City logistics – literature review

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RESUMO

O transporte de mercadoria e passageiros de e para as cidades tem vindo a criar um interesse especial junto dos investigadores, devido ao impacto que esta área de investigação tem na vida diária de milhões de pessoas por todo o mundo. A qualidade e quantidade de soluções de transporte de passageiros e mercadorias oferecidas pelo setor público e pelo setor privado, as distâncias percorridas em termos de quilómetros e tempo, os impactos ambientais nas cidades e na qualidade de vida das pessoas têm sido as principais áreas investigadas pelos académicos. O objetivo deste trabalho é fazer uma revisão de literatura que foca as principais tendências no estudo desta temática assim como enunciar os principais autores, analisar os desenvolvimentos efetuados nesta área de estudo e apontar linhas futuras de investigação.

PALAVRAS-CHAVE

Logística das cidades; revisão de literatura; transporte urbano; envolvimento de *stakeholders*.

ABSTRACT

The importance of the transport of goods and passengers into and from the cities had create an increased interest in the researchers and communities due to the daily impact of this field of study in millions of people all over the world. The quality and quantity of transport of passengers and goods in terms of solutions offered by public and private sectors, the travel distances in kilometers and time, the environmental impacts in the cities and in the quality of life of the people are the mains areas of research that have been studied by the academics. The purpose of this paper is to present a literature review that aims to highlight the mains trends in City Logistics as well as focus principal authors, analyze the development of the field of study, and provide future research directions.

KEYWORDS

City logistics; literature review; urban freight; stakeholder involvement.

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INTRODUCTION

The transport of the goods and passengers into and from the cities is a major enabling factor for most economic and social activities that take place in the urban areas and it is reaching its capacity limit (Crainic, Ricciardi & Storchi, 2009). The cities are growing very fast and the world urban population that was 70% in 2007, it is expected to reach 85% in the year of 2020 (Crainic, 2008). Another issue related with City Logistics, refers to the interaction between the public and private sector that are involved in the public transport, due to the increase of the passenger vehicle traffic and mainly due to the increase of the freight vehicle traffic, the levels of congestion, energy consumption, noise and pollution in the urban areas are rising (Thompson and Taniguchi, 2001). This growth constitutes a major challenge for all the stakeholders in the urban areas, mainly due the deterioration of the quality of the air and life in the urban areas. Most of the firms and factories are established in the city surroundings and very few logistics facilities are inside the cities limits (Dablanc, 2007), so the shippers or vendors need to make deliveries to their customers or retailers that are inside the city limits and some of them in the downtown, place with more busy arteries and few parking places. The low levels of stock in production and retail, timely deliveries, the explosive growth of the e-commerce business that generates an increasing volume of personal deliveries (Crainic, 2008) puts a pressure in the city arteries.

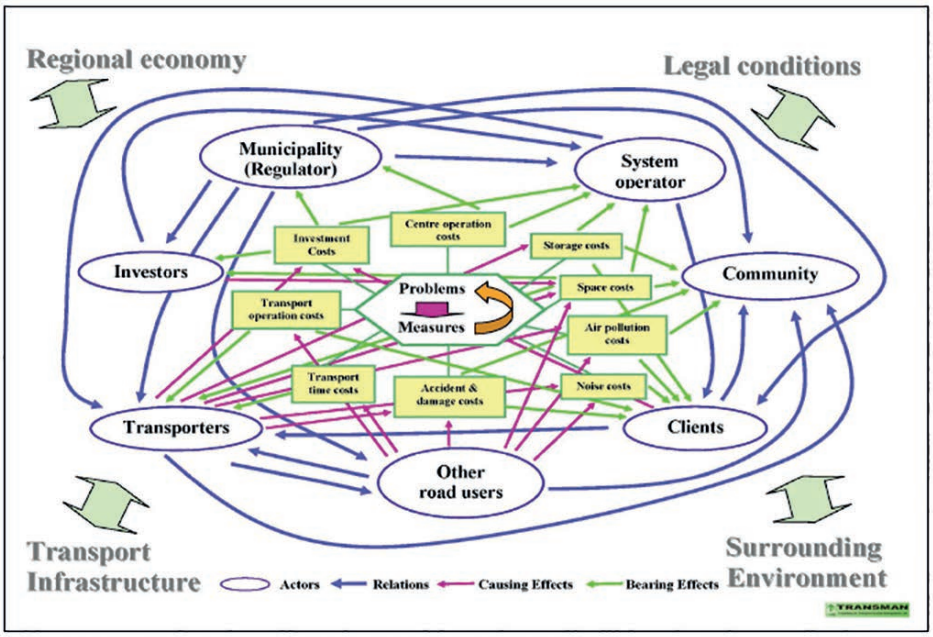
Innovative, environmentally friendly policies and resource saving supply chain concepts for the cities are becoming even more important to solve the problems of the very congestion arteries, mainly due to the fact that the road capacity cannot easily be increased, and in some cases, it cannot be increased at all (Wolpert and Reuter, 2012).

This paper presents a review of the theme and in the section 1 we make a definition of City Logistics, in the section 2 it is presented the research methodology used. In the section 3 we point out the seminal studies made in the area and the most relevant frameworks used in those studies. Finally in the section 4, it is the conclusion and insights for future research in this field of study.

