RESTRUCTURATION OF LOGISTIC NETWORKS: AN INDUSTRIAL CASE STUDY IN COLOMBIA

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ABSTRACT

In the current competitive environment, logistics has been considered one of the key elements that allows growth strategies for countries and companies. Emerging economies such as Colombia have implemented different plans to achieve sustainable development and technology advantages for the national firm's supply chain, but sometimes the region characteristics difficult the creation of networks. This inconvenient leads to the question: how can viable tactics lead companies to affront management logistic challenges in developing countries? The present paper introduces a proposal that contributes in the search of a possible solution in the Fast-Moving Consumer Goods (FMCG) industry case in Colombia and similar regions.

In first place, this paper presents the general variables that are affecting the management of logistic networks in Colombia based on specialized literature. After this, a Colombian FMCG corporation is studied in order to develop a simulation model and identify possible opportunities and solutions. Finally, relations between the results of the case study and the impact that would be generated through a general proposal for the country and comparable areas is established.

As a result of this work, the status of Colombian logistics is evidenced, as well as the future perspectives and opportunities of strengthening in the management of networks in the country. Additionally, this investigation seeks to promote the discussion around possible applications and systems to increase the present performance in the FMCG business.

People, organizations and productive sectors constantly need to update their methods and technology according to their objectives. The study aims to provide a divulgation space of experiences and impacts, and give logistics practitioners the opportunity to adapt the knowledge and strengthen the development of sustainable innovation for competitiveness. It is expected that over the years, the implementation of new procedures can be expanded to remote regions.

Key words: Supply Chain Management, Logistics, Development, Network, Strategy.

INTRODUCTION

In face of the free trade agreements, management tendencies and globalization; firms and countries are focusing on logistics components in order to increase their own competitive level and generate service advantages in global markets. These elements are principally associated to buying,

warehousing, distribution and transportation management where every activity has a cost related; however, as stated in Portal (2012) the transport in a lot of cases is the biggest cost in a logistic operation given the fact that generates 55% to 60% of the total rate, therefore an small change is a big variation in the whole process.

The transportation includes all activities implemented to move goods or materials from the origin point to its final destination, and the procedure's success depends on the correct administration between people, mediums and resources. Without a good strategy of transportation, firms cannot guarantee service quality, low logistics costs, operating speed, deliveries on time and will be even more difficult to expand the current market toward places with difficult geographic access.

In addition to the last items, the transfer of stuffs presents a big challenge since it produces the necessity to create networks between connection points and different actors in the supply chain, where the link of nodes is more expensive or less depending on the country characteristics. The World Bank (2014) defines that the logistic competitive of a country is directly proportional with the level of: “efficiency of customs clearance process, quality of trade- and transport-related infrastructure, ease of arranging competitively priced shipments, quality of logistics services, ability to track and trace consignments and frequency with which shipments reach the consignee within the scheduled time”, components where the logistic transport has a big influence.

To face the last variables is a hard task for countries and companies and it is necessary to know the logistic situation of the work place to create competitive plans and networks. In this paper we introduce a model based on the results of a Colombian case study company, however, first it is necessary to establish country's situation in terms of logistics to purpose a general strategy.

COLOMBIAN LOGISTICS

Colombia has an excellent geographic position in the world since it is located in the middle of America and it facilitates to link South and North America, Asia, Africa and Europe. The country is over the equatorial line and it allows to have good climate conditions in the whole year, in addition, it is the only country in South America with coastlines on the Atlantic and Pacific Oceans, characteristic that is even more important thanks to the connection of more over 30 rivers into the country.

Taking into account the last data, Colombia has the possibility to create strong networks with almost the whole principal markets in the world, nevertheless, the internal logistic process in the country hinders the last affirmation for these three principal reasons: The majority of the production cities are located in highlands of the Andes mountains, second, the capital city is situated far away from the principal ports, and third, low development and investment of transportation mediums.

