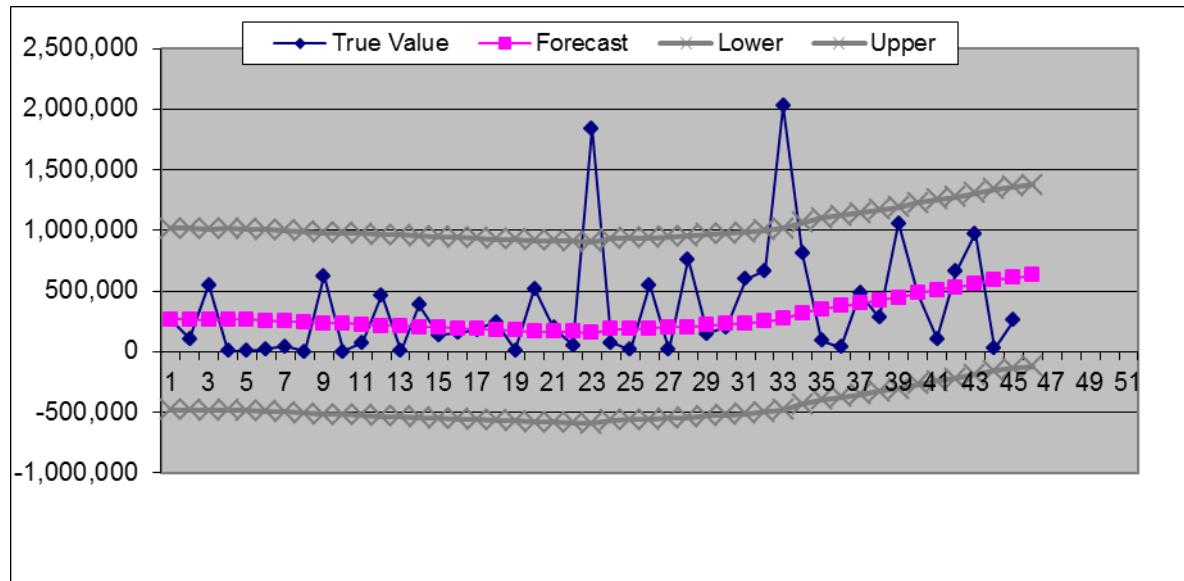
Figure 21 Forecast of the Caribbean Region

Region	Lower: 5%	Forecast	Upper: 95%
Central America	445,461	1,090,749	1,736,036
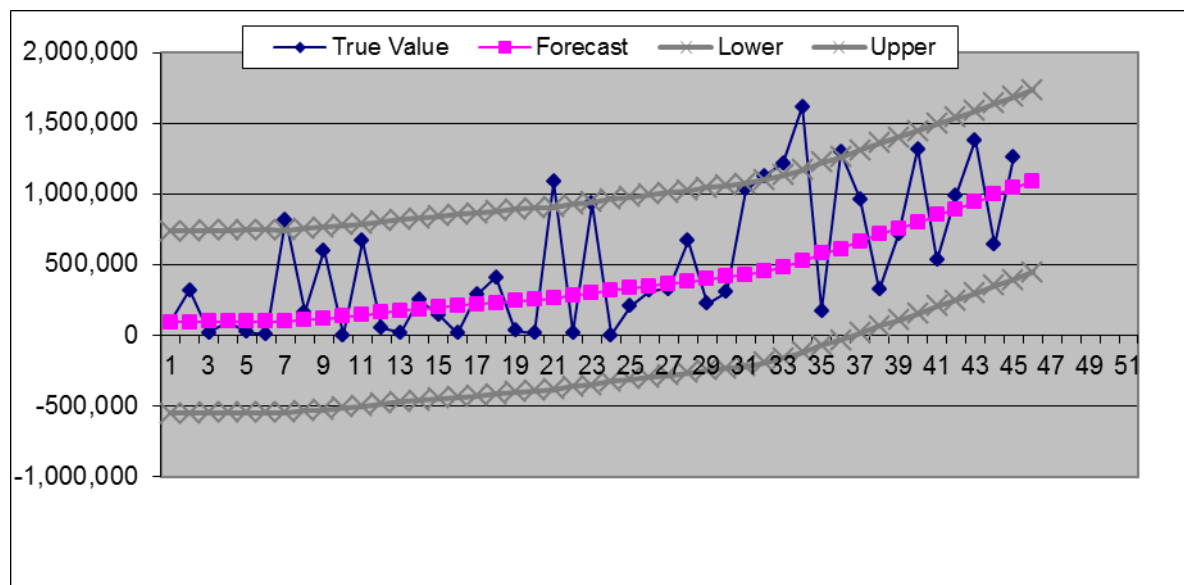
Figure 22 Forecast of the Central America Region

Region	Lower: 5%	Forecast	Upper: 95%
South America	283,492	1,037,241	1,790,991
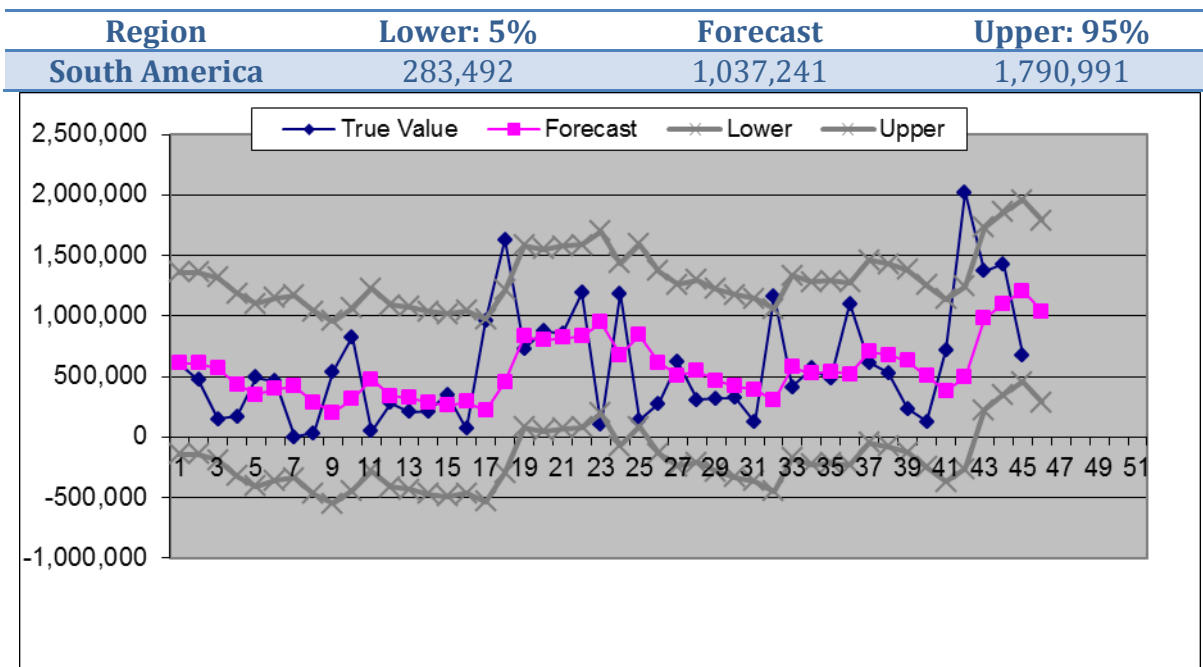
Figure 23 Forecast of South America Region

With this scenario there was an increase in the expected number of affected people for the region of The Caribbean, this is mainly due to the addition of Venezuela to the forecasting model. As seen on the previous state there is an increasing trend of affected people.

In Central America Region there is also an increase in the expected number of affected people as well as an increase in the trend with respect to the previous scenario. This is attributed to the addition of Colombia to this region.

South America now presents a very interesting situation; it went from one increasing trend and another one almost constant, to a very variable trend. This can be attributed to the addition of the whole Southern Cone region, and the removal of Venezuela and Colombia. A lot of variation could be seen in this last model, the MAD had increase with respect to the previous state.

Region	Forecast Affected People
Caribbean	23%
Central America	39%
South America	37%

Table 9 Forecast Percentage of Affected People

Now with this distribution of countries, two regions are overcharged. As discussed previously this scenario caused more variation in the forecast, increasing the MAD. Based on the previous statements we recommend the four warehouse scenario over the scenario with three warehouses.

Region	Historic Affected People
Caribbean	24.96%
Central America	35.02%
South America	40.02%

Table 10 Historic Percentage of Affected People

Region	Historic Events
Caribbean	28.76%
Central America	38.42%
South America	32.82%

Table 11 Historic Occurrence of Events in LAC

The demand estimate demonstrated that the South America sub-continent should be treated as a whole; therefore the Southern Cone and the South America sub-regions were eliminated. The factor rating analysis was conducted from Colombia through Chile. The region was denoted South America.

Network design for three warehouse scenario

SOUTH AMERICA									
Data									
	Weight	Chile	Brasil	Argentina	Paraguay	Uruguay	Peru	Ecuador	Bolivia
Logistics Performance Index	25	3.09	3.20	3.10	2.75	2.75	2.80	2.77	2.51
Lead Time	25	3.71	1.43	1.71	0.43	2.14	4.14	4.00	1.00
Enabling Trade Index 2010	25	5.00	3.76	3.64	3.53	4.29	4.04	3.74	3.59
World Risk Index of Vulnerability	25	5.00	2.00	2.00	2.00	2.00	3.00	4.00	2.00
Results									
Total	100								
Weighted sum		420.11	259.71	261.36	217.71	279.57	349.57	362.75	227.50
Weighted average		4.20	2.60	2.61	2.18	2.80	3.50	3.63	2.28
		MAX	4.20	CHILE					

Figure 24: Factor Rating Analysis for South America

Based on the analysis, Chile would be the ideal location to set a sub-regional warehouse.