1. DEFINING CITY LOGISTICS

According to Wolpert and Reuter (2012: 110), one of the challenges in evaluating the City Logistics literature is the lack of a single definition concept. The most common definition of City Logistics can be "the process for totally optimizing the logistics and transport activities by private companies in urban areas while considering the traffic environment, the traffic congestion and energy consumption within the framework of a market economy" (Taniguchi and Thompson (2002: 394). City Logistics is a concept that tries to optimize urban freight transport systems by considering all stakeholders and movements in urban areas (Crainic, Ricciardi & Storchi, 2009) can be another definition or even "City Logistics incorporates many activities (i.e. production, commerce and supply) between different actors, which appear in form of inner urban goods transport or distribution of interurban freight, fulfilling a substantial contribution to economy, city life and operation" (BESTUFS, 2006: 5). The aim of the City Logistics is to promote new policies that may balance the key stakeholders in the City Logistics and they are the shippers and receivers, freight carriers, residents, administrators (public authorities). The main interest of each one of this intervenient collide with the interests of the others, for example: shippers want to offer different services from other competitors to gain competitive advantages; costumers and retail companies want to receive the orders when they need and they want to keep low stock levels and for that, they must receive frequent deliveries; residents want low traffic and pollution levels but on the other hand they want to buy articles in the shops when they want or need them and receive their online orders at a certain hour (Thompson and Taniguchi, 2001); the administration wants to reduce the congestion and pollution as well as to increase mobility, while not penalizing the city center activities for retailers and services. Also, one of the aims of public policy is to reduce and control the number, dimension and characteristic of the freight vehicles operating inside the city limits, to reduce the number of empty trucks and increase the ton per truck per trip made (Crainic, 2008).

FIGURE 1
RELEVANT ACTORS AND THEIR RELATION IN THE CITY LOGISTICS CONTEXT



Source: Transman Consulting

Since the stakeholders develop the most important role in this thematic, it is important to detail their relevance:

Residents

Residents are the persons that live and may work in the city and that want to live in a pleasant place, with quality of life, reduced traffic, decongestion arteries, free parking places that will not harm their mobility. So, they do not welcome large trucks that enter the cities with commodities to supply the retail areas that are necessary for them. Some cities have implemented regulations for limiting the maximum size of the trucks that can enter the city limits. As a result, an increase of smaller trucks enter in the city to perform the deliveries and the effect was the opposite of the one expected, the car traffic increased. To solve this issue some measures have been taken and implemented models of vehicle routing and scheduling programs (VRP) with time windows to perform the deliveries. This measure needs coordination between residents, retailers and freight carriers. Another measure is to control the load factor of the trucks – this measure has been applied in Copenhagen and Amsterdam since 1998 (Thompson and Taniguchi, 2001). The creation of an urban consolidation center (UCC) together with a cooperative freight transport is another measure that conducts to a reduction of the traffic inside city. These UCC are located outside the city, receive and store the products from different shippers and carriers. A single operator than performs the transport from the UCC to the city. With this measure the traffic is reduced and the cost is competitive, example is the Motomachi project in the city of Yokohama (Taniguchi, 2012).

The key factor is to establish a platform of discussing between the residents and the other stakeholders that enable the quality of living in the city together with the supply of products and services (Thompson and Taniguchi, 2001).

Shippers and receivers

The demand of the goods is increasing his complexity, the retailers want to have low stocks in their stores and for this require frequent deliveries (JIT and Lean philosophies), and these deliveries are frequent to minimize the storage costs. Narrow time windows created by public policies together with narrow time windows created by the outlet operators has led to an increase in the number of vehicles that transport the goods. These vehicles are smaller and the economies of scale are lost, resulting in an increase of costs.

The quality and reliability of the service is another relevant issue for the shippers and receivers. The flexibility, security and reliability are crucial factors for the logistics operator. To match the frequent deliveries with reliability and quality, the shippers need to have sophisticated management and control techniques.

The demand for urban freight is now seen as interdependent and this adds more complexity to the distribution system and increases the challenges for the optimization of transport costs. Supply chain involves an integrated vision of logistics where all the elements of the chain are coordinated and aligned. The quick response systems involve the quick flow of information and for that we need integrated information technology.

The development of technology helps to improve the security and the managements of vehicles (E.g.: GPS) results in an increase of reliability of deliveries and allows for example to book unloading docks or packing places in advance; this will reduce the time stopped by the driver (Thompson and Taniguchi, 2001).

Carriers

Increase the utilization of the fleet is a major issue for operators. Often the vehicles travel without full loads, there is an under-utilization of capacity. The development of the IT and management systems allow booking systems to optimize the loads and reduce the problem of back loads. Transporting freight outside working hours, during the night, offers potential increase for the utilization of vehicle fleets and leads to a cost reduction. Reduced travel times and reduced fuel consumption will be realized by the operators that will introduce this measure. On the other side of this measure, we have the noise that the vehicles may cause during the night deliveries, which may disturb the residents. The security of the deliveries and the extra-hours that will be paid to the staff are creating difficulties to the

democratization of this measure. Specialized transport companies and third party logistics are becoming more prevalent in the urban areas. With the use of this type of operators, manufacturers and retailers can outsource the transport activity. This allows more sophisticated logistics systems and expertise to be created and increased.

Developments in vehicle technology provide significant economic and safety benefits. More efficient engine performances and design, braking systems, tires, unloading platforms and suspension systems enable the increase of the productivity of the vehicle fleets.

Often the drivers have to choose the best arteries to use when they are travelling in urban areas. When a driver select a route within the urban areas, have been found to be more sensitive to congestion, distance and number of turns, so developments in VRP and tools that help drivers to reduce travel time are quite important to increase the performance of deliveries (Thompson and Taniguchi, 2001).