According to The Global Competitiveness Report presented by World Economic Forum (2014), Colombia is ranked in terms of competitiveness in number 66 out of 140 countries around the world; the country has good scores in most pillars; however, one of the principal reasons of this place is the Transport Infrastructure level where it falls to position 104, the Table 1 shows the pillar components.

Table 1: Transport Infrastructure Components for Colombia

Transport infrastructure	Global Position of Colombia
Quality of overall infrastructure	108
Quality of roads	126
Quality of railroad infrastructure	102
Quality of port infrastructure	90
Quality of air transport infrastructure	78
Available airline seat kilometers	39

Source: World Economic Forum (2014)

Other statistics have evidenced the transport and infrastructure inconvenients in Colombia, the Table 2 compares three of the principal rankings around the world, the Global Competitiveness Index of World Economic Forum (2014), the Logistics Performance Index of the World Bank (2014) and Trading Across Borders Index of Doing Business (2014). There it is possible to relate the Colombian logistic level with the principal development countries and the CIVETS, name used by the CEO of HSBC Geoghegan (2010) referring to "emerging economies that will have a special dynamism in the next years" formed by: Colombia, Indonesia, Vietnam, Egypt, Turkey and South Africa, nations with similar characteristics of population level, growth potential and economic agreements.

Table 2: Comparison of the GCI, LPI and DB index.

Economy	GCI 2014-2015	LPI 2010-2014	DB 2014
Switzerland	1	14	22
Singapore	2	5	1
United States	3	9	16
Finland	4	23	14
Germany	5	1	18
Japan	6	10	20
Hong Kong SAR	7	15	2
Netherlands	8	2	13
United Kingdom	9	4	15
Sweden	10	6	4
Indonesia	34	53	62
Turkey	45	30	90
South Africa	56	34	100
Colombia	66	97	93
Vietnam	68	48	75
Egypt	119	62	99

Source: World Economic Forum (2014), World Bank (2014) and Doing Business (2014).

The analysis of indexes reflects that Colombia has big costs to export, import and transport internally goods, where it is a fact that is less expensive to move a charge of products from an Asian Port to a Colombian Port, than to move the same charge from a Colombian Port to the capital city. These results are based on information of Doing Business (2014) and are represented in the Table 3 where it is possible to make a comparison between countries of the Pacific Alliance (Latin American

agreement to create a trade bloc). It is clear in the table that the Colombian inland transportation and handling represents more than the double of the cost than Peru to export and three times approximately to import.

Table 3: Logistics costs to export and import in countries of the Pacific Alliance.

Nature of Export Procedures	US$ COST			
	Colombia	Chile	Mexico	Peru
Documents preparation	300	220	200	150
Customs clearance and inspections	350	100	150	130
Ports and terminal handling	170	190	200	330
Inland transportation and handling	1535	400	900	280
Totals	2355	910	1450	890
Percentage of cost of inland transport on the total	65,2%	44,0%	62,1%	31,5%
Nature of Import Procedures	**Colombia**	**Chile**	**Mexico**	**Peru**
Documents preparation	250	170	290	150
Customs clearance and inspections	170	100	300	185
Ports and terminal handling	150	190	300	395
Inland transportation and handling	1900	400	950	280
Totals	2470	860	1840	1010
Percentage of cost of inland transport on the total	76,9%	46,5%	51,6%	27,7%

Source: Doing Business (2014)

The situation is even more difficult to affront because of the current infrastructure, based on information of the World Bank (2014) and Revista de Logistica (2014), Colombia has nine zone ports, 900 kilometres of dual highway and 10% of roads in excellent conditions in a difference to the regional average that is 20% and in other countries of the Pacific Alliance like Mexico or Chile it is 28 zone ports, 1500 kilometres of dual highway and have 30% of roads in excellent conditions approximately.

