Freight Vehicle Circulation Restriction Policy in an Emerging Country Metropolitan Area: undesired impacts

Lars Meyer Sanches [a]

Janaina Antonino Pinto [b]

Orlando Fontes Lima Júnior [c]

[a] Insper

Rua Quatá, 300 – Vila Olímpia – São Paulo, SP – Brazil 04546-042

Phone/Fax: 55-11-4504-2300 / 2350

larsms@insper.edu.br

[b] UNIFEI/Campus Itabira

R. Irma Ivone Drummond, 200, Sala 312 - Distrito Industrial II, Itabira, MG - Brazil 35903-081

Phone/Fax: 55-31-3834-3544

janainaantonino@unifei.edu.br

[c] LALT/UNICAMP

President of the Brazilian Urban Logistics Center (CLUB)

R. Albert Einstein, 951 – Sala 8 P.O. Box 6021 – Cidade Universitária, Campinas, SP – Brazil 13083-852

Phone/Fax: 55-19-3521-2346

oflimaj@fec.unicamp.br

Abstract

The objective of this study is to investigate the long term effects of freight vehicle circulation restriction policies in the Sao Paulo metropolitan area. The analysis will encompass the impacts of this policy in the congestion level as well as the transportation costs. The findings showed that the freight vehicle circulation restriction policies fail to reduce its impacts on the congestion level and causes an increase in the transportation costs. Alternative policies, like the implementation of a urban logistics platform, were pointed as more effective to reduce the traffic impact of freight vehicles and were capable of reducing transportation costs.

Keywords: City Logistics, System Dynamics, Developing Countries, public policies, traffic level

Introduction

Freight vehicles traffic help to increase the congestion, air and sound pollution in urban centers. Dablanc (2007) showed that cargo vehicles represents 30% of the traffic volume and between 20 to 35% of the gas emission in European cities. They are also responsible from around 20% of the accidents. But freight vehicles can be consider an “necessary evil”, because studies show that each 1000 habitants of metropolitan areas in developed countries require in average 40 tons of products per year (Dablanc, 2009). Deliveries to urban centers represent in average 28% of the total transportation costs (CSCMP, 2012) showing that this issue is also very important for companies as well.

Lack of infrastructure and the huge number of older vehicles have to be consider as challenges to deal with city logistics issues in developing countries. In 2011, 32% of the Brazilian truck fleet had more than 20 years of age and 17% was 30 years or older (CNT, 2012). Another problem of the developing cities is the lack of ring roads that forces freight vehicles to cross the city to access other highways (Dablanc, 2009). Chinitz (1960) was the pionner of city

logistics studies followed by Button and Pearman (1981). Ogden (1992) made an important contribution by pointing a wide range of issues related to city logistics. Many other studies followed those (Fischer and Meyburg, 1990; Viseer et al, 1999; Czerniak et al, 2000; Russo and Comi, 2010). Taniguchi et al (2001) introduced the concept of City Logistics. In Brazil the topic is relative new (Novaes, 2003; Lima, 2003; Sinay et al, 2004; Lima, 2011).

Measures to reduce the impacts of freight transport in urban areas have been taken by cities authorities around the globe (Filippi et al., 2010) being one of the most common policies to restrict freight vehicle circulation. Quak and Koster (2009) showed the impacts of vehicle restrictions policies on retailers. Luan (2010), using a system dynamics simulation model, pointed that freight consolidation tends to increase the capacity utilization factor and therefore reduce freight costs and the number of utilized vehicles.

The objective of this study is to investigate the long term effects of freight vehicle circulation restriction policies in the São Paulo metropolitan area (Brazil). A simulation model based on the system dynamics methodology (Sterman, 2000) was built to evaluate the effectiveness of this policy to reduce traffic congestion level.

São Paulo case

São Paulo metropolitan area has more than 20 million habitants with over 8,2 million vehicles. During the last 30 years, São Paulo city authorities have implemented restrictions on movement of trucks at certain times of the day on main avenues and areas (Silva, 2011) as a way of reducing traffic congestion levels. In 1986, CET - Traffic Engineering Company of São Paulo - created the ZMRC - Maximum Area Movement Restriction. The ZMRC became one of the instruments used to minimize traffic problems by distributing the flow of vehicles during daytime and nighttime (Silva, 2011). The size of the ZMRC area increased from 11,5 Square Kilometers in 1986 to 100 Square Kilometers in 2008. Since 2008 additional freight vehicles restrictions have been putted in

place to prohibit medium and large size freight vehicles to circulate in the main avenues of the city during significant portions of the day. An exception is made to small size freight vehicles (Urban Cargo Vehicles – UCV) that are allowed to circulate inside the ZMRC.