Government

Public administrators that include traffic authorities, infrastructure authorities, municipalities, railway, terminal port authorities, can also be named as authorities (Anand et al., 2012) attempt to enhance the economic development of the city and increase employment opportunities and, on the other hand, they also want to reduce traffic congestion, improve the environment and reduce car accidents. The major role of the authorities is solving the conflicts among the key stakeholders in the City Logistics context, since they are not attached to any of the parties. Historically the administrators have been involved in the provision of transport infrastructure and regulation of the freight industry. The role of the administrators changed and they are more actively involved in facilitating and promoting the economic development. The public sector has a major role in land use and public transport planning, in the standardization and harmonization of regulations to reduce the costs of goods distribution, road safety, reviewing vehicle designing standards to reduce the number of crashes involving trucks, in regulations that can reduce the environmental and social costs of road freight without increasing significantly the costs of the freight transport. The management of transport networks can be done using demand management techniques and intelligent transport systems that offer high potential to increase the capacity of the existing road systems without having to construct any additional infrastructure.

The economic analysis made by the authorities should also include the side effects created by their policies. For example when the authority constructs a new road that can have reduced impact in goods transport, while the side effects can be the improve of fleet management and logistics management costs, not incorporated in the standard road user costs algorithms, economies of scale through the use of more efficient vehicles and more efficient utilization of land for production purposes.

Public authorities also play a major role in encouraging the experimental programs and trails in the City Logistics field. These policies often involve establishing working groups and promoting the involvement from the industry and logistics operators as well as publicizing the outcomes (Thompson and Taniguchi, 2001).

City Logistics usually includes one or more than one of the following initiatives (Thompson and Taniguchi, 2001):

1) Advanced information systems
2) Co-operative freight transport systems
3) Public logistic terminals
4) Load factor control
5) Underground freight transport systems

Thus, it is very important to define Urban Goods Movement (UGM) that comprises all the freight distribution in an urban area (urban area usually is considered for the population of above 50.000) and this distribution is mainly made using freight vehicles (McDermott, 1980). Another term used is urban logistics, which is defined by Dablanc (2007) as a service provision that contributes to an optimized management of the movement of the goods in to the cities.

Consolidation of services and cargo from different shippers is also very important in this thematic because it can reduce the costs for a firm and the freight vehicles traffic, that it is very important for the shipper but it is even more important for a society at large (Taniguchi et al., 2012). The

consolidation of the cargos is mainly made at CDC (City distribution centers) (Crainic, Gendreau & Potvin, 2009), that are located in the limits of the cities. These facilities receive the large trucks and unload them, store the goods and after they load the orders in smaller trucks or even vans that perform the delivery to final destination inside the city. There is not a single term used for this centers (Wolpert and Reuter, 2012); they can be called urban distribution centers (Roca-Riu and Estrada, 2012; Awasthi and Chauhan, 2012), urban consolidation center (Correia et al., 2012), freight terminals (Dablanc, 2007) or urban freight consolidation center (Marcucci and Danielis, 2008).

According to Taniguchi (2012), the essential viewpoints in the field of City Logistics are: Intelligent Transport Systems (ITS), Information and Communication Technology (ICT); Corporate Social Responsibility (CSR); Urban planning and City Logistics; Land use planning and City Logistics; Units of urban freight transport planning; Subsidies and additional charges from the public.

The key performance indicators that the projects in the City Logistics field must observe are (Taniguchi, 2012):

1) Life quality is the criteria and the objective it is to reduce emissions. We can use as indicator the noise, air quality, CO2 emissions, traffic volume, car accidents. The source for this criterion can be the field of study, local authority or the police. The measurement for this criteron can be modeling measures, traffic counts and literature research.
2) Economic development is the criteria and the objective is to measure this economic development. We can use as indicator the commercial floor space, number of visitors. The source for this criterion can be the local authorities, offices, real estate. The measurement for this criterion can be statistics, questionnaire study.
3) Accessibility is the criteria and the objective is improving accessibility. We can use as indicator the vehicle-kilometer, travel time, number of obstacles. The source for this criterion can be the carriers, drivers, field study and police. The measurement for this criterion can be questionnaire study, traffic counts.
4) Transport efficiency is the criteria and the objective it is to improve vehicle loading factors. We can use as indicator the average load factor of vehicles, fuel consumption per unit. The source for this criterion can be the operators. The measurement for this criterion can be a study.

2. METHODOLOGY

Since this paper is a literature review, we have search for the best methodology to carry out this work and according to the literature, they are three (Marasco, 2008): Delphi method, that is used when we want to survey experts in the field of study; Meta-analysis, in which empirical studies on the specific subject are gathered and statistically analyzed; Content analysis, that is a research method for systematic, qualitative and quantitative description of the manifest content of literature in an area.

To perform our work we have chosen to use the content analysis methodology and for that, we must follow two major steps (Li and Cavusgil, 1995):

1) Definition of sources and procedures for the search of articles to be analyzed.
2) Definition of categories instrumental to the classification of the collected articles.