The data presented reflects the necessity to invest in transport infrastructure to optimize the different modes (marine, air, road, rail and river) and the government is already focused on it. Currently, according to ANI (2014), Colombia between the year 2015 and 2020 will manage more 40 transport projects, one of the biggest worldwide logistic projects named Fourth Generation (4G), distributed 80% to invest in highways (US$ 25 billion) and the other 20% will be for the other transport mediums (US$ 5 billion);

It is clear that the last investments will decrease the logistics costs inland the country; still, it is necessary that companies complement the infrastructure plan with other strategies to increase the supply chains competitive level of the region in less time.

METHODOLOGY

The FMCG industry is one of the most competitive on a national level, is structured by approximately 400 companies among which there are some firms who have adapted international quality policies and are contributing to national production by exporting products; the difficulties with production standardization, to reduce logistics costs and to create innovative products are major limitations that

have segmented the market cake in a disproportionate way, 80% of total industry sales is managed by only 9% of companies.

Given that it is a consumer products business, the logistics operations are an elementary factor and could be useful to identify and propose possible solutions in this process optimization companies. This industry has particular features to reflect the general logistic behaviour in Colombia, mentioned previously; according to ANDI (2013) the transport cost represents the third production price with more increments (31,5% of FMCG companies have reported increases), in first place is the row materials (55,2%) and in second place the labour (42,5%). Additionally DANE (2014) informs that this industry represents more of the 40% of the actual production in the country, the data have represented in Figure 1.

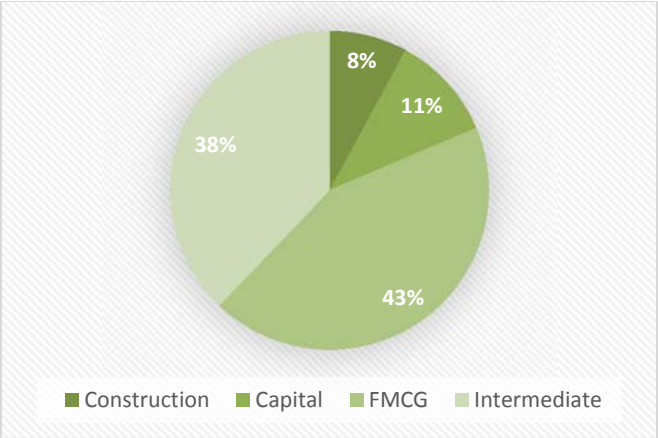

Figure 1: Distribution of actual production in Colombia, Source: Monthly Manufacturing Sample. DANE (2014).

The current situation of the sector turns around great changes for future expansion like the others Colombian industries, however, it is appropriate to develop continuous improvements in every process of the value chain in order to maintain or increase leadership and to affront the international competence, for these reasons was started this research looking for to support firms with a proposal in terms of logistics to create more competitive sectors based on the logistic challenges of the FMCG industry.

The methodology employed to analyse the possible opportunities, complements and solutions in Colombia to affront the current management logistic challenges is based on a simulation model realized in a Colombian company of the FMCG industry with national and international presence in order to generate applicable results for countries and firms with similar characteristics. The procedure was broken down in five steps: first, a general description of the company distribution inconvenients with the objective to present the variations in the procedure and to evidence the principals system restrictions, second, the digitization in a BPM scheme of the process from the purchase of materials to the inventories including the different actors of the supply chain, third, the development of the current simulation discrete events model developed in the software Arena based on the first scheme, fourth, the new BPM scheme in order to clarify the changes maked, and finally, the model proposed based on the second scheme and used to generate general results.

GENERAL SITUATION

It is clear that local and international distribution and transport are critical to improving outcomes in the logistics; companies and countries should monitor their systems and transport networks in order to identify where in the process are generating unnecessary costs, which reduce the usefulness and affect responsiveness.

The company evaluated has reached unexpected demand levels and cannot respond productively on time, for that reason they are having overruns because of they have to send products in process from the productive center to a maquila[1] specialized in the company's products and is located more than 400 km away. Moreover, the company needs special trucks to transport the raw materials and products and for this reason requires a logistics company (OPL) to do the process.