CENTRAL AMERICA								
Data								
	Weight	Costa Rica	Guatemala	El Salvador	Honduras	Nicaragua	**Panama**	Colombia
Global Logistic Index	30	2.91	2.63	2.67	2.78	2.54	**3.02**	2.77
Lead Time	30	4.86	4.43	4.29	4.43	4.71	**5.00**	4.71
Enabling Trade Index 2010	20	4.45	3.97	4.16	4.43	3.85	**4.12**	3.72
World Risk Index of Vulnerability	20	4.00	4.00	4.00	4.00	4.00	**4.00**	3.00
Results								
Total	100							
Weighted sum		402.01	371.16	371.87	384.83	374.63	403	358.93
Weighted average		4.02	3.71	3.72	3.85	3.75	4.03	3.59
		MAX	4.03	PANAMA				

Figure 25: Factor Rating for Central America and Colombia

CARIBBEAN											
Data											
	Weight	Antigua	Bahamas	Barbados	Cayman Islands	Cuba	Dominica	**Dominican Rep.**	Grenada	Venezuela	Guadalope	Guyana
Global Logistic Index	30	3.29	2.71	4.14	4.71	2.07	1.00	**2.82**	4.29	2.68	3.29	2.27
Lead Time	30	3.29	2.71	4.14	4.71	2.57	3.71	**4.43**	4.29	4.14	3.29	3.00
Enabling Trade Index 2010	20	1.00	1.00	1.00	1.00	1.00	1.00	**3.94**	1.00	3.04	1.00	3.42
World Risk Index of Vulnerability	20	3.00	3.00	3.00	3.00	3.00	3.00	**4.00**	3.00	3.00	3.00	4.00
Results											
Total	100											
Weighted sum		277.14	242.86	328.57	362.86	219.24	221.43	376.26	337.14	325.40	277.14	306.50
Weighted average		2.77	2.43	3.29	3.63	2.19	2.21	3.76	3.37	3.25	2.77	3.07
		MAX	3.76	DOMINICAN REPUBLIC								

CARIBBEAN											
Data											
	Weight	Haiti	Jamaica	Martinique	Puerto Rico	St. Lucia	St. Vincent	Trinidad	Turks	Virgin Islands	Belice	Suriname
Global Logistic Index	30	2.59	2.53	4.14	4.43	3.57	3.57	4.00	1.00	3.71	3.43	3.71
Lead Time	30	4.43	4.14	4.14	4.43	3.57	3.57	4.00	1.00	3.71	3.43	3.71
Enabling Trade Index 2010	20	1.00	3.92	1.00	5.00	1.00	1.00	1.00	1.00	5.00	1.00	1.00
World Risk Index of Vulnerability	20	5.00	4.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00
Results											
Total												
Weighted sum		330.56	358.59	328.57	425.71	294.29	294.29	320.00	140.00	382.86	285.71	322.86
Weighted average		3.31	3.59	3.29	4.26	2.94	2.94	3.20	1.40	3.83	2.86	3.23
		MAX	3.76	DOMINICAN REPUBLIC								

Figure 26: Factor Analysis for the Caribbean

Three Warehouse Scenario Potential locations

After the-what if analysis was conducted to assign countries to the 4 potential sub-regional warehouses determine that only three sub-regional warehouses where needed. Therefore after re-evaluating the sub-continent of South America, the proposed network is as follow.
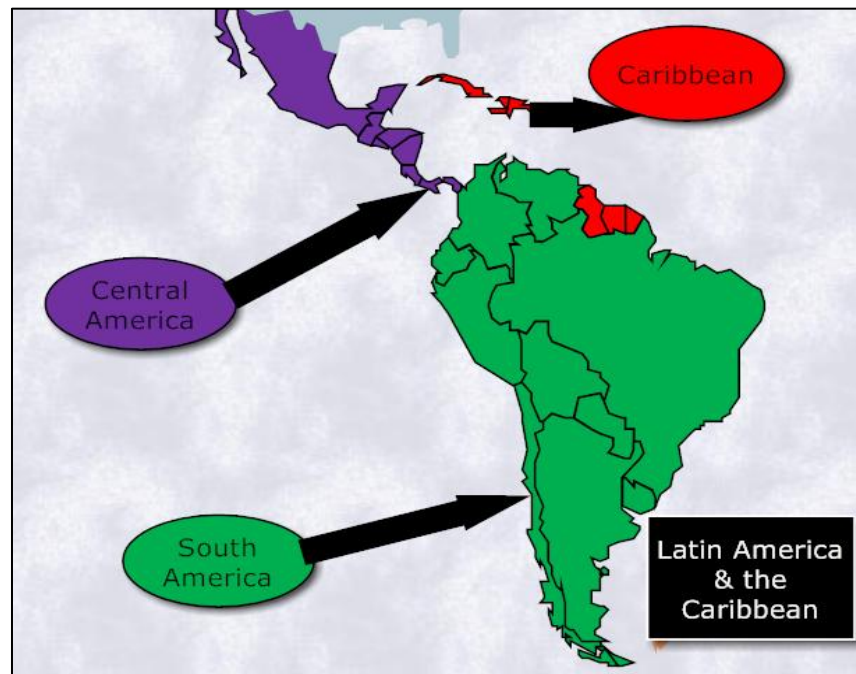
Figure 27: What If Potential Locations in LAC

Our suggested sub-regional warehouses based on only three locations are:

- **Central America:**   Panama

- **Caribbean**:   Dominican Republic

- **South America:**   Chile

You can refer to previous facts about these countries in the four location analysis.

PANAMA'S ASSESSMENT

Why Panama is a suitable Hub in the region?

Panama is building a new future and is getting closer to its ambition of becoming a trade hub for the Americas. It has signed a long term plan to expand its Canal in order to keep up with the international trade growth.

Panama is at a convenient equidistant point from most production and consumption centers stimulating management activities related to maritime, port and logistics. Due to this, transportation companies have invested in new facilities, machinery, and manpower in Panama. This allows them to provide the required attention to their customers. Panama itself has also done its fair share of investing, and is now in the process of Expanding the Canal to allow post "Panamax" Ships, and a new Pacific side container movement terminal.

Panama's trade policy is geared towards the promotion and strengthening of its transportation, logistics and maritime sector. With the Canal expansion, Panama will reinforce its competitive location, transport, and logistical hub. Using larger vessels, for instance, will be forced to dock at fewer ports with the result that the volume of cargo that has to be relayed, whether by smaller ships and/or overland, will increase, thereby raising overall distribution costs. This will strengthened Panama as the main focal point now allowing these vessels to dock, and then using its converging routes between North and South America and transcontinental routes, between east and west of the planet. This will also boost other local services such as transferring containers, using the railway, or local airline (Copa Airlines) to reach other destination in South America or the US.

Tourism will also, no doubt, increase. Other services that should grow are: services to ships in ports, railways, shipping agencies, fuel sales to vessels (bunker), intermodal ground transportation and others.

When the Canal expansion concludes by 2014, it will transform Panama into a global supply chain center. Manufacturers, distributors and logistics companies will be

drawn to Panama as the Canal begins to attract more commerce through North, Central and South America.

By focusing on logistics, for this globalized world, Panama as a transshipment center cannot remain distant to the pressures and demands of international trade, and thanks to our privileged geographical position, we have the most modern and competitive port terminals in Latin America.

We have an air terminal (Tocumen International Airport) that is the focal point for the different airlines and in coming years their facilities will be compared to the largest, modern and comfortable international airports.

Figure 28: Tocumen International Airport is Copa Airlines Hub of the Americas.

There is a huge and wealthy exchange of goods that occurs daily in the Colon Free Zone, which is in an expansion project of 243 hectares, of which 23 will be designed as a terminal for transshipment of goods by land. Continuously under processes of modernization and remodeling of their deposit, shipping and transit systems .Today, it counts with over 2,700 domestic/ foreign companies with an annual trade of over 12 billion dollars.

Figure 29: Aerial View of the Colon Free Zone

We also have a transoceanic railway "The Panama Canal Railway" that moves container goods from ports and also moves passengers between the coastal cities of Panama and Colon. The amount of cargo moved in recent years has come to be about 8 million of tons which is around 500,000 containers per year.

Figure 30: Panama Canal Railway locomotive.