The purpose of this article is to gather all the papers that are published in the thematic of City logistics in the relevant journals that are searched when we use scientific databases as the search engine to found relevant papers. In a previous work carried in this field, Wolpert and Reuter (2012) defined 15 keywords as the sample to search when you are looking for the theme of City logistics. Use only City Logistics as a keyword for performing our searches can reduce the quantity of the articles in the sample, due to the fact that this theme as a larger scope. In order to describe the movement of the goods in to the cities, we need to include more relevant words. In our work we have decided to use the same keywords as Wolpert and Reuter (2012), with few modifications. We had reach to 14 keywords that we will use to search, between quotation marks to narrow the scope of the search, and they are: City logistics, Urban logistics, Urban goods transport, Urban freight

transportation, City consolidation, City distribution, Urban consolidation, Urban distribution center, Urban distribution centre, Last mile logistics, Urban freight distribution, Urban freight transport, Urban goods, Urban goods distribution.

We have used the scientific database ISI Web of knowledge to perform our search. The main reason behind this choice is due to the fact that ISI makes the search in 19708 relevant journals published subject to peer review.

We made the searches in the database on 25th and 26th April 2013, using the above 14 keywords and we had a result of 560 articles. During the searches we realized that several studies had appeared in more than one search, because they had in their content more than one of the keywords used above. Elimination of the duplicates has reduced the sample to 424 papers.

Listed below is the output's resume of the search performed:

TABLE 1
RESUME TABLE OF THE STUDIES

Year	Total Papers	Papers repeated	Valid papers in the search	Citations	Repeated citations	Valid Citations
2013	6	2	4			
2012	176	56	120	34	10	24
2011	28	4	24	40	6	34
2010	85	26	59	236	91	145
2009	38	5	33	130	25	105
2008	29	2	27	65	24	41
2007	21	5	16	172	61	111
2006	18	2	16	61	4	57
2005	18	6	12	143	47	96
2004	42	12	30	182	75	107
2003	12	1	11	9		9
2002	8		8	5		5
2001	7	1	6	54		54
2000	4	2	2	1		1
1999	8	1	7	5		5
1998	10	2	8	128		128
1997	4		4	2		2
1996	4		4	4		4
1995	4		4	13		13
1994	1		1	3		3
1993	3		3	6		6
1992	6	2	4	5		5
1991	1		1	1		1
1989	2		2	1		1
1986	1		1	1		1
1985	1		1			

(cont.)

Year	Total Papers	Papers repeated	Valid papers in the search	Citations	Repeated citations	Valid Citations
1984	1		1			
1983	4	2	2			
1982	3	2	1	3		3
1981	1		1			
1980	2		2	1		1
1979	1		1	1		1
1978	1		1			
1976	3	1	2	2		2
1975	3	1	2	4	2	2
1974	1		1	3		3
1971	1		1	1		1
1965	2	1	1			
Total	560	136	424	1316	345	971

The top five papers have 261 citations that represent 26.8% of the total citations and the first paper has 121 citations (Marsili and Zhang, 1998, Title: Interacting individuals leading to Zipf's law), so we had conclude that the theme of this paper is not related with City Logistics, but it has appeared in our search due to the fact that we have used city distribution as a keyword and this paper has in its content this keyword.

So, we found extremely important to review all the articles to search for articles that are only related with the thematic of City logistics. To ensure the relevance of the articles that will be used in this review, we read all the abstracts of the articles and found that 47 articles appeared in the search but they aren't related with the City Logistics thematic, so the final sample is established in 377 papers. The papers excluded from our sample are related with health, estate, electricity power, population and water field of investigation.

3. STUDIES MADE AND KEY FINDINGS

Due to the methodology framework and keywords used, we strongly believe that we have covered almost all the publications made in the field of study on City Logistics. The first paper published in this area was in 1971 (Urban goods movement research – Proposed Approach) made by S. J. Hille and till the 2003 only 62 studies were made in 22 years in this thematic (Table 1). From 2003 up to the date of the search made in ISI, 315 papers were published and 28.30% of the paper publication was made in the year of 2012, after the 7th Conference in City Logistics that happened in the Mallorca in June 2011, which counts 59 papers published. The publications in the area of the City Logistics are mainly made in the proceedings of the International Conference on City Logistics organized by the Institute for City Logistics based in Kyoto University, managed by the Professor Eiichi Taniguchi. These conferences started in 1999 and happen every two years (10 already took place); the last one was in 2017 and the next one will happen in Dubrovnik from 12th to 14th June 2019. Last year's conference has in the program preview 63 papers to be presented. The majority of papers submitted in this conference are then published in the journal *Procedia* – Social and Behavioral Sciences.

TABLE 2
RANKING OF THE SOURCES

Year	Source	Count
2012	7TH INTERNATIONAL CONFERENCE ON CITY LOGISTICS – PROCEDIA	59
2010	6TH INTERNATIONAL CONFERENCE ON CITY LOGISTICS – PROCEDIA	51
2004	LOGISTICS SYSTEMS FOR SUSTAINABLE CITIES	26
2010, 2008, 2005, 1982, 1976	TRANSPORTATION	9
2012, 2004, 2003, 2000	TRANSPORT REVIEWS	8
2012, 2010, 2007, 1993, 1983, 1982	TRANSPORTATION RESEARCH PART A-POLICY AND PRACTICE	8
2012, 2011, 2009, 2006	JOURNAL OF TRANSPORT GEOGRAPHY	7
1999	WORLD TRANSPORT RESEARCH	7
2012, 2011, 2009, 2004	TRANSPORTATION RESEARCH PART C-EMERGING TECHNOLOGIES	6
2013, 2012	EUROPEAN JOURNAL OF TRANSPORT AND INFRASTRUCTURE RESEARCH	5

The top ten sources count 186 papers, 49.30% of papers published in all the sources. Note that we have found 230 publications with articles that are related with this thematic.