The problem mentioned previously is even more difficult if considered others inconvenient into the distribution process like:

1. The system information of the company (ERP) does not record directly the inventory movements towards the maquila and the inventory storage there (WIP) in an appropriate manner.
2. The maquila does not have the ability to report directly the production of goods in the ERP and it is necessary to wait the company staff to modify the data.
3. Does not exist an adequate exchange of information between the two chain links (Firm - Maquila), which makes almost impossible to do a synchronous job and restricts the generation of trust and shared knowledge for both organizations.

[1] Maquila: Refers to the firm that processes other company's products or materials.

CURRENT PROCESS

The process in general terms is better described through the next diagrams that address from the purchase of materials to the maquila inventory.

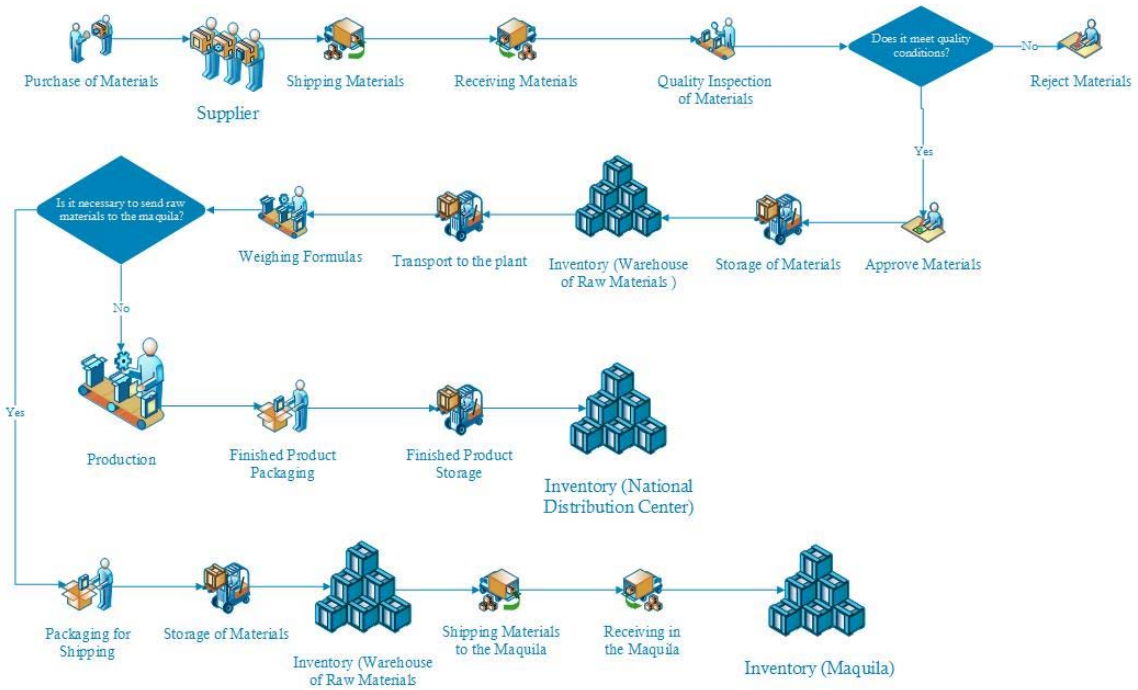

Diagram 1. Purchase of materials - National Distribution Centre and OPL Inventory