Since 2008 we have been developing the Special Economic Area Panama-Pacific, located in the former Howard Air Force Base, with an investment of more than 705 million dollars in the next 40 years. This project aims to combine our logistics and telecommunications platform with business, financial and service experience. This will make Howard one of the most attractive international trade hubs.
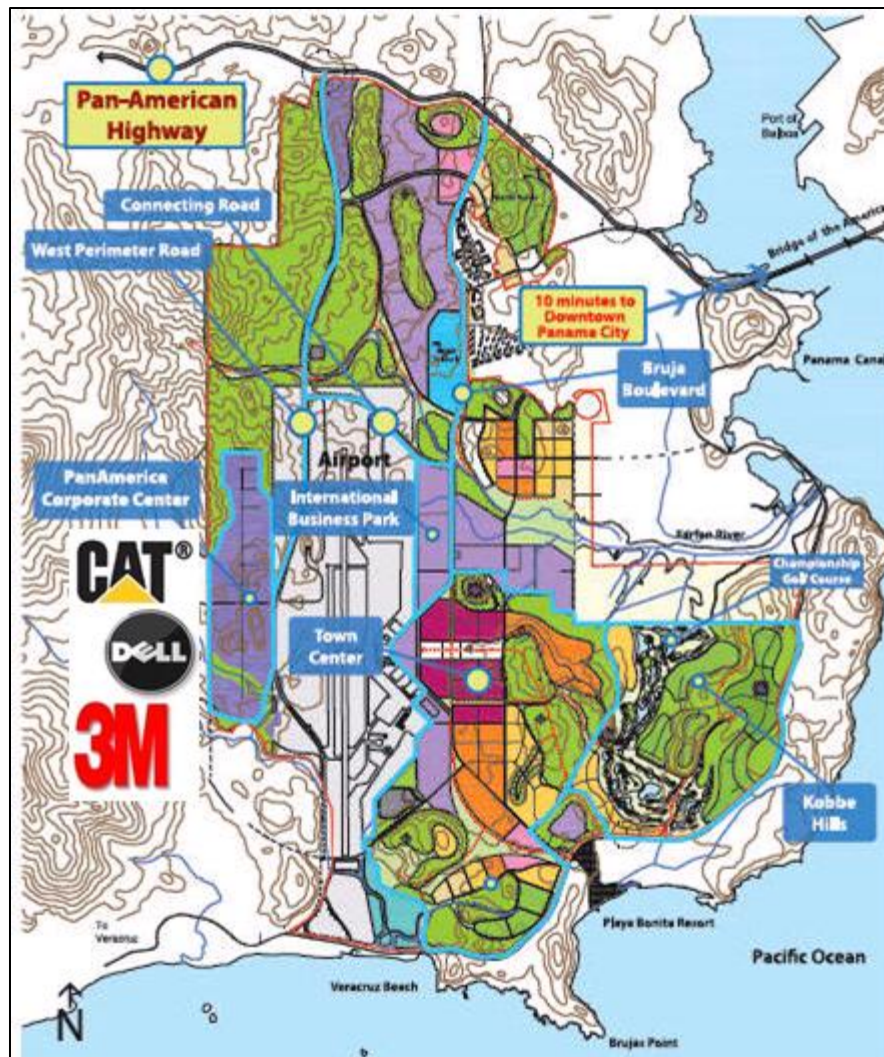
Figure 31: Special Economic Zone Panama Pacific and some of the Multinationals present here.

Who is here and why?

The United Nations Office for the Coordination of Humanitarian Assistance for the region of Latin America and the Caribbean (OCHA's ROLAC) facilitates the work of the Risk, Emergency and Disaster Task force Inter Agency Workgroup for Latin America and the Caribbean (REDLAC) , which is comparable to a regional Inter-Agency Standing Committee structure. REDLAC promotes coherence for inter-agency preparedness and response measures from the regional to the country level. The

active participation of regional cluster leads in REDLAC ensures a coordinated inter-agency approach to set implementing and further developing the cluster system. This work benefited the response to the disasters in Chile and Haiti in 2010. This agency has its regional office in Panama.

The Bureau for Crisis Prevention and Recovery (BCPR) is part of the United Nations Development Program (UNDP) posted a Disaster Reduction Advisor unit in Panama in 2002 to provide support to the approximately 30 UNDP disaster focal points in the region. In all UNDP field offices in disaster prone countries a senior national officer is designated as a disaster focal point for all disaster-related matters, including mitigation, response and international UN/UNDP preparedness. The major emphases of the bureau are risk reduction, capacity building and sustainable disaster reconstruction programs.

The International Strategy for Disaster Reduction (ISDR) has a regional office in Panama, who is focused on improving national compliance with the Hyogo Framework for Action (HFA) on disasters, signed in 2005 by 168 member states of the UN at the World Disaster Reduction Conference, which took place just a few weeks after the Indian Ocean Tsunami. The HFA is a 10 year plan to make the world safer from natural hazards and it engages with national partners in different sectors (health, education, agriculture, and housing) to promote risk reduction.

The international disaster focal points for the various international agencies operating in disaster prone countries form United Nations Technical Teams for Emergencies, linked to the Disaster Management Teams in each country, under the Resident Representative. Then each UN Country Teams report to OCHA through its ROLAC office in Panama and, at government request, will formally seek international assistance in disaster response. The country teams work on an ongoing basis with governments to build capacity. (Weiss Fagen Patricia, 2008)

AECID

In January 2008, the Spanish Agency for International Cooperation inaugurated a humanitarian logistics location in Panama to accelerate and improve their response to disasters in LAC.

The Agency for Humanitarian Assistance is able to handle several crises simultaneously. The principal areas of intervention are health care, water supply with advanced equipment for water treatment, sanitation, and shelter.

The Panama location helps in adapting materials and relief procedures to local needs. AECID has signed an agreement with PAHO/WHO to collaborate in facilitating health response for emergencies in Latin America and the Caribbean. (AECID)

Pan American Disaster Response Unit (PADRU)

Since the 1990's, with experiences such as hurricanes Mitch and George and flooding in Venezuela, the Red Cross has seen the need to build its capabilities in order to respond to natural disasters. Based on the lessons learned from these disasters, the International Federation has integrated new elements into the disaster response system in the Americas. The Pan American Disaster Response Unit (PADRU) is one of the instruments added to the Red Cross' disaster response mechanism in the Americas. The unit provides support to approximately 35 National Societies and 16 overseas branches in the region in evaluation, planning, monitoring, coordination, and support tasks during the implementation of response operations. Its first goal is to: "Reduce the number of deaths, injuries and impact from disasters". The Federation thus renews its mandate to mobilize the power of humanity in favor of the most vulnerable, especially when disaster strikes. Their roles are: When disaster strikes coordinate and provide for a more efficient international response from the Red Cross in Latin America and the Caribbean. When not responding to disasters, contribute to build local and regional response capacity in the National Societies. (IFRC)

World Food Program

WFP has established the United Nations Humanitarian Response Depot (UNHRD) network with five strategic hubs; they are located in Brindisi (Italy), Dubai (United Arab Emirates), Panama City (Panama) and Accra (Ghana) with Subang (Malaysia). The UNHRD is a preparedness tool supporting the strategic stockpiling efforts of UN, International, Governmental and non-Governmental organizations, and reinforcing the capacity of the humanitarian community to respond to emergencies.

The depots provide logistics and procurement services for the emergency response operations of all UN agencies, as well as international, governmental and non-governmental organizations.

UNHRD Panama is located at Corozal Free Zone, within Panama City and mainly serves the LAC Region. The current warehouse consists of 1600 sq. /m of dry storage area and 110 sq. /m temperature controlled storage area. Currently under project is the construction of 5,000 sq. /m covered and 5,000 sq. /m of open storage space, including temperature controlled area, office and training facilities. The depots stock vital supplies such as high-energy biscuits, drugs and other rapid response equipment essential for emergency operations.

The Pan American Health Organization (PAHO)

PAHO is an international public health agency with over 100 years of experience working to improve health and living standards of the people of the Americas. It enjoys international recognition as part of the United Nations system, serving as the Regional Office for the Americas of the World Health Organization, and as the health organization of the Inter-American System. The Organization's essential mission is to strengthen national and local health systems and improve the health of the peoples of the Americas, in collaboration with Ministries of Health, other government and international agencies, nongovernmental organizations, universities, social security agencies, community groups, and many others.

PAHO promotes primary health care strategies, which reach people in their communities, to extend health services to all and to increase efficiency in the use of scarce resources. It assists countries in fighting old diseases that have re-emerged, such as cholera, dengue and tuberculosis, and new diseases such as the spreading AIDS epidemic, providing technical cooperation including education and social communications support, promoting work with non-governmental organizations, and support for programs to prevent transmission of communicable diseases. The Organization is also involved in prevention of chronic diseases such as diabetes and cancer, which are increasingly affecting the populations of developing countries in the Americas.

World Vision International

WVI is a Christian humanitarian organization dedicated to work with children, families, and their communities worldwide reaching their full potential by tackling the causes of poverty and injustice. They serve close to 100 million people in nearly 100 countries around the world. World Vision serves all people, regardless of religion, race, ethnicity, or gender.

The millions of people they serve include earthquake and hurricane survivors, abandoned and exploited children, survivors of famine and civil war, refugees, and children and families in communities devastated by AIDS in Africa, Asia, and Latin America..

With natural and man-made disasters predicted to be on the rise in the next decade, World Vision has developed the Global Pre-positioning Resource Network (GPRN), a specialized logistics unit that is always on standby to provide assistance in emergency logistics preparedness and planning at all levels within the organization, including logistics assessments, preparedness plans, programming standards, development of logistics plans, and pre-positioning of NFI (non-food items). NFI are pre-positioned for up to 225,000 beneficiaries in seven strategically located global warehouses around the world. This extensive global infrastructure enables them to respond anywhere in the world .The warehouse for LAC region is located in Panama City, Panama.

The GPRN's primary mandate is to be constantly prepared to provide rapid emergency logistics support to World Vision emergency relief teams globally. The GPRN has relief supplies sufficient for 500,000 disaster-affected people pre-positioned in warehouses located strategically around the world and can transport these supplies to the last mile to reach those in need.