Regarding the importance of the papers published, according to the citation ranking, we found the paper "An evaluation methodology for City Logistics" as the paper more times cited (Table 3).

TABLE 3
PAPER RANKING BY TIMES CITED

Ranking	Year	Paper	Author(s)	Source	Times Cited
1	2001	An evaluation methodology for city logistics	Taniguchi, E. and van der Heijden, R.E.C.M.	Transport Reviews	38
2	2007	Goods transport in large European cities: Difficult to organize, difficult to modernize	Dablanc, L.	Transportation Research Part A-Policy and Practice	36
3	2004	Advanced freight transportation systems for congested urban areas	Crainic, T. G., Ricciardi, N. and Storchi, G.	Transportation Research Part C-Emerging Technologies	33
4	2005	Solutions applicable by local administrations for urban logistics improvement	Munuzuri, J., Larraneta, J., Onieva, L. *et al.*	Cities	33
5	2004	Intelligent transportation system based dynamic vehicle routing and scheduling with variable travel times	Taniguchi, E. and Shimamoto, H.	Transportation Research Part C-Emerging Technologies	25
6	2009	Models for Evaluating and Planning City Logistics Systems	Crainic, T. G., Ricciardi, N. and Storchi, G.	Transportation Science	25

(cont.)

Ranking	Year	Paper	Author(s)	Source	Times Cited
7	2009	Intelligent freight-transportation systems: Assessment and the contribution of operations research	Crainic, T. G., Gendreau, M. and Potvin, J.	Transportation Research Part C-Emerging Technologies	21
8	2006	Travel time reliability in vehicle routing and scheduling with time windows	Ando, N. and Taniguchi, E.	Networks & Spatial Economics	20
9	2009	Delivering Goods in Urban Areas: How to Deal with Urban Policy Restrictions and the Environment	Quak, H. J. and de Koster, M. B. M.	Transportation Science	18
10	2004	Objectives, methods and results of surveys carried out in the field of urban freight transport: An international comparison	Ambrosini, C. and Routhier, J. L.	Transport Reviews	17
11	2007	Exploring retailers' sensitivity to local sustainability policies	Quak, H. J. and de Koster, M. B. M.	Journal of Operations Management	16
12	2006	A novel dynamic resource allocation model for demand-responsive city logistics distribution operations	Sheu, J.	Transportation Research Part E-Logistics and Transportation Review	14
13	2005	Refocusing the modelling of freight distribution: Development of an economic-based framework to evaluate supply chain behaviour in response to congestion charging	Hensher, D. A. and Puckett, S. M.	Transportation	14
14	2009	An exact solution approach for vehicle routing and scheduling problems with soft time windows	Qureshi, A. G., Taniguchi, E. and Yamada, T.	Transportation Research Part E-Logistics and Transportation Review	13
15	2001	Understanding the movement of goods, not people: Issues, evidence and potential	Woudsma, C.	Urban Studies	13
16	2010	A modelling system to simulate goods movements at an urban scale	Russo, F. and Comi, A.	Transportation	12
17	2008	The potential demand for a urban freight consolidation centre	Marcucci, E. and Danielis, R.	Transportation	12
18	2010	Two-Echelon Vehicle Routing Problem: A satellite location analysis	Crainic, T. G., Perboli, G., Mancini, Simona *et al.*	6th International Conference on City Logistics – *Procedia*	11
19	2010	Unintended impacts of increased truck loads on pavement supply-chain emissions	Sathaye, N., Horvath, A. and Madanat, S.	Transportation Research Part A-Policy and Practice	11
20	2008	The Impact of Urban Freight Transport: A Definition of Sustainability from an Actor's Perspective	Behrends, S., Lindholm, M. and Woxenius, J.	Transportation Planning and Technology	10

The total papers in the sample are 377 and we noticed that in average these papers are few times cited– average of 2.29 citations per paper and 265 papers do not have any citation at all. This finding is in accordance with the fact that most of the papers were published in the recent years. Regarding the authors with more publications, they are: Eiichi Taniguchi, J. H. R. van Duin, Antonio Como and Luis Onieva. The search gave us a figure of 666 authors that have already published or participated in some work in this field.

TABLE 4
AUTHOR RANKING BY PAPER PUBLISHED

Ranking	Authors	Count publication
1	Taniguchi, Eiichi	26
2	van Duin, J. H. R.	19
3	Comi, Antonio	16
4	Onieva, Luis	16
5	Routhier, Jean-Louis	14
6	Quak, H. J. (Hans)	13
7	Munuzuri, Jesus	13
8	Yamada, Tadashi	13
9	Browne, Michael	10
10	Patier, Daniele	10
11	Perboli, Guido	10
12	Thompson, Russell G.	10
13	Nuzzolo, Agostino	9
14	Russo, Francesco	9
15	Crainic, Teodor Gabriel	8
16	Dablanc, Laetitia	8
17	Gao, Meijuan	8
18	Gonzalez-Feliu, Jesus	8
19	He, Mingke	8
20	Ambrosini, Christian	7

Regarding the participation of the 666 authors, we found that 138 papers only have one author, 242 papers have two authors and the remaining papers have 3 or more authors that participated in the paper.

Regarding the geographical distribution shows that most of the research in the area is done in Asia (China, Australia, Japan), in Europe (France, Italy, Spain, Netherlands), in North America (USA, Mexico) and South America (Brazil).