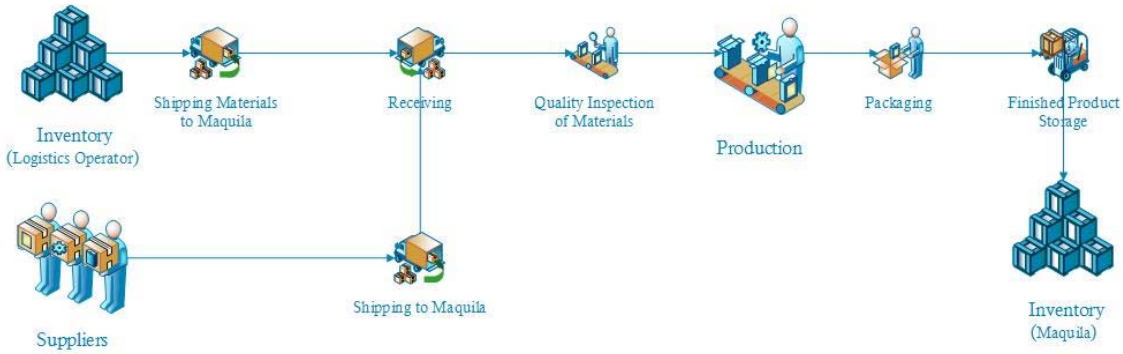

Diagram 2. OPL Inventory - Inventory of Final Products Maquila

SIMULATION MODEL

The simulation generates performance indicators according to the parameters and variables discussed. The initial stage sends 25% of the total production to the maquila, the total procedure produces 210 batches (every batch contains 500 boxes and every box contains 48 units of final product). The system model indicates a mean of 2 hours for the charge process, 8 hours for the transport to the maquila and 5 hours to discharge and locate in the warehouse.

Process Purposed

To arrive on the times agreed with customers and ensure the quality of products on the way is possible thanks to the generation of infrastructure and a strategic geographical distribution of the nationwide support points.

The company has covered proportionally each area of the country, presenting a more influence for the Andina region; however, fluctuations in demand have generated the need to resort to other companies in specific situations, such as previously mentioned. This generates an increase in delivery

times, less responsive capacity and the increase of the company costs, along with other risks if the plan is not structured.

Given the importance of the correct coordination between the strategic points of the company and the influence over operating costs, the proposal involves the removal of the maquila process, through the construction and start of a second own plant, which performs the same processes near to the Productive Center, as stated in Diagram 3. The new plant would have greater flexibility for the additional products, which is very convenient due to increased demand for other company products.