The team works to help build the operational capacity of World Vision's regional disaster management teams to support emergency programs through its emergency logistics training and capacity assessments and provides "first responder" emergency logistics personnel on stand-by, ready to deploy at short notice. (World Vision International, 2011)
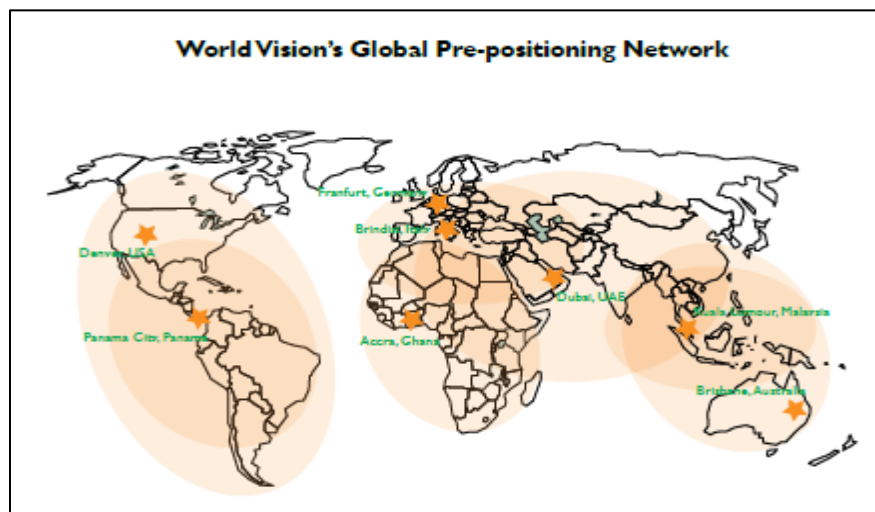
Figure 32: WVI Global Prepositioning Network. Source: GPRN Brochure

USAID

The United States Agency for the International Development in Panama is committed to maintaining and strengthening the ongoing partnership between the United States and Panama in economic growth, democracy and governance.

USAID provided in the sixties through most of the eighties substantial financial resources to assist the Government of Panama (GOP) in a range of socioeconomic

sectors. Activities financed targeted the health, education, and housing sectors. Also, assistance was aimed at population, nutrition, rural and urban development. Following Operation Just Cause, the focus turned in the nineties to revitalization of the financial sector, humanitarian assistance, conservation of the Canal Watershed, administration of justice, and economic policy reforms. Towards the end of the decade, USAID embarked on a process of reengineering to achieve greater efficiencies and development impacts with increasingly limited resources.

In Panama, USAID currently pursues two Strategic Objectives: Ruling Justly: More Responsive, Transparent Governance, and Economic Freedom: An Open, Diversified, and Expanding Economy. The bilateral program also supports activities to strengthen selected communities. In addition, the USAID Regional Programs include HIV/AIDs Prevention, Environmental Protection, and Disaster Preparedness. (USAID)

After Hurricane Mitch affected Central America in 1998, the world saw it devastating effects and created conscience of preparedness in order to successfully respond to disasters. This set the way for NGO'S, UN agencies and Donors to establish regional offices in the LAC region from where they were able to coordinate disaster responses, create mitigation plans and collaborate among them in order to be able to have a fast response.

The mechanisms and the communication channels established after the effects of Hurricane Mitch were tested, when Haiti suffered the strongest earthquake since 1770, according to USGS.

Current Needs

Aware of what awaits, Panama needs to prepare manpower in logistics and related fields. From all our assets, we lack high level of integration for trade hub status. We also lack logistic services and supporting infrastructures such as public warehousing, logistic technologies.

We used the Logistic Performance Index, which is an interactive benchmarking tool created to help countries identify the challenges and opportunities they face in their performance on trade logistics and what they can do to improve their performance, to analyze the current logistic status of the country.

We used the Country Scorecard which uses six key dimensions to benchmark countries performance and also displays the derived overall LPI index. The scorecard allows comparisons with the World (with the option to display World best performer) and with the Region or income group (with the option to display the Region's or income group best performer) on the six key dimensions and the overall LPI index. (World Bank, July)
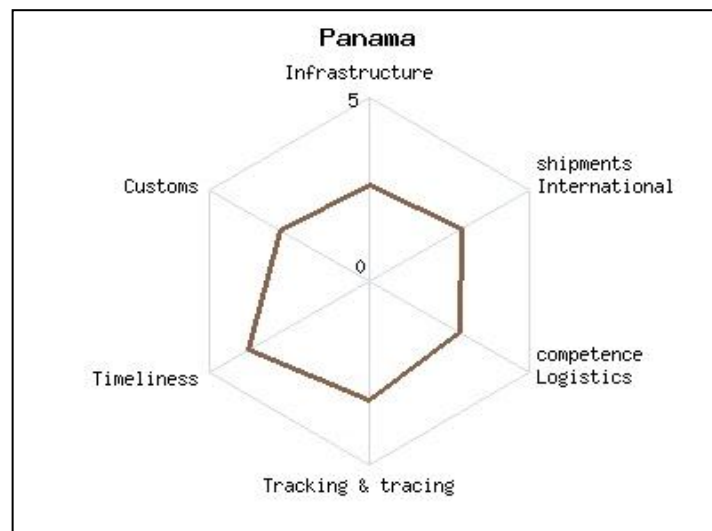
Figure 33: Country Scorecard LPI (World Bank)

From this scorecard, we can infer that even though Panama is in the average range, we are not scoring higher than what the country wants.

As we can see Panama score well on Customs, Tracking and Tracing, and Timeliness, but if we compare those scores to the rest of the region (Table 19-Annex) we can see that Panama has great opportunities to improve the Infrastructure, International Shipments, Logistics Competence, Tracking and Tracing and Timeliness areas, because their scores are just among the top five in the region. The first position of almost every aspect is Brazil, and the distance between us is considerable. We need to see what Brazil is doing to score better on Logistics Aspects; continue building more infrastructures; and continue with the improvement on customs to keep the current pace.

		Panama
Overall LPI	score	3.02
	rank	51
Customs	score	2.76
	rank	49
Infrastructure	score	2.63
	rank	61
International shipments	score	2.87
	rank	71
Logistics competence	score	2.83
	rank	57
Tracking & tracing	score	3.26
	rank	47
Timeliness	score	3.76
	rank	47

Table 12: Panama's LPI rank and score.

Agencies working together: the coming together of agencies around common strategies at the regional and country levels as "a new way of doing business" in support of development and humanitarian action.

The strategies for facing natural disasters or financial crises require global response, shared leadership and practical coordination mechanisms. In this sense, Panama, thanks to its strategic position and the facilities it affords from the logistic viewpoint, favors the consolidation of a new humanitarian model, a new international architecture for humanitarian response to natural disasters in the region. The consolidation of an international humanitarian hub for Latin America and the Caribbean, with headquarters in Panama, allows humanitarian organizations a prompt, coordinated and more efficient response whenever a disaster occurs. We are thus witnessing a humanitarian response decentralization process, unheard of in any other region and which could be taken as a model to be followed.

The consolidation in Panama of this working Group has been a step forward in interagency coordination. In addition, it also involves the necessary responsibility of the humanitarian international community, governments and national authorities that require a coordinated humanitarian community that may facilitate support and will not generate further chaos to that already existing when a disaster occurs in some area of the region.

This humanitarian working table includes the main United Nations agencies in this sphere, such as the Office for Coordination of Humanitarian Affairs, Unicef, the World Food Program or the PanAmerican Health Organization, among others, as well as nongovernmental organizations such as Oxfam or Doctors without Borders and some donors such as the Humanitarian Office of the European Commission or Spanish Cooperation.

Secondly, from a practical standpoint, Panama is becoming the platform for humanitarian response to the region of the Americas, from which organizations and

governments offer their technical and material support to the victims of natural disasters. The logistic and supply facilities, together with its geographical position make Panama a suitable place for this initiative. For this reason, for several years the International Red Cross Federation, through its PanAmerican Unit of Response to Disasters and recently, the United Nations, through its Humanitarian Response Warehouse or Spanish Cooperation, through its Humanitarian Logistic Center in Latin America, among others, have based their humanitarian response operations in Panama. The devastation caused by hurricanes "Gustav", "Hanna" and "Ike" is a good example thereof. Over eight humanitarian charters from different organizations and some containers with humanitarian aid have been sent from Panama to Cuba, Jamaica, Haiti and other places.

The dimension of this platform and its operation as a whole, is still a challenge. However, there is already a requirement for all of them; that is, they are obliged to understand each other and work as a responsible, humanitarian community that maximizes its resources and guarantees that their support will cause an impact. It is necessary to ensure tangible results.

More than ten years have elapsed since hurricane "Mitch" .It's devastating effect shattered the Central American economies and jeopardized the development of these countries for many years. Therefore, we are all obliged to reflect on how to reduce risks, temper the impact of these natural phenomena and provide an adequate response, to soothe the suffering of those affected during the critical moments.

Case Study: Panama vs. Costa Rica

From the weighted factor rating method, for the Sub-region of Central America, the results gave a technical tie between Panama and Costa Rica. Therefore, a case study of these two countries was developed to prove why Panama is the best location to set a sub-regional warehouse and why Panama is the ideal place to be in terms of a Regional Logistics Hub.

Panama has the third or fourth largest economy in Central America and it is the fastest growing economy and the largest per capita consumer in Central American. As of 2010, Panama is the second most competitive economy in Latin America according to the GCI from the WEF. The WEF's Centre for Global Competitiveness and Performance through its Global Competitiveness Report and report series, aims to mirror the business operating environment and competitiveness of over 130 economies worldwide. The report series identify advantages as well as impediments to national growth thereby offering a unique benchmarking tool to the public and private sectors as well as academia and civil society.

RANKS	Panama	Costa Rica
Overall LPI	51	56
Customs	49	58
Infrastructure	61	67
Intl Shipments	71	105
Logistic Competence	57	59
Tracking & Tracing	47	54
Timeliness	47	51

Table 13: International LPI ranking for Panama and Costa Rica.

Country	LPI	Customs	Infrastructure	International shipments	Logistics competence	Tracking &tracing	Timeliness
Panama	3.02	2.76	2.63	2.87	2.83	3.26	3.76
Costa Rica	2.91	2.61	2.56	2.64	2.8	3.13	3.71

Table 14: Comparison between the LPI 2010 of Panama and Costa Rica.

While other countries have struggled during the recent global recession, Panama's democracy and free market economy have demonstrated their resilience. The country also was recognized as worthy of Investment Grade bond ratings and the WEF's ranking as the 2nd most competitive economy in Latin America. Below are just a few of the highlights of Panama's global and regional rankings for freedom and economic competitiveness:

1.5 - Most Free.