TABLE 5
COUNTRY OBJECT OF STUDY

Country	Framework	Type
China	45	45
Australia	16	16
France	14	16
USA	14	14
Italy	10	10
Spain	9	11
Japan	8	8
Netherlands	8	9
Mexico	7	7
Brazil	5	5

In accordance with the geographic distribution per country, the city ranking also puts on top of the ranking the city of Beijing with 10 studies made (E.g: Cui et al., 2010; Hou et al., 2010), mainly due to importance of solving the problems of distribution in the city (5 studies made on this subject). Interesting fact is the city of Seville, a medium city, has 5 studies made by Jesus Munuzuri in the thematic of City Logistics.

TABLE 6
CITY OBJECT OF STUDY

Rank	City	Count
1	Beijing	10
2	Sydney	7
3	Seville	5
4	Tokyo	4
5	Rome	4
6	New York	4
7	Mexico City	4
8	Shanghai	3
9	Pearl River Delta	3
10	Montreal	3
11	London	3
12	La Rochelle	3
13	Barcelona	3
14	Wuhan	2
15	Rio de Janeiro	2
16	Regensburg	2
17	Paris	2

(cont.)

Rank	City	Count
18	Lyon	2
19	Los Angeles, Long Beach	2
20	Jinan	2

Regarding the object of the study, the impact of the public policies measures in the City Logistics context is the subject that has more studies and in the table 7 we have the ranking of the frameworks used in the papers.

TABLE 7
FRAMEWORK USED PER STUDY

Ranking	Object of study / Framework used	Count
1	Public policies measures	10
2	Scenarios created	8
3	Empirical analysis	6
4	Interviews, questionnaire	5
5	Survey	4
6	Cost benefit analysis	3
7	Inventory of policy measures	3
8	ITS Freight	3
9	Modeling system	3
10	Multi-Agent system	3
11	Rail system	3
12	Urban Distribution Centers	3
13	2 companies – Retailers and stores	2
14	2E-VRP	2
15	Decision making model	2
16	Demonstration research	2
17	Genetic Algorithm	2
18	Mathematical model	2
19	Rural logistics	2
20	UCC	2

Regarding the frameworks, Taniguchi et al. (2012) categorize the models that have been applied to practical problems for evaluating policy measures of City Logistics in nine types: optimization models, simulation models, transport networks, multi-criteria analysis, bi-level decision making process, impact analysis of policies, risk management, reliability and humanitarian logistics.

Optimization models incorporate dynamic and stochastic elements, since the urban freight transport faces varying demand and travel times. Those models are divided in three broader areas: Vehicle Routing Problem, Multiobjective optimization and Intelligent agents.

There are several works in VRP area mainly due to the fact that they are basic tools for understanding distribution

in urban areas and due to the time windows that this tool may include. These works were made by Woensel et al. (2008), Qureshi et al. (2009), Wen et al. (2010) and Kok et al. (2010). Multiobjective optimization has the objective to identify the Pareto optimal set, since not all the objective functions can be simultaneously optimized. This model is focused in heuristic algorithms to obtain approximate solutions and we can find works made in this area by Mansouri et al. (2010) and Moncayo-Martinez and Zhang (2011). Developing intelligent agent software can be used to solve complex optimization problems in dynamic environments, therefore there are a number of areas where intelligent agents can assist in implementing City Logistics schemes such as determining optimal paths for delivery vehicles in road networks and dynamic VRP. Work in this area has been made by Lam et al. (2002).

Simulation models use multi-agent systems, as multiple stakeholders are involved in planning City Logistics schemes. Those models are divided in three areas: Systems dynamics, Multi-agent systems and Game theory.

System dynamics is a simulation modeling approach for predicting the behavior of complex systems and can be used to gain insights into the effects of freight policies considering the complex interactions between stakeholders. Work in this area has been made by Luan (2010). Multi-agent modeling techniques allow complicated urban freight transport system with multiple actors to be investigated. These models generally deal with the behavior and interaction among multiple agents, that are most suitable to understand and study the behavior of stakeholders in urban freight transport systems and their response to policy measures, and we can find works made by Holguin-Veras et al. (2008) and van Duin et al. (2012) in this area. Game theory is a tool used to understand gamming situation of multiple stakeholders involved in City Logistics systems. Bell (2004) made a work on this area.

Transport networks are one of the systems where computer simulation models have been applied, since it is not practical to experiment with real networks. Traffic simulation models can be divided in two areas: macroscopic, microscopic, mesoscopic and continuous, discrete time approach. Macroscopic traffic simulation models describe the traffic flow in aggregated manner without looking at their elements in detail (work made in this area by Helbing et al., 2001). Mesoscopic is an intermediate simulation model and link performance functions and capacities (work made in this area by Mahut, 2001). Microscopic traffic simulation models represent traffic at the level of individual vehicles and their interactions (work made in this area by Barcelo et al., 1999).

Multi-criteria analysis methods allow alternatives to be ranked where a number of evaluation criteria are considered important. This method allows urban freight planners to incorporate a range of sustainability related objectives. These models must be robust to allow quality in the outputs, and this analysis has three main components: a finite number of alternative plans or options, a set of criteria by which the alternatives or options are to judged, method for ranking the alternatives or options according to how well they satisfy the criteria. There are several works made using this approach mainly by Russo et al. (2006) and Wheeler and Figliozzi (2011).

Bi-level decision-making framework is often represented within a decision making process, because the behavior of a stakeholder may influence one or more of the other stakeholders. Works in this area were made by Chiou (2009) and Kuo and Han (2011).