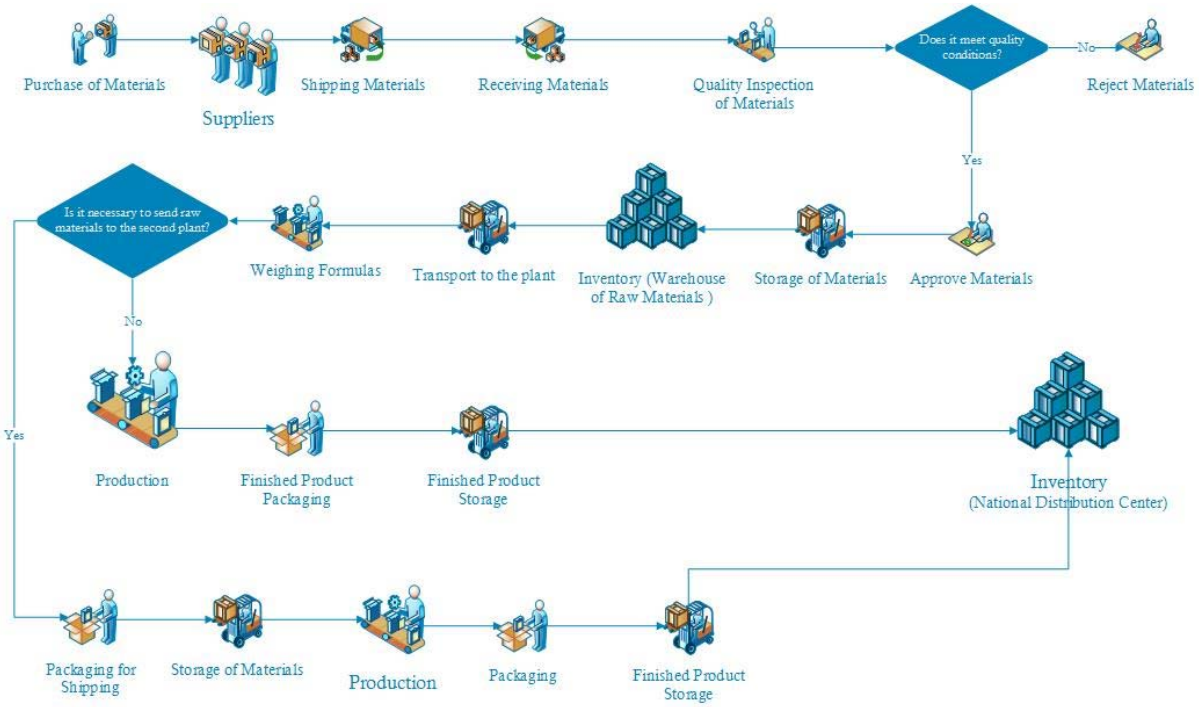

Diagram 3. Process Purposed

The purpose is focused on simulate a small logistic cluster; firstly the company will be the owner of the second plant because of the shortage of support firms in the zone, however, in future changes and into other Colombian companies the objective is to promote the cooperation between firms strategically located, organized and associated around to similar production activities.

Simulation Model of The Process Purposedo

The new simulation generates better performance indicators, this continuous sending 25% of the total production to the second plant; still, the quantity of batches were raised to 230. Other good result is the total time of transport process that decreases from 15 hours to 2 hours since in short distances is easier to manage small charges.

FINDINGS

Advantages of the proposal:

- Increased production capacity: To have a new plant the production will improve system to meet the increase in demand for the product and the opening of new markets, the total production increases 15% approximately. The benefits generated under the simulation results generate an increase in revenue of 17% represented in $ 250 million pesos (US$

125.000 approximately) considering the net sales of products in the second plant, the last incomes allow to recover the investment in one and half year after to finish finally the plant.

- The risk in transporting materials will decreased: Materials in process require special conditions of transport and storage. Send by ground transportation over long distances involves risk of contamination or deterioration. Furthermore, the fact to ensure appropriate transport conditions implies a higher cost with regard to the transport of Finished Product.
- Decrease the cost of staff present in the maquila: currently the company has operating personnel (quality and production engineers) who guarantee the conditions in the maquila operation, the proper use of the resources provided to the maquila and the security of the information shared. By eliminating the need to produce in the maquila, the firm eliminates the risk of data loss and the need to have extra operational personnel.
- Another aspect to consider is the increase in the company stuff, it is expected that the new plant will generate new jobs for 150 people directly, which is a factor that positively affects the country and people who lived in the zone.
- Decreased operating times: Transport of materials to the maquila increases the lead-time, and it is necessary wait much longer from receipt of raw materials to have the finished product. The simulation shows that in the first stage it has an average wait time of 46 hours and a queue of 11 lots on average to be transported to the maquila by truck. In the second stage, the plant efficiency produced by the short distance from the principal plant reduces to zero the timeout and the batch queue to be transported. In this way, the number of batches change from 30 distributed by truck in the first stage to 62 carried on the truck in a period of 15 days.

Disadvantages of the proposal:

- Cost of investment in fixed assets for the new plant (more than US$ 1 million).
- Loss of flexibility in the supply chain, because of production sites are located on a near location, it generates different inconvenients for example in case of a natural disaster or in face of problems in the principal highways, will be more difficult to generate a timely solution.
- Decrease of the production in the maquila.

CONCLUSIONS

It is possible to generalize the last findings with objective to obtain the conclusions presented below, these are useful in macro level for others companies and countries with logistic challenges generated by the economic evolution, globalization and the distribution schemes.