Freedom House's 2010 Freedom in the World combined score of Panama's political and civil liberties system.

#1–for Financial Freedom In Latin America.
According to the 2010 Index of Economic Freedom (IEF), Panama's financial freedom score of 70.0 is tied with two other countries for the best in Latin America and is more than 20 points higher than the world average.

#1 – for Port Facilities in the Western Hemisphere.
Panama ranked first in the Western Hemisphere and 11th in the World for the quality of port facilities, according to the WEF Global Competitiveness Report (GCR) 2010-2011.

#1 – in Latin America for Availability of Venture Capital.
The WEF GCR 2010-2011 ranked Panama number one in the region, and third in the Western Hemisphere behind Canada and the U.S., for availability of venture capital.

#1 – for Air Transport Facilities in Latin America.

Panama ranked 1st in Latin America and 24th in the world for the quality of its air transport facilities, according to the WEF GCR 2010-2011.

#2 – among Most Competitive Economies in Latin America

The WEF GCR 2010-2011 ranked Panama number two in the region based on infrastructure quality, increased macroeconomic stability and technological readiness.

#3 – for Business Freedom in Latin America

Panama ranks behind only 2 other countries in Latin America for business freedom according to the 2010 IEF. Panama's business freedom score of 75.9 is more than 10 points higher than the world average.

#4 – in the World for Affordability of Financial Services

Panama ranked fourth in the world and first in the Western Hemisphere for the affordability of financial services, according to the WEF's GCR 2010-2011.

Below is a comparative chat extracted from the GCR 2010-2011 conducted by the WEF. This report counts with 12 pillars of competitiveness which are:

1. **Institution:** The institutional environment is determined by the legal and administrative framework within which individuals, firms, and governments interact to generate income and wealth in the economy.

2. **Infrastructure:** Extensive and efficient infrastructure is critical for ensuring the effective functioning of the economy, as it is an import factor determining the location of economic activity and the kinds of activities or sectors that can develop in a particular economy.

3. **Macroeconomic environment:** The stability of the macroeconomic environment is important for the overall competitiveness of a country.

4. **Health & Primary Education:** A healthy workforce is vital to a country's competitiveness and productivity.

5. **Higher Education & Training:** Quality higher education and training is crucial for economies that want to move up the value chain beyond simple production processes and products.

6. **Goods Market Efficiency:** Countries with efficient goods markets are well positioned to produce the right mix of products and services given their particular supply-and-demand conditions, as well as to ensure that these goods can be most effectively traded in the economy.

7. **Labor Market Efficiency:** The efficiency and flexibility of the labor market are critical for ensuring that workers are allowed to their most efficient use in the economy and provided with incentives to give their best efforts in their jobs.

8. **Financial Market Development:** An efficient financial sector allocates the resources saved by nation's citizens, as well as those entering the economy from abroad, to their most productive used.

9. **Technological Readiness:** Measures the agility with which an economy adopts existing technology to enhance the productivity of its industries.

10. **Market Size:** The size of the market affects productivity since large markets allow firms to exploit economies of scale.

11. **Business Sophistication:** Is conductive to higher efficiency in the production of goods and services. This leads, in turn to increased productivity, this enhancing a nation's competitiveness.

12. **Innovation:** It is important for economies as they approach the frontiers of knowledge and the possibility if integrating and adapting exogenous technologies tends to disappear.

The Global Competitiveness Index 2010			
The 12 pillars of Competitiveness		Panama	Costa Rica
Basic Requirements		**49**	62
1	Institution	73	**51**
2	Infrastructure	**44**	78
3	Macroeconomic environment	**30**	108
4	Health & Primary Education	76	22
Efficiency Enhancers		62	**58**
5	Higher Education & Training	82	**43**
6	Goods Market Efficiency	50	**48**
7	Labor Market Efficiency	106	**45**
8	Financial Market Development	21	85
9	Technological Readiness	41	57
10	Market Size	85	**82**
Innovation & Sophistication factors		54	**33**
11	Business Sophistication	46	**32**
12	Innovation	64	**35**

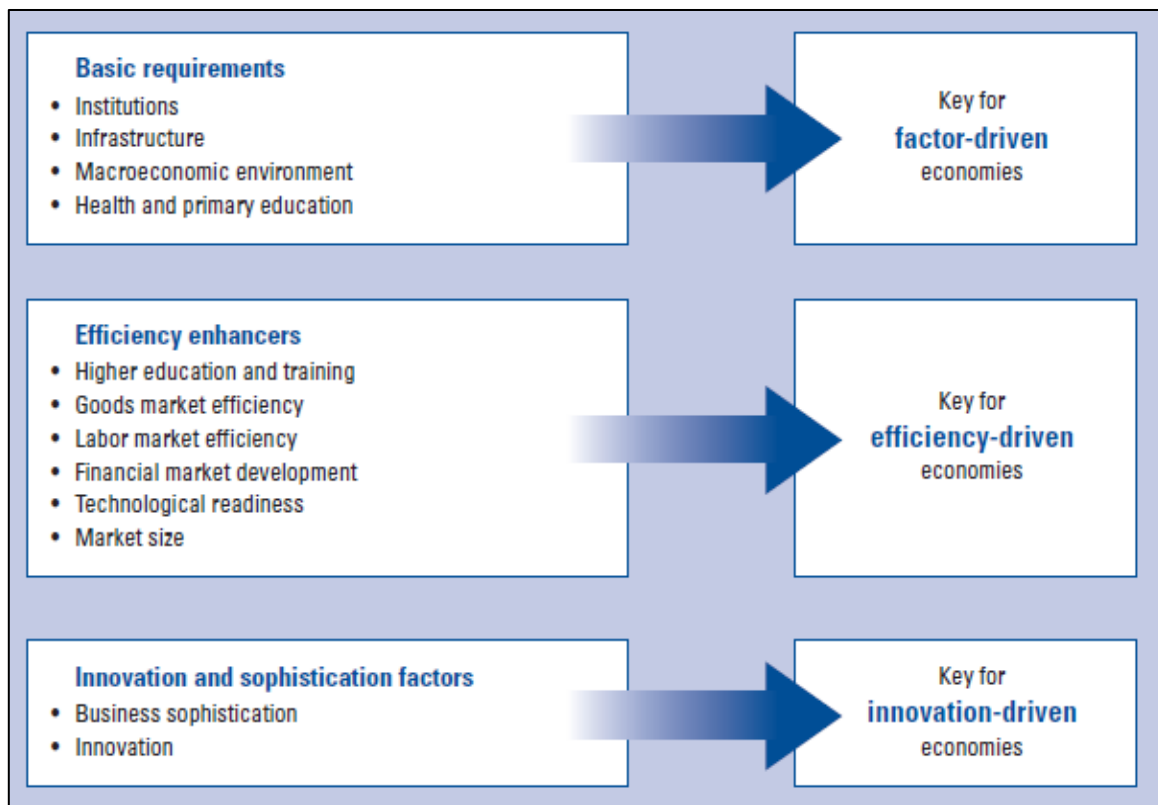**Table 15: Panama vs. Costa Rica results from the GCI 2010.**

Figure 34: The 12 pillars of competitiveness. Retrieved from The Global Competitiveness Index 2010-2011.

The basic requirement sub index groups those pillars most critical for countries in the factor-driven stage. The efficiency enhancers sub index includes those pillars critical for countries in the efficiency-driven-stage. And the innovation and sophistication factors sub index includes the pillars critical to countries in the innovation-driven stage. The three sub-indexes are shown in Figure 17. (Schwab, 2010)

As shown in Table 12, Panama beats Costa Rica in the basic requirements. Nonetheless, the results are clear Costa Rica scores better in the Efficiency enhancers and in the Innovation and Sophistication factors. This means that even though Panama is in a higher rank in overall, it still needs to develop in the areas where Costa Rica outsets it.

The Regional Disaster Information Center for Latin America and the Caribbean (CRID) was established in 1997 in San Jose, Costa Rica, when five organizations agreed to pool their disaster-related information and cooperate in its dissemination: Pan-American Health Organization (PAHO), ISDR, the International Federation of Red Cross (IFRC), Doctors Without Border regional office and the Costa Rica National Risk Prevention and Emergency Commission. PAHO and ISDR provide most of the resources for CRID, supplemented by European donors and the system's users.

Due to the great number of humanitarian agencies established in Panama, such as IFRC PADRU Depot, UN WFP Response Depot and the AECID Depot. It makes sense that CRID be moved to Panama City, in order to provide their information where is most needed, helping the big players of the region to work among each other. Since its creation in 1997, Panama has progress in the infrastructure provided to these agencies, this trigger the establishment of many regional offices in Panama City.