"...we decided to allow the UCV circulation in São Paulo as a part of a very well thought program aimed to improve the congestion level in the city". Gilberto Kassab – São Paulo Mayor. (G1 São Paulo, 2012).

According to CET measurements, traffic congestion level reduced right after the new policies were implemented (CET, 2012) but longer term measurements showed different results. According to Resende and Sousa (2009) traffic congestion level in São Paulo has an annual average increase of 17% between 2005 and 2007. A survey conducted by the local traffic authority (CET, 2012) shows an increase in slowness in the years 2011 and 2012 throughout the São Paulo city (Table 1).

Table 1: São Paulo – Slowness km

All the city (in slowness Km)		**2011**	**2012**	**Variation**
Time	7 am to 9 am	78 km	85 km	+9%
	9 am to 5 pm	75 km	90 km	+20%
	5 pm to 8 pm	108 km	130 km	+20,4%

Source: Adapted from CET, 2012 apud Castro, 2012.

Authorities can easly blame the increase of the number of vehicles. The total number of vehicles in the São Paulo metropolitan area increased 68,2% in the last decade totalizing more than 8,2 million vehicles (Estado de SP, 2012). Because of this huge increase of the number of vehicles is hard to evaluate the effectiveness of the freight vehicles restriction policies. Because of that a simulation model was developed (see Figure 1). A system dynamics model is adequate to deal with problems with dynamic complexity, where different agents are involved and ones actions cause reactions from other agents (Sterman, 2000). Those reactions can be delayed on time. Is this context a simulation

model can help decision makers to choose a policy that does not affect other agents goals.

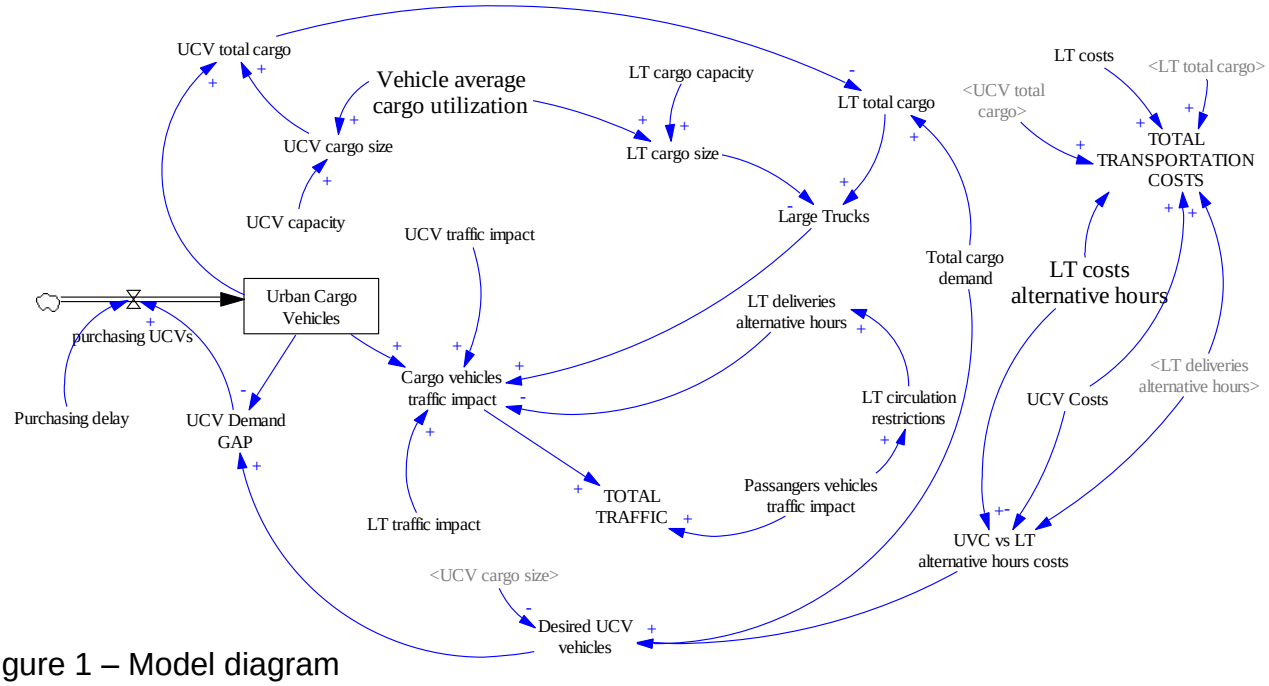

Figure 1 – Model diagram

Results and Discussion

Before the implementation of freight vehicles restrictions most of the carriers opted to use middle and large size trucks (LT) that had a better load capacity / freight costs ratio. The increased number of passengers cars caused the increase of the traffic congestion and the public authorities decided to create new freight vehicles restrictions that forced the carriers to start delivering the cargo during alternative schedules (most during the night). This shift, that in our simulation model occurred on the 40th month, on the delivery schedules reduced the impact of the freight vehicles on the traffic congestion (see Figure

2) and the total traffic level reduced as well. Apparently the freight vehicle policy was being effective.

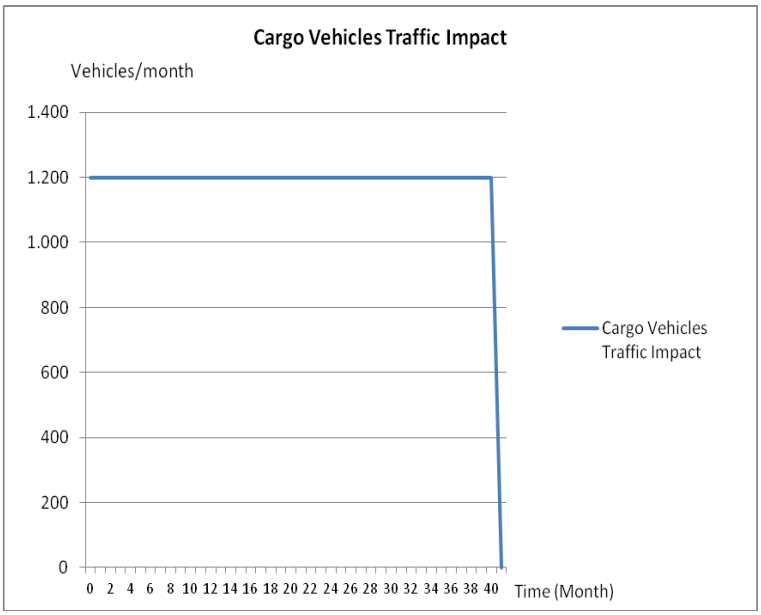

Figure 2 – Cargo Vehicles Traffic Impact

But night deliveries were very expensive due to additional labor costs and the higher rates of theft causing a significant increase in transportation costs (see Figure 3). Customers also didn´t want to receive deliveries at this time. Carriers started to buy urban cargo vehicles (UCV) that, besides having a worst load capacity / freight costs ratio than the large size trucks, allowed them to make daytime deliveries. The avoidance of the huge additional labor costs and reduction of theft rates more than compensated the smaller load capacity allowing the carriers to mitigate a share of the freight vehicles restrictions impact on their costs. Added to these benefits was the increase of customer satisfaction with the return of daytime deliveries.

“the number of UCVs register in the city jumped 40% from 2008 until now, totalizing 768.811 vehicles” (UOL, 2012).

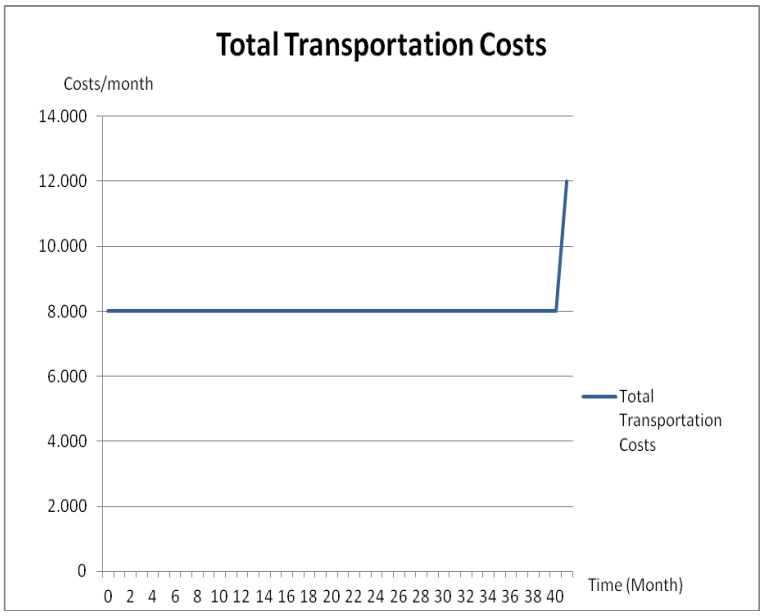

Figure 3 – Total Transportation Costs

The increase on the number of UCV was not immediate because there was lack of UCV production capacity as well as the carriers needed to accumulate financial resources to purchase new vehicles (see Figure 4). Once new UCV vehicles were available, carriers reduced the number of night deliveries reducing its total costs (see Figure 5).

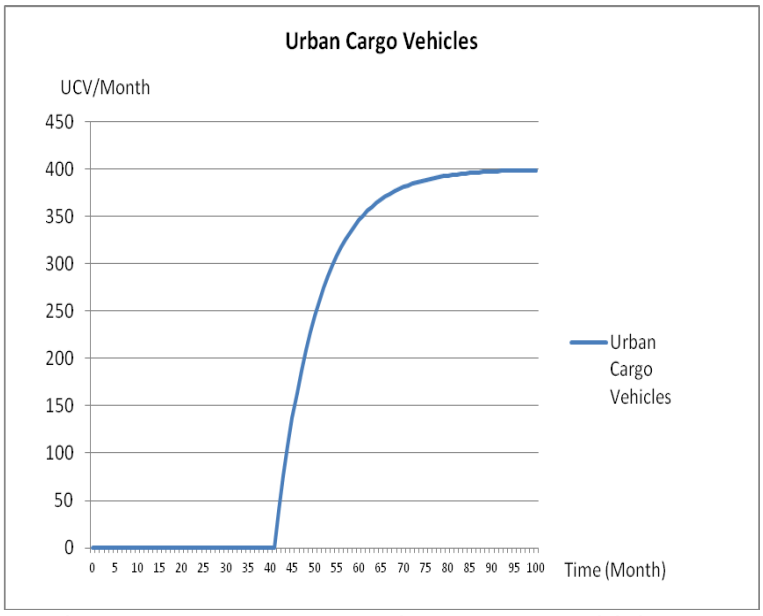

Figure 4 – Increase of Urban Cargo Vehicles

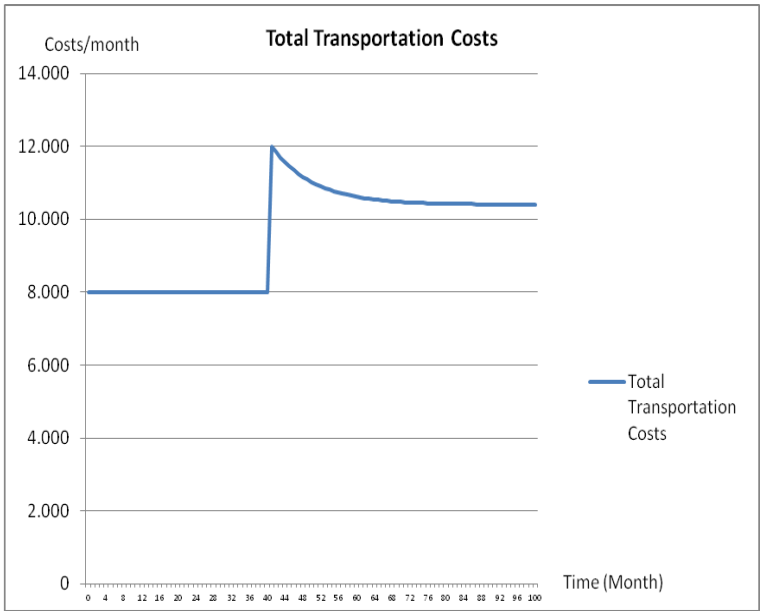

Figure 5 – Total Transportation Costs

If you consider that in average an UCV load capacity is one fourth of a large truck (LT), for every LT delivery is now necessary four UCV. On the contrary, an UCV occupies around half of the area on the streets of a large truck. But considering both effects the total impact of freight vehicles on traffic congestion double with the use of UCV (see Figure 6).

"A middle size truck has 10 to 12 meters and is able to carry 14 tonnes of load. An UCV, has 6 meters, and carries an average load of 2 tonnes. We need seven UCV for each truck." Claudinei Pelegrini – President of the Brazilian Truck Driver Association - (Carga Pesada, 2012)

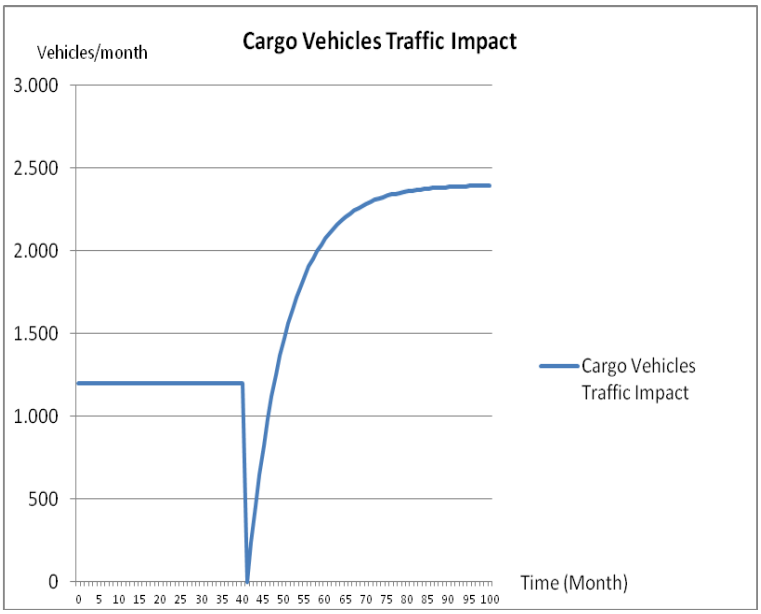

Figure 6 – Cargo Vehicles Traffic Impact – UCV

Alternative policies

The simulation model indicated that the use of UCV did not only caused an increase in the freight vehicle impact on traffic congestion but also caused an increase in the transportation costs for the carriers. If you consider that these additional costs will be transfer to consumer prices, the São Paulo population will pay for this inefficiency as well. An alternative policy would be to implement urban logistics platforms that may allow carriers to consolidate its loads with other companies and increase the vehicle average utilization factor. With a bigger percentage of the cargo capacity being utilized (see Figure 7), a smaller number of trucks will be necessary to make the daily deliveries. Another benefit is that the number of stops to unload the products will also reduce if you consider that a certain customer, like a small grocery store, will receive its products in a smaller number of trucks. The average length of the trip will also reduce because customers will receive larger lot sizes. These additional benefits will also contribute to the freight vehicle traffic congestion impact reduction (see Figure 8) as well will reduce transportation costs. Another alternative, with qualitative same impacts of the previous alternative, would be to reduce the average truck impact on the traffic by increasing the efforts to

enforce the laws concerning the minimum vehicle conservation requirements. Is estimated that 25% of São Paulo fleet have more than 20 years (Planeta Sustentavel, 2012) and do not have the minimum requirements to be on the road. Those old cars and trucks are responsible for a significant portion of accidents and its respective traffic problems.

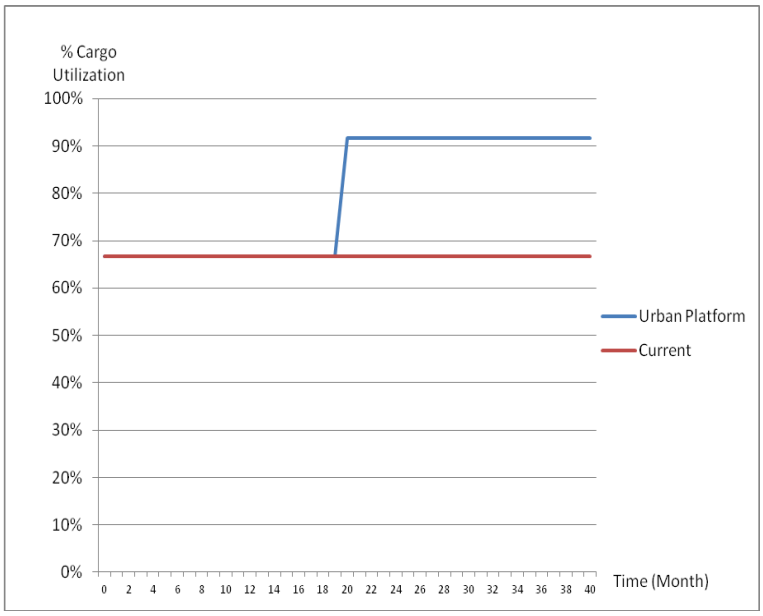

Figure 7 – Vehicle Average Cargo Utilization Runs

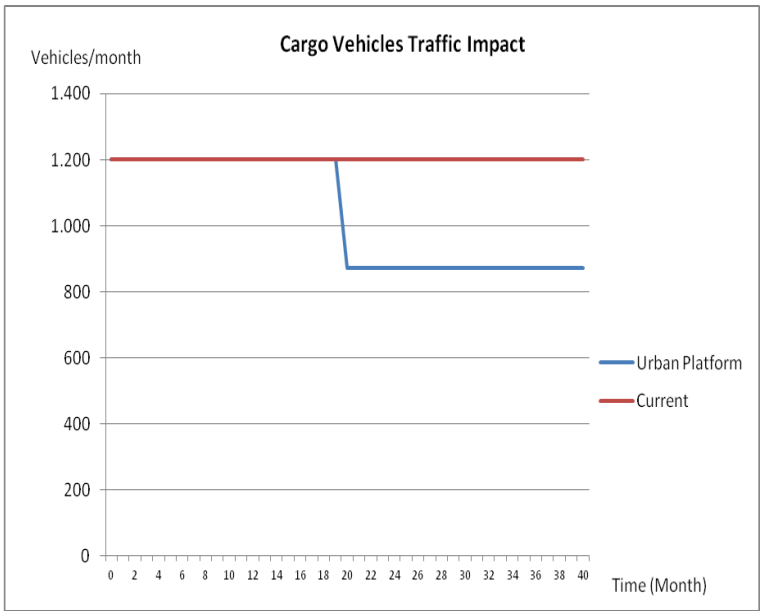

Figure 8 – Cargo Vehicles Traffic Impact

Conclusions and next steps

This study shows that the use of freight vehicles circulation restrictions caused an increase in the cargo vehicles impact on traffic congestion level in the long run. But similar to other problems with dynamic complexity, the short term results were good. On the other hand is it totally understandable why such a policy was putted in place if you consider that most politicians, concerned with the next election, opt to policies that have a high visibility and whose results can be seen on short term. Alternative policies proposed don´t have the same short term impacts and require a lot of efforts by the public authorities.

The model above was created mainly with secondary data resources. The next step will be to use the data from a group of carriers to calibrate the model. Another option is to increase the number of variables to measure the vehicle impact on the traffic, considering variables like: number of stops; average speed; maneuvering capabilities and so on.

References

Button, K. J., Pearman, A. D. 1981. The economics of urban freight transport. Holmes & Meier Pub, New York.

Carga Pesada. 2012. Caminhões pequenos invadem Marginais. Available at http://cargapesada.com.br/revista/2012/05/11/caminhoes-pequenos-invadem-marginais/> Access in Jan. 2013.

Castro, C. M. de. Caminhão volta à marginal na hora de pico. *Folha de S. Paulo*, São Paulo, 21 set. 2012. Folha Cotidiano.

CET – Companhia de Engenharia de Tráfego. Available in < http://www.cetsp.com.br/>. Access in: Dez. 2012.

Chinitz, B.. 1960. Freight and the metropolis. Havard University Press: Cambridge, MA.

CNT – Confederação Nacional dos Transportes. Available in <http://www.cnt.org.br>. Access in: Set.2012.

Crainic TG., Ricciardi N., Storchi G. 2009. Models for evaluating and planning city logistics systems. *Transportation Science.***43**(4): 432-454.

CSCMP – Council of Supply Chain Management Professionals. Available in < http://cscmp.org/> . Access in: Set.2012.

Czerniak, R. J., Lahsene, J. S., Chatterjee. 2000. A Urban Freight Movement – What Form will take. *TRB A1B07 - Committee on Urban Goods Movement* .

Dablanc, L. 2007. "Goods transport in large European cities: Difficult to organize, difficult to modernize", *Transportation Research Part A: Policy and Practice*. **41**(3): 280-285.

Dablanc, L. 2009. Freight Transport for Development Toolkit. *World Bank Transport Research Support*. July. 52p.

Estado de São Paulo. Frotas de capitais quase dobra em 10 anos: SP ganha quase 3,4 milhões de veículos. Estadão, São Paulo. 2012. Available at http://www.estadao.com.br/noticias/cidades,frota-das-capitais-quase-dobra-em-10-anos-sp-ganha-34-mi-de-veiculos,938682,0.htm > Access in Jan. 2013.

Fischer, G.P., Meyburg, A. H. 1990. Urban Goods Movement in the 1980"s.*Transportation Research Record*. 920p.

G1 São Paulo. 2012. Available at< http://g1.globo.com/sao-paulo/noticia/2012/05/vucs-causam-menos-impacto-no-transito-de-sp-diz-cet-.html> Access in: Jan. 2013.

Lima Junior, O. F.. 2003. The load in the city: Today and Tomorrow. *Journal of Public Transportation*. São Paulo. **25** (3): 219-230.

Lima Junior, O. F. 2011. Frugal Innovation: The New way to city logistics – rethink strategies and operations. *Mundo Logística Journal*. São Paulo, Brasil. **23** (1): 24-40.

Luan L. Simulation of freight consolidation strategy based on systems dynamics. 2010. *Proceedings ICLEM: logistics for sustained economic development – infrastructure, information, integration – system optimization and simulation models*. **IV** (1): 3616-3622.

Novaes, A. G.. 2003. Smalls Vehicle to shift goods in urban environment: Trends and Developments. *Lecture given at the workshop: "Distribution Trends in Urban Routes"*. April. Fiat, Minas Gerais, Brasil.

Planeta Sustentável. 2012. Carro velho só atrapalha. Available at http://planetasustentavel.abril.com.br/noticia/cidade/prefeitura-paris-proibir-trafego-carros-velhos-sp-incentivo-nao-pagar-ipva-726007.shtml> Access in Jan. 2013.

Resende, P. T. V de., Sousa, P. R de. 2009. Mobilidade Urbana nas grandes cidades brasileiras: um estudo sobre os impactos do congestionamento. *SIMPOI – Simpósio de Administração da Produção, Logística e Operações Internacionais.* **I** (1): 1-16.

Russo, F., Comi, A. 2010. A modelling system to simulate goods movements at an urban scale. *Transportation.* **37**(1):987–1009.

Silva, M. R. M. 2011. Zona Máxima de Restrição de Circulação (ZMRC): restrição de trânsito de caminhões em São Paulo. *São Paulo: Companhia de Engenharia de Tráfego*. Boletim Técnico 47. 52 p.

Sinay, M. C. F.; Novaes, A. G.; Campos, V. B. G.; Dexheimer, L. 2004. Load Urban Distribution: Components, Constraints and Trends. *Rio de Transportes II, 2004*. Rio de Janeiro. **II** (1).

Sterman JD. 2000. *Business Dynamics: System Thinking and Modeling for a Complex World.* Irwin McGraw-Hill: Boston MA.

Taniguchi, E., R.G. Thompson, T. Yamada and R. van Duin. 2001. City Logistics- Network Modelling and Intelligent Transport Systems. Pergamo.

UOL. 2012. Pequenos caminhões crescem mais que frota total de SP e devem se tornar próximo problema do trânsito, dizem analistas. Available at http://noticias.uol.com.br/cotidiano/ultimas-noticias/2012/03/27/caminhoes-vuc-crescem-mais-que-a-frota-total-de-sp-e-devem-se-tornar-proximo-problema-do-transito-dizem-analistas.htm> Access in Jan. 2013.

Viseer, J., Bindbergen, A., Nemoto, T.. 1999. Urban Freight Transport: Policy and Planning. *First International Symposium on City Logistics:* Australia.