In order to complement the Logistic National Policies, to take advantages of the geographic location and to be more competitive in face of Trade Agreements, Colombia needs the support of the companies to strength the industry development. To increase the investments in transport infrastructure is an excellent start and this would generate more benefits if the national firms link production activities with others companies having the objective of maximize outcomes, to reduce costs, to create new business and increase the productivity.

Every node in the network needs to have a strategic geographic position to promote synergy between the participants of the supply chain; at the same time, it is necessary to grow according to the 4G plan to take advantages of the more of 8000 kilometers of highways and others transportation mediums.

The productive centers have to adapt themselves with more flexibility to the mobilization of people, infrastructures and chain links and the exchange of information, technology and knowledge, this brings industry development efficiently and creates a bigger market and with more value added that is more competitive in face of international commerce.

The government has to manage a strategy of infrastructure development, in the same time to adapt and support the creation of clusters, where universities, companies, technological centers and entrepreneurship institutions have to assume an active role in the changes through the creation of knowledge networks, innovation and new logistics solutions. It is recommendable to continue in the research of new strategies to expand the current study and promote the development.

REFERENCES

Agencia Nacional de Infraestructura. ANI (2013). Plan de Accion 2014. ani.gov.co/

Altiok, Tayfur and Benjamin Melamed (2007). Simulation Modeling and Analysis with ARENA. Elsevier, Inc. ISBN 978-0-12-370523-5

ANDI (2013). Informe Balance 2013 y Perspectivas 2014. www.banrep.gov.co

Castellanos (2014). Importancia de los cluster. Universidad del Norte. www.portafolio.co

Concluye IX Cumbre con Compromiso de Profundizar Integración. (July 20 of 2014). http://alianzapacifico.net/

DANE (August 12 of 2014). Cuentas Trimestrales – Colombia Producto Interno Bruto (PIB). From: http://www.dane.gov.co/files/investigaciones/boletines/pib/bol_PIB_Itrime14.pdf

Doing Businees. (September 9 of 2014) Trading Across Borders Index of Doing Business. http://www.doingbusiness.org/

Geoghegan (2010). From West to East. HSBC. www.forbes.com

Guillen (2003). Multinationals, Ideology, and Organized Labor. The Limits of Convergence. Princeton University Press. ISBN 0691116334.

Jimenez and Sanau (2011). Infrastructure and Industrial Productivity in Colombia. Universidad de los Andes. ISSN: 01203584.

Mitchell (2014). Colombia Infrastructure: The open road. Latin Finance. ISSN: 1048-535X

Nedelescu and Rujan (2014). Why do Logistics and Transport Matter for Development. Annals of the University of Oradea and University of Economic Studies Bucharest, Romania. Economic Science Series. ISSN: 1582-5450

Parker, David John (2013). Microsoft Visio 2013 Business Process Diagramming. Packt Publishing. ISBN 978-1-78217-800-7

Portal (2012). Costos Logisticos. EAE Editorial Academia Espanola. ISBN-10: 3659035661. ISBN-13: 978-3659035661

Ramos, Gomes and Barbosa-Póvoa. (2014). Planning a sustainable reverse logistics system: Balancing costs with environmental and social concerns. Omega. ISSN: 0305-0483

Revista de Logistica (September 29 of 2014). Los puertos marítimos colombianos se la juegan por la infraestructura. http://www.revistadelogistica.com/

Rey (2008). Encuesta Nacional Logística. Resultados del Benchmarking Logístico - Colombia 2008. Latin America Logistics Center.

Ventura Amaral and Guerreiro (2014). Knowledge and Assessment of Logistics Cost Trade-offs: a Study with Brazilian Professionals. Revista Contabilidade & Finanças. ISSN: 1519-7077.

World Bank. (October 9 of 2014). Logistic Performance Index. http://datos.bancomundial.org/indicador/LP.LPI.OVRL.XQ

World Economic Forum (2014). The Global Competitiveness Report 2013–2014: Full Data Edition. ISBN-13: 978-92-95044-73-9.