Other advantages of Panama
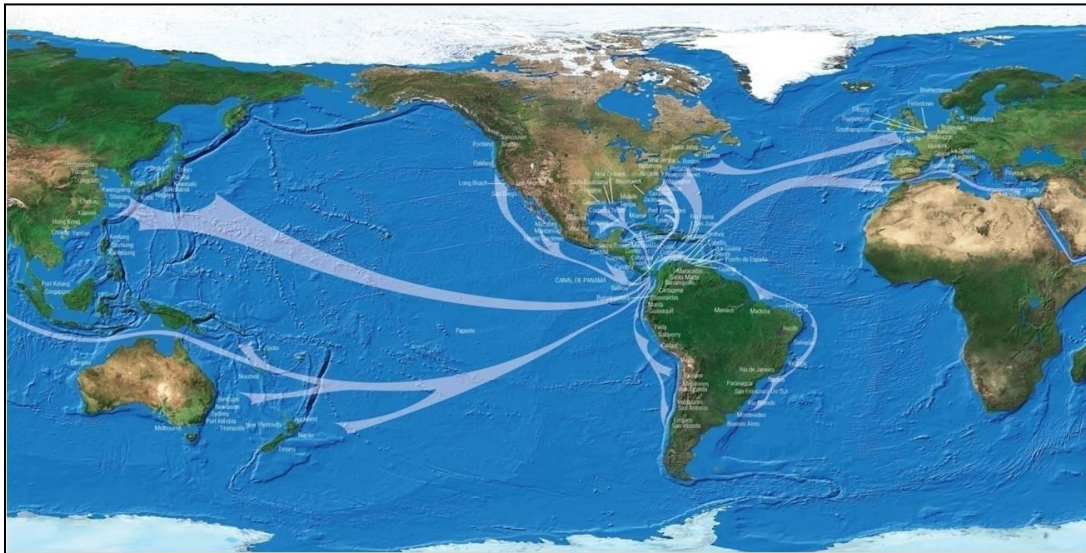
Figure 35: Market Access from Panama. Panama offers direct access to a market of more than 3.5 B people.

Panama offers direct access to a market of more than 3.5 billion people.

Panama has highly ambitious infrastructure plans for 2011-2014 (the new administration will step down in 2014). The government's budget for 2011 may well be the biggest ever, with massive infrastructure projects such as the Panama Canal expansion, a new airport, and major road works fueling the economy while costing the nation billions.

Figure 36: Panama's Connectivity

Best Connectivity in Latin America

Panama could improve its educational system, labor market flexibility, and human resource initiatives to further spur long-term growth and become more competitive, says the WEF report.

Although Costa Rica is very close to Panama in term of ranks, the severe inefficiencies at the Limon-Main Port are proving to be a critical bottleneck to Costa Rican exports, particularly considering that 90 percent of Costa Rica's container sea traffic goes through this port. Occupancy rates at the docks have been very high and this led to an average 13.6 hour wait time per ship. They should develop a new organizational structure for the port that will impact the entire logistic chain and reduce costs to users. Also Costa Rica must improve their business climate. There is no doubt that

improvements to the business climate increases productivity and Costa Rica could make huge advances in this field.

The Doing Business 2009 report ranked Costa Rica 117 out of 180 countries, suggesting its business regulation procedures were not efficient compared to most countries. It is important to mention that Costa Rica felt the effects of the crisis more acutely than most of its Central American neighbors because of its greater dependence on the global economy. As for infrastructure, it is a major or severe constraint to growth.

Even though Costa Rica's endowment of infrastructure is comparatively much better than neighboring countries - underinvestment, lack of innovation, limited private sector participation, and weak regulation are hurting infrastructure quality. Given that Costa Rica is dependent on an export-led growth strategy, poor infrastructure is particularly worrisome since it damages firms' competitiveness in the global market. Bottlenecks preventing the movement of goods or high logistic costs reduce opportunities for greater international integration for Costa Rican firms.

The World Bank's Doing Business rankings identified shortcomings for Costa Rica's business regulation, a key element of its competitiveness. Costa Rica's overall ranking improved one place (from 118 to 117) between the Doing Business 2008 and 2009 reports. However, the country's ranking in several key categories dropped over the last year and it continues to receive low rankings in other categories. Among the processes where Costa Rica ranked poorly overall were starting a business (123), dealing with construction permits (123), protecting investors (164), paying taxes (152), and enforcing contracts (132). Particularly troubling are its drops in starting a business, getting credit, and trading across borders. These drops indicate a faltering performance that could hurt the country's position as an attractive place for business, even within Central America.

RANKS	2008	2009
Overall Ranking	118	117
Starting a Business	116	123
Dealing with construction permits	117	123
Employing workers	76	77
Protecting Investors	161	164
Paying Taxes	164	152
Enforcing Contracts	131	132
Registering Property	42	45
Getting Credit	51	59
Trading Across Borders	82	94
Closing a Business	107	98

Table 16: Costa Rica Doing Business 2008-2009 rankings Source: World Bank (2008), Doing Business database

The WEF's GCR cites Costa Rica as a success story in competitiveness in Central America. The report states that the reasons for this are its ―fairly efficient institutions, relatively good primary and higher educational systems, flexible labor markets, and the impressive sophistication and capacity for innovation displayed by its business sector. The report also identifies key bottlenecks, specifically infrastructure. Among the worst performers within infrastructure are the quality of roads, railroads, and ports. Confirming the severity of infrastructure concerns, as part of the report, 20.5 percent of respondents to the World Economic Forum's executive survey cited infrastructure as the most problematic factor for doing business, ranking second to inefficient government bureaucracy.

Overall we can conclude that Costa Rica has a certain degree of consensus on the role that infrastructure plays as a barrier to competitiveness and growth.

Different indicators used for measuring logistics performance in Costa Rica demonstrate mediocre results. The Logistics Perception Index (LPI)—probably the best indicator for measuring logistics performance in a country - ranks Costa Rica as number 56 out of a total of 155 countries. The most serious problems that are highlighted by the sub-indices (those that tend to worsen a country's ranking) are linked to the organization of logistics services.

INTERNAL TRANSPORT	Highways	◑	Highways in deficient condition, low efficiency trucks, high fees to users.
	Railways	-	Minimum freight services
TRANSFER NODES	Ports	●	Low efficiency; do not fulfill functions, serious in Limon-Moin, affecting the entire value-chain
	Airports	○	Juan Santamaria International Airport operates cargos, with room for improvements. Potential in Liberia
	Border Checkpoints	●	Serious problems in the north; long waits. Poor procedures and infrastructure
EXTERNAL TRANSPORT	Sea	●	Ports suffer from lack of dredging, lack of cranes, inefficient operations
	Air	○	No significant problems, with opportunities for improvements
	Land	○	Companies function well; problems at border checkpoints
BUSINESS LOGISTICS	Managing Supply Chains	○	Large companies are well organized; there is ample space for improving SMEs
	Logistics Operators	◑	Transport companies do not incorporate logistics functions
TRADE FACILITATION	Inspection	◑	Intermediate performance; need to improve systems and unify inspections
	Security	◑	Problems due to robberies of highway transporters

○ Good, minor problems   ◑ Average, considerable problems   ● Poor, serious problems

Figure 37: LPI sub indexes.

SWOT Analysis

Strength
- Regional offices of most NGOs are located here in Panama
- Low risk of damages due to natural disasters to logistic infrastructure.
- Political stable and secure

Weakness
- Poor connectivity with Caribean Islands
- Lack of regional suppliers

Opportunities
- Increase Govenment funds and support such as the International Humanitarian City of Dubai.

Threats
- Neighboring countries that enforce their weekness and start becoming a direct competitor eg. Costa Rica.

Figure 38: SWOT analysis created by Juan et all.

This SWOTS analysis shows the current strategic view of Panama, and what should be enhanced in order to improve our position in the region and the world. Panama lacked of regional suppliers and based on our conversations with the UNHRD and IFRC-PADRU, their depots in Panama are isolated in terms of proximity to suppliers. Most of their suppliers are located in Asia and despite Panama's great connectivity the distance is quite large, locating suppliers in the region will have a considerable effect on lead time for prepositioning items and for response in a major emergency. Another aspect that weakened Panama's position is their connectivity with certain island in the Caribbean. To mitigate threats, Panama is investing to improve its LPI, but the country should pay close attention to the neighbors, especially Costa Rica, as was discusses previously.

In areas for improvement, Panama should standardize the customs procedure for the Humanitarian Organization, since they all not play with the same rules, this would allow the country to standardize their service in this area, trying to emulate what is currently being done by Dubai in their Humanitarian City.

CONCLUSIONS

In order to avoid variability in the demand, we suggest IFRC to develop a four Warehouse Strategy instead of a three Warehouse Strategy. Further research can be done in this area, exploring these two scenarios with other country distribution, for example.

RECOMMENDATIONS

It's imperative to remark the importance of the forecast on humanitarian relief operations, despite no forecast is accurate, it will give us an idea of what should be expected, allowing aid organization to prepare themselves, raising the necessary funds to be able to help the people in need.

We enforce the importance of been close to disaster prone areas, being able to respond faster and help or save more lives. Additionally, is beneficial for this Sub Regional Warehouses have regional suppliers, to reduce their lead times.

Panama should continue its policy of continuous improvement of logistics factors, and concentrate on educational aspects, as is doing right now. This would be the only way to mitigate the threat of Costa Rica, since in this area is where Panama is more vulnerable, according to the studies mentioned in the paper.

WORKS CITED

AECID. (n.d.). *AECID*. Retrieved June 2011, from Agencia Española de Cooperacion Internacional para el Desarrollo: www.aecid.es/web/es

AECID. (n.d.). *AECID*. Retrieved June 2011, from Actuaciones de la Cooperación Española en Haiti: http://www.aecid.es/web/es/noticias/Haiti/2010_02_03_respuesta_cooperacion_espanola.html

Andeen Community. (n.d.). Retrieved from http://www.comunidadandina.org/ingles/who.htm

Andersen, T. (2007). *Developing and supporting the use of disaster -linked financial instruments: The role of the IDB in Latin America and the Caribbean.* Washington, D.C.: Inter-American Development Bank.

Deutsche Welle. (n.d.). *Deutsche Welle*. Retrieved from http://www.dw-world.de/dw/article/0,,15160415,00.html

El Universo. (2010). Retrieved from http://eluniverso.com/2010/05/26/1/1356/ecuador-incentivara-14-sectores-economicos.html?p=1354&m=638

Government of Chile. (2011, April). *Ministry of Finance, Chile*. Retrieved from http://www.minhda.cl/english/investor-relations-office/why-chile.html

IFRC. (2011, July). *Federation Procurement Services*. Retrieved from http://procurement.ifrc.org/en/aboutus/Pages/Ourglobalstructure.asp

IFRC. (n.d.). *PADRU*. Retrieved June 2011, from Pan-American Disaster Response Unit: www.cruzroja.org/padru/

IFRC-Global Logistics Service. (2011). *Annual Report.* Geneva: IFRC.