Impact analysis of policy measures gives important components for evaluation methodology. These measures should be evaluated before implementing in a real situation. Some models have been developed and applied to evaluate these policy measures, made by Quak and Koster (2009), Sathaye et al. (2010) and Russo and Comi (2011).

Risk management, mainly in the urban freight transport is related with the circulation of hazardous materials that creates pressure in the authorities to demand policies for restricting their circulation and creates trade constraints for the shippers and receivers. So there is the need to create models for minimizing the impacts in the circulation of vehicles (Bell [2006] made a work on this area). Reliability is also studied in City Logistics in the context of travel time for better environmental solutions for urban freight transport systems and vehicle navigation (Example is the study made by Bell, 2009). Humanitarian logistics is a new and challenging topic in City Logistics area and it has the objective to minimize the sufferings of affected people. The

constraints in humanitarian logistics are the lack of commodities, capacity of trucks, quantity of drivers and the response time. The planning has to be done quickly, but it is very hard to perform due to the fact that demand is unknown and it is difficult to calculate the travel time. Works in this area have been made by Balcik et al. (2010) and Caunhye et al. (2011).

In the context of City Logistics, urban goods movement has a great importance in the literature and we can realize that importance since we found 33 studies that focus this thematic, mainly in the early days of the investigation. In the urban goods movement domain, the different descriptors are divided by market. In the market we have the commodity and the descriptors are the freight generation, commodity flow, industry structure; transport service and the descriptors are vehicle loading, vehicle design, trip generation, cost; traffic service and the descriptors are traffic design, traffic flow, pollution level; infrastructure and the descriptors are land use, location, building and site design, modal transfer (Ogden, 1992). Many modeling efforts consider traffic flow and commodity flow as the descriptor and use the four-step approach as the suitable model. Examples of papers that use one or both of the above descriptors are the studies made by Visser and Maat (1997), Hensher et al. (2005), Munuzuri et al. (2005) and Russo (2010).

Urban goods movement can be analyzed from different perspectives for the same objective and these perspectives for urban freight modeling are: planner's perspective, technology perspective, behavioral perspective, policy perspective, Multi-actors perspective (Anand et al., 2012).

The earlier attempts for urban freight transport are made on the planner's perspective and deals with organizing vehicle flow by efficient use of current and proposed infrastructure and services. The planner is interested in knowing what will be the best combination of urban freight transport that will serve better the city. There are studies made by Figliozzi (2007), Munuzuri (2009) and Munuzuri et al. (2010). Regarding the technology perspective, the recent evolution in the new technologies brought a new world for the researchers to explore. Tools like ITS, ITC, GIS (Geographic Information Systems) bring benefits for the carriers to develop better and more reliable freight solutions with controlled costs. Works made by Hill et al. (2002), Yu et al. (2001), Xu et al. (2003), and Taniguchi and Shimamoto (2004), focus this area. Behavioral perspective is an analysis that attempt to understand and describe the behavior of the agents under different situations. Behavioral models consider complexities of attribute and decision making ability of various stakeholders that aren't considered in the other modeling efforts. Studies in this area were made by Boerkamps et al. (2000), Wisetjindawat and Sano (2003), and Holguin-Veras et al. (2004). Policy perspective differs from planner's perspective, as planner's concerns with planning new infrastructure or traffic planning to enhance urban goods movement and reduce externalities. Policy perspective aim is to introduce policy measures as rules, regulation or initiatives mainly to reduce externalities related to urban goods movement – the most well-known is vehicle restriction based on weight, size and time for delivery vehicle. Studies in this area were made by Taniguchi and Tamagawa (2005) and Quak et al. (2006). Per definition urban freight transport is characterized by the multiple stakeholders with different and conflicting interests. Multi-actors perspective refers to analyzing interactions of autonomous stakeholders with a view to assessing their effects on the system as a whole. Examples of this perspective are found in the studies made by Hensher et al. (2005) and van Duin et al. (2007).

The project BESTUFS – *Best Urban Freight Solutions* is made in the field of urban freight transport and aims to maintain and expand an open European network between urban freight transport experts, user groups/associations, ongoing projects, the relevant European Commission Directorates and representatives of national, regional and local transport administrations and transport operators in order to identify, describe and disseminate best practices, success criteria and bottlenecks with respect to City Logistics Solutions. The aim of this project is to develop a product that can be used by municipal policy makers and companies active in urban freight transport. The approach used is a problem-solving based approach that the authors think that should be the most suitable approach to solve the problems of urban freight. The study involves the analysis of 20 applications of single measures and 14 applications of multiple measures in several European cities

in 14 countries, including the Portuguese project LogUrb in the year of 2007 in the Alvalade neighborhood in Lisbon (BESTUFS, 2006).

Another project made in the area of urban freight transport and City Logistics context is the SUGAR – *Sustainable Urban Goods Logistics Achieved by Regional and Local Policies*, which is composed by 17 partners in 10 different countries and was born in 2008. They work to provide a common background to the modern cities. That background is to enhance capability in terms of infrastructures and design of urban mobility through the efficiency of freight transport systems. The policy leverages include transport, environment, space and territory and harmonization. The book *City Logistics Best Practices: a Handbook for authorities* (SUGAR, 2011) identifies the following 44 best practices:

France (13): Paris – Consignity, Mobility Master Plan including freight, Technical Guidelines for delivery spaces, Urban Logistics Space (ULS), Urban Rail Logistics (Monoprix); Marseille, Dijon, Bordeaux – Data Collection Modeling; La Defense – Cityssimo; Poitiers – Dynamic delivery areas; La Rochelle – Elcidis, Urban Consolidation Center; Bordeaux – Espace Logistique de Proximité (ELP); Toulouse – Partnership on Goods Pratices; Rouen – Petit Reine (electrically assisted trycicles for deliveries); Pick up points for B2C in French cities.

Italy (8): Regione Emilia-Romagna – Lorry Routes, Traffic Limitation by Euro standards, Inter City Coordination, Ecologistics Parma; Bologna – Freight Distribution Plan; Reggio-Emilia – ARIAMIA electric delivery vehicles for rent; Padua – Cityporto; Lucca – Life CEMD.

United Kingdom (6): London – Freight Information Portal, Freight Operators Recognition Scheme (FORS), London Construction Consolidation Centre (LCCC), London Lorry Control Scheme, Low Emission Zone; Bristol – Urban Consolidation Centre.

Netherlands (4): Amsterdam – Citycargo; Utrecht – Low emission zone; Binnenstadservice in Dutch cities, Silent Deliveries with PIEK labeling in Dutch cities.

Spain (3): Barcelona – Multiuse lanes, Night deliveries, Using building code regulations for off-street delivering areas.

Switzerland (3): Zurich – Cargotram; Thun – SPEDITHUN; Heavy goods Vehicle Fee (HVF) on local and urban roads in Swiss cities.

Germany (2): Bremen – Lorry routes; Packstation for B2C in German cities.

Japan (2): Yokohama – Motomachi Urban Consolidation Center (UCC); Tokyo – Urban logistics terminals.

Czech Republic (1): Prague – Protected delivery zones.

Norway (1): Trondheim – SMARTFREIGHT.

Sweden (1): Stockholm – Congestion charging.

Planning the future and the visions of City Logistics is the project from DHL, Delivering Tomorrow, which was created and has been developed by the company DHL – Deutsche Post AG, and aims to create visions about the role of logistics in the year 2050. So, they invited several experts from the field of logistics to imagine and create scenarios about how the world will be in 2050 in what concerns to population and its location, weather and its effects in the daily life of the population, trends in international trade and their impacts in the economy, status of the economy, technology innovations and it´s impacts in the logistics industry. The study finishes with 5 different selected scenarios that are quite different and sometimes with complete opposite visions about the world concept in 2050. The first scenario created is the untamed economy is impending the collapse, the global mass consumption has reached unthinkable levels of growth, the global trade is growing and even more complex and reliable logistics services are created to supply this vast demand. The world is getting hot and the competition for natural resources is reaching its limit putting the ecosystems in risk. The second scenario created is mega-efficiency in megacities that are the pillar of progress, ambient protection and cooperation. The problem is that the rural areas are left behind. Innovative and more efficiency technologies create faster and more sustainable transport for humans and for goods. There is unlimited interaction and global cooperation amongst different latitudes. The third scenario is related with customized lifestyles – technological progress especially in 3D printing turns consumers in to producers and

self-tailored products are made by consumers. Several and different kinds of productions create a multitude of lifestyles. Awareness of need for recycling is creating new commercial perspectives that turn the world, characterized by diversity. The fourth scenario is related with paralyzing protectionism nationalism dominates and globalization is a thing of the past. Borders are again imposed, trade is restricted to regional blocks and mutual mistrust creates high customs barriers. Stagnation is the normal standard and international trade is almost reduced to zero. Conflicts on natural resources are in the daily life of the population. The fifth scenario created is related with global resilience and local adaptation. Extreme weather conditions create the need for a supply rethink. The weather is changing rapidly, creating catastrophes, so the humanitarian logistics and rapid response to tragedies is in the order of the day, the security of supply chain is also a concern and the world is becoming resilient (DHL, 2012).

CONCLUSION AND FUTURE RESEARCH

The field of City Logistics is very young and the production in the area is rapidly increasing in the recent years as shown in this study. Still, there is incoherence in the terminologies used, since there are several different terms to describe the same reality (E.g. urban distribution center and urban consolidation center). The future research in City Logistics requires advanced optimization and simulation modeling approaches to assist in the design, evaluation and operation of schemes that satisfy the concerns of all major stakeholders (Taniguchi et al., 2012). Decision making process for the different stakeholders, understanding about interactions among different stakeholders for fulfilling (supply) goods and services demand provides insights in urban goods movement causes, understand more the commodity flow while vehicle flow is the effect (Anand et al., 2012). Research on the suitability of descriptors for different stakeholders is also needed to justify policymaking based on urban freight analysis (Anand et al., 2012). Generic factor such as the objective, stakeholder's involvement, descriptor of their activities and means available for achieving objectives are more determinative for carrying out urban freight modeling (Anand et al., 2012). New indicators made for the urban environment to provide more quantitative data are need, and they can grant post evaluation and ensure greater comparability between the results of the different projects (Wolpert and Reuter, 2012). Analysis of City Logistics measures to reveal under which conditions these measures are effective and in which environment they perform best (Wolpert and Reuter, 2012). Most City Logistics projects that use an UCC is not profitability, and approaches that go beyond the pure transportation task are needed to gain economic success and, for example, new city services (Wolpert and Reuter, 2012). Understanding of the traffic needs the understanding of the related logistics processes and the multi-level, multi-dimensional, multi-disciplinary approach (Anand et al., 2012). Development in IT technology allow richer sources of data and information, so incorporating real time data relating to the performance of the traffic system can provide net benefits for