MERCOSUR. (n.d.). Retrieved from http://www.mercosur.int/t_generic.jsp?contentid=655&site=1&channel=secretaria&seccion=2

Schwab, K. (2010). *The Global Competitiveness Report.* Geneva: World Economic Forum.

UNDP. (May 2008). *Fast Facts Latin America: Bureau for crisis prevention and recovery.* New York: UNDP Publications.

UNHRD. (n.d.). *Weekly Report: UNHRD*. Retrieved June 09, 2011, from UNHRD: http://www.unhrd.org/new/?category_name=weekly-reports&paged=22

USAID. (2000). *USAID.* Retrieved from
http://www.usaid.gov/dr/docs/resources/competitive_strategy_dr.pdf

USAID. (n.d.). *USAID*. Retrieved June 2011, from United States Agency for International
Development: www.usaid.gov

Weiss Fagen Patricia. (2008). *Natural Disasters in Latin America and the Caribbean:*
national, regional and international interaction. London: HPG.

WHO/CRED. (n.d.). *EM-DAT*. (U. C. Louvain, Producer) Retrieved June 2011, from The
OFDA/CRED International Disaster Database: www.emdat.be

Wikipedia. (n.d.). Retrieved June 09, 2011, from 2010 Haiti Earthquake:
http://en.wikipedia.org/wiki/2010_Haiti_earthquake

WIKIPEDIA. (2011). *Southern Cone*. Retrieved from
http://en.wikipedia.org/wiki/Southern_Cone

WIKIPIDEA. (2011, JULY). Retrieved from
http://en.wikipedia.org/wiki/Global_Enabling_Trade_Report

World Bank. (July). *Logistics Performance Index.* Retrieved from
http://info.worldbank.org/etools/tradesurvey/mode1a.asp

World Economic Forum. (n.d.). *International Trade*. Retrieved from
http://www.weforum.org/issues/international-trade

World Vision International. (2011, June). *WVI*. Retrieved from World Vision International:
wvi.org/wvi/wvieb.nsf

ACRONYMS

WFP	World Food Program
LACERN	Latin America and Caribbean Emergency Response Network
PADRU	Pan-American Disaster Relief Unit
REDLAC	Risk, Emergency and Disaster Task force Inter Agency Workgroup for Latin America and the Caribbean.
IFRC	International Federation of Red Cross and Red Crescent
UNDP	United Nations Development Program
PAHO	Pan American Health Organization
ROLAC	Regional Office for Latin America and the Caribbean

CEPREDENAC Center for the Coordination and Prevention of Natural Disasters for Central America.

CDEMA	Caribbean Disaster Emergency Management Agency
CAPRADE	Andean Committee for the Prevention and Assistance of Disasters
REHU	Specialized Meeting for the reduction of Humanitarian Assistance for the members of MERCOSUR.
OCHA	Office for the Coordination of Humanitarian Affairs
UNDMT	UN Disaster Management Team
UN	United Nations
BCPR	Disaster Reduction Unit for Crisis Prevention and Recovery
ISDR	International Strategy for Disaster Reduction
CRID	Regional Center of Information on Disasters
MSF	Doctor without Borders- Spain
REDHUM	Humanitarian Alert Network for Latin America and the Caribbean
WVI	World Vision International
UNICEF	United Nations Infant Children Emergency Fund

ECHO   European Commission-Humanitarian Aid & Civil Protection

AECID   Spanish Agency of International Cooperation for the Development

USAID   United States Agency for the International Development

UNHRD   United Nations Humanitarian Response Depot

LPI   Logistics Performance Index

GRIV   Global Risk Index of Vulnerability

ETI   Enabling Trade Index

WEF   World Economic Forum

GCI   Global Competitiveness Index

GCR   Global Competitiveness Report

GTI   Global Trade Index

FTA   Free Trade Index

PRF   Pension Reserve Fund

ESSF   Economic and Social Stability Fund

IMD   International Institute for Management Development

GLS   Global Logistics Services

IEF   Index of Economic Freedom

LTI   Lead Time Index

APPENDIX

Year	Drought	Earthquake (seismic activity)	Flood	Mass movement wet	Storm	Volcano	Grand Total
1966	156,000	111,362	344,228		354,925		966,515
1967		121,736	503,688		272,000		897,424
1968	670,217	2,920	27,760		1,083	15,671	717,651
1969	128,604	3,216	117,508		22,842		272,170
1970		106,370	414,471		5,000		525,841
1971			393,400	6	94,650	5,600	493,656
1972		720,000	140,370				860,370
1973		3,745	190,199		2,810		196,754
1974	507,000	43,674	383,000	14,500	820,000		1,768,174
1975			828,000				828,000
1976		20,008	23,000	16	576,400	170,003	789,427
1977	450,000	40,100	242,440	100	66,900		799,540
1978		3,850	217,600		13,770		235,220
1979		22,317	710,000		97,713	20,000	850,030
1980		9,586	488,400		135,564		633,550
1981		12,299	207,300	18,000			237,599
1982		33,017	1,021,456	30,000	306,300	40,500	1,431,273
1983	156,000	43,259	1,094,575	700,040	286,040	3,500	2,283,414
1984			415,600	12,014	343,373	3,000	773,987
1985		50,638	837,370	4,000	502,191	12,700	1,406,899
1986		804,680	1,272,465	366	61,806		2,139,317
1987	750,000	158,168	321,899	29,851	1,438	3,035	1,264,391
1988		2,050	398,878	6,025	2,463,022	3,900	2,873,875
1989		2,350	1,089,374	79,060	90,164		1,260,948
1990		121,919	228,836		3,500	4,000	358,255
1991		102,707	818,922	83,528	10,000	126,400	1,141,557
1992		13,683	598,819	660	49,750	305,075	967,987
1993		3,456	1,286,129	76,146	368,685	356	1,737,183
1994	125,000	37,416	176,355	165,518	113,308	75,700	693,297

Year							
1995		88,059	467,515	2,000	257,465	17,000	832,039
1996		107,427	462,806	7,390	1,166,463	4,743	1,748,829
1997	931,200	74,298	533,507	30,000	1,390,988	4,200	2,964,193
1998	920,000	20,328	414,800	2,758	2,298,237	1,808	3,657,931
1999	105,000	146,325	2,438,570	4,609	270,001	30,545	2,995,050
2000	21,125	7,908	438,364	143,585	96,010	41,800	748,792
2001	896,596	610,271	736,768	182	160,558	22,770	2,427,145
2002	103,500	727	845,672	3,974	957,617	149,950	2,061,440
2003	35,000	182,168	866,099	2,200	20,155	25,000	1,130,622
2004	192,500	9,071	634,722	7,045	1,160,863		2,004,201
2005	52,990	30,901	1,007,448	2,540	827,889	2,000	1,923,768
2006		16,470	736,687		285,968	320,463	1,359,588
2007		685,931	2,046,285	5,000	936,157	3,000	3,676,373
2008	45,500	1,754	2,201,576	16	1,442,952	30,358	3,722,156
2009	352,500	178,754	1,317,864	22,085	224,985		2,099,216
2010	124,500	25,232	893,573	51,750	1,099,160	4,300	2,198,515
Grand Total	6,723,232	4,780,150	30,834,298	1,504,964	19,658,702	1,447,377	64,954,162

Table 17 Affected People in LAC from 1966 to 2010

Year	Drought	Earthquake (seismic activity)	Flood	Mass movement wet	Storm	Volcano	Grand Total
1966	1	2	7		6		16
1967		2	9		2		13
1968	4	3	2		1	1	11
1969	1	1	4		3		9
1970		3	9		1		13
1971			5	1	2	2	10
1972		1	3				4
1973		1	6		2		9
1974	1	1	3	2	4		11
1975			1				1
1976		2	2	1	2	3	10
1977	1	1	7	1	3		13
1978		1	8		4		13
1979		5	10		4	1	20
1980		5	9		5		19
1981		3	4	2			9
1982		3	11	1	5	1	21
1983	2	4	6	2	4	1	19
1984			9	1	5	1	16
1985		3	7	1	3	1	15
1986		7	14	1	4		26
1987	1	4	19	5	3	1	33
1988		2	15	1	11	2	31
1989		2	7	2	8		19
1990		4	16		3	1	24
1991		8	7	3	1	2	21
1992		3	15	2	5	2	27
1993		3	14	4	10	2	34
1994	2	1	10	2	4	2	21
1995		9	14	1	18	2	44
1996		3	15	5	12	2	37
1997	3	5	12	1	10	2	33
1998	2	3	7	5	15	3	35
1999	2	6	19	4	13	4	48
2000	2	3	27	4	8	2	46
2001	4	5	22	2	14	1	48
2002	2	1	34	3	17	3	60
2003	1	5	33	4	6	1	50
2004	2	5	18	3	19		47
2005	1	3	23	2	26	1	56

2006		1	18		5	6	30
2007		7	30	1	19	1	58
2008	2	1	26	1	20	4	54
2009	3	2	27	6	7		46
2010	2	1	27	2	17	2	51
Grand Total	39	135	591	76	331	57	1231

Table 18 Number of events that caused Affected People in LAC from 1966 to 2010

Rank	Int. Rank	Country	LPI	Customs	Infrastructure	International shipments	Logistics competence	Tracking & tracing	Timeliness
		Latin America and the Caribbean Logistics Performance Index 2010							
1	41	Brazil	3.2	2.37	3.1	2.91	3.3	3.42	4.14
2	48	Argentina	3.1	2.63	2.75	3.15	3.03	3.15	3.82
3	49	Chile	3.09	2.93	2.86	2.74	2.94	3.33	3.8
4	50	Mexico	3.05	2.55	2.95	2.83	3.04	3.28	3.66
5	51	Panama	3.02	2.76	2.63	2.87	2.83	3.26	3.76
6	56	Costa Rica	2.91	2.61	2.56	2.64	2.8	3.13	3.71
7	65	Dominican Republic	2.82	2.51	2.34	2.59	2.42	3.17	3.85
8	67	Peru	2.8	2.5	2.66	2.75	2.61	2.89	3.38
9	70	Honduras	2.78	2.39	2.31	2.67	2.57	2.83	3.83
10	71	Ecuador	2.77	2.32	2.38	2.86	2.6	2.84	3.55
11	72	Colombia	2.77	2.5	2.59	2.54	2.75	2.75	3.52
12	76	Paraguay	2.75	2.37	2.44	2.87	2.59	2.72	3.46
13	77	Uruguay	2.75	2.71	2.58	2.77	2.59	2.78	3.06
14	84	Venezuela, RB	2.68	2.06	2.44	3.05	2.53	2.84	3.05
15	86	El Salvador	2.67	2.48	2.44	2.18	2.66	2.68	3.63
16	90	Guatemala	2.63	2.33	2.37	2.16	2.74	2.71	3.52
17	98	Haiti	2.59	2.12	2.17	3.17	2.46	2.43	3.02
18	107	Nicaragua	2.54	2.24	2.23	2.63	2.31	2.51	3.21
19	108	Jamaica	2.53	2	2.07	2.82	2.32	3.07	2.82
20	112	Bolivia	2.51	2.26	2.24	2.53	2.38	2.38	3.2
21	140	Guyana	2.27	2.02	1.99	2.31	2.25	2.28	2.7
22	150	Cuba	2.07	1.79	1.9	2.32	1.88	2.03	2.41

The scores are from one to five, one being the worst performance for the given dimension.

The LPI also allows deriving a country's Logistics Performance Index (LPI). Results are averaged for each key dimension by country rated.

To facilitate meaningful comparisons, results have been averaged by regions, which are defined by the World Bank classification with an equal weight for each country in the survey.

Table 19: Latin America and the Caribbean LPI.

Technical Annex

Exponential Smoothing

Exponential smoothing is a technique that can be applied to time series data, either to produce smoothed data for presentation, or to make forecasts. The time series data themselves are a sequence of observations. The observed phenomenon may be an essentially random process, or it may be an orderly, but noisy, process. Whereas in the simple moving average the past observations are weighted equally, exponential smoothing assigns exponentially decreasing weights over time.

Exponential smoothing is commonly applied to financial market and economic data, but it can be used with any discrete set of repeated measurements. The raw data sequence is often represented by x_t , and the output of the exponential smoothing algorithm is commonly written as s_t , which may be regarded as a best estimate of what the next value of x will be. When the sequence of observations begins at time t = 0, the simplest form of exponential smoothing is given by the formulas.

$s_1 = x_0$

$s_t = \alpha x_{t-1} + \ 1 - \alpha \ s_{t-1}, t > 1$

where α is the smoothing factor, and 0 < α < 1.

Simple exponential smoothing does not do well when there is a trend in the data. In such situations, double exponential smoothing can be used.

Again, the raw data sequence of observations is represented by x_t , beginning at time t = 0. We use s_t to represent the smoothed value for time t, and b_t are our best estimate of the trend at time t. The output of the algorithm is now written as F_{t+m}, an estimate of the value of x at time $t + m$, m>0 based on the raw data up to time t. Double exponential smoothing is given by the formulas:

$$
\begin{aligned}
s_0 &= x_0 \\
s_t &= \alpha x_t + (1 - \alpha) F_t \\
b_t &= \beta(s_t - s_{t-1}) + (1 - \beta) b_{t-1} \\
F_{t+m} &= s_t + m b_t,
\end{aligned}
$$

Where α is the data smoothing factor, 0 < α < 1, β is the trend smoothing factor, 0 < β < 1, and b0 is taken as (xn-1 - x0)/ (n - 1) for some n > 1. Note that F0 is undefined (there is no estimation for time 0), and according to the definition F1=s0+b0, which is well defined, thus further values can be evaluated.

Weighted Factor Rating Method

Factor analysis is a statistical method used to describe variability among observed variables in terms of a potentially lower number of unobserved variables called factors. In other words, it is possible, for example, that variations in three or four observed variables mainly reflect the variations in a single unobserved variable, or in a reduced number of unobserved variables. Factor analysis searches for such joint variations in response to unobserved latent variables. The observed variables are modeled as linear combinations of the potential factors, plus "error" terms. The information gained about the interdependencies between observed variables can be used later to reduce the set of variables in a dataset. Factor analysis originated in psychometrics, and is used in behavioral sciences, social sciences, marketing, product management, operations research, and other applied sciences that deal with large quantities of data.

Suppose we have a set of p observable random variables, $x_1, \cdots, x_p$ with means $\mu_1, \ldots, \mu_p$.

Suppose for some unknown constants l_{ij} and k unobserved random variables F_j, where $i \in 1, \ldots, p$ and $j \in 1, \ldots, k$, where $k < p$, we have

$$x_i - \mu_i = l_{i1}F_1 + \cdots + l_{ik}F_k + \varepsilon_i.$$

Here, the ε_i are independently distributed error terms with zero mean and finite variance, which may not be the same for all i. Let $\mathrm{Var}(\varepsilon_i) = \psi_i$, so that we have

$$\mathrm{Cov}(\varepsilon) = \mathrm{Diag}(\psi_1, \ldots, \psi_p) = \Psi \text{ and } \mathrm{E}(\varepsilon) = 0.$$

In matrix terms, we have

$$x - \mu = LF + \varepsilon.$$

If we have n observations, then we will have the dimensions $x_{p \times n}$, $L_{p \times k}$, and $F_{k \times n}$. Each column of x and F denote values for one particular observation, and matrix L does not vary across observations.

Also we will impose the following assumptions on F.

1. F and ε are independent.
2. $\mathrm{E}(F) = 0$
3. $\mathrm{Cov}(F) = I$

Any solution of the above set of equations following the constraints for F is defined as the *factors*, and L as the *loading matrix*.

Suppose Cov(x − μ) = Σ. Then note that from the conditions just imposed on *F*, we have

$$\mathrm{Cov}(x - \mu) = \mathrm{Cov}(LF + \varepsilon),$$

or

$$\Sigma = L\mathrm{Cov}(F)L^T + \mathrm{Cov}(\varepsilon),$$

or

$$\Sigma = LL^T + \Psi.$$

Note that for any <u>orthogonal matrix</u> *Q* if we set *L* = *LQ* and *F* = *Q^T F*, the criteria for being factors and factor loadings still hold. Hence a set of factors and factor loadings is identical only up to orthogonal transformations.

Criteria for determining the number of factors

Using one or more of the methods below, the researcher determines an appropriate range of solutions to investigate. Methods may not agree. For instance, the Kaiser criterion may suggest five factors and the screen test may suggest two, so the researcher may request 3-, 4-, and 5-factor solutions discuss each in terms of their relation to external data and theory.

Comprehensibility: A purely subjective criterion would be to retain those factors whose meaning is comprehensible to the researcher.

Kaiser criterion: The Kaiser rule is to drop all components with eigenvalues under 1.0 – this being the eigenvalue equal to the information accounted for by an average single item. The Kaiser criterion is the default in SPSS and most statistical software but is not recommended when used as the sole cut-off criterion for estimating the number of factors as it tends to over extract factors.

Variance explained criteria: Some researchers simply use the rule of keeping enough factors to account for 90% (sometimes 80%) of the variation. Where the researcher's goal emphasizes parsimony (explaining variance with as few factors as possible), the criterion could be as low as 50%

Scree plot: The Cattell scree test plots the components as the X axis and the corresponding eigenvalues as the Y-axis. As one moves to the right, toward later components, the eigenvalues drop. When the drop ceases and the curve makes an elbow toward less steep decline, Cattell's scree test says to drop all further components after the one starting the elbow. This rule is sometimes criticized for being amenable to researcher-controlled "fudging". That is, as picking the "elbow" can be subjective because the curve has multiple elbows or is a smooth curve, the

researcher may be tempted to set the cut-off at the number of factors desired by his or her research agenda.

Horn's Parallel Analysis (PA): A Monte-Carlo based simulation method that compares the observed eigenvalues with those obtained from uncorrelated normal variables. A factor or component is retained if the associated eigenvalue is bigger than the 95th of the distribution of eigenvalues derived from the random data. PA is one of the most recommendable rules for determining the number of components to retain, but only few programs include this option.

Before dropping a factor below one's cut-off, however, the researcher should check its correlation with the dependent variable. A very small factor can have a large correlation with the dependent variable, in which case it should not be dropped.

Advantages

- Both objective and subjective attributes can be used provided the subjective attributes can be converted into scores
- Factor Analysis can be used to identify hidden dimensions or constructs which may not be apparent from direct analysis
- It is easy and inexpensive to do

Disadvantages

- Usefulness depends on the researchers' ability to collect a sufficient set of product attributes. If important attributes are missed the value of the procedure is reduced.
- If sets of observed variables are highly similar to each other and distinct from other items, factor analysis will assign a single factor to them. This may make it harder to identify factors that capture more interesting relationships.
- Naming the factors may require background knowledge or theory because multiple attributes can be highly correlated for no apparent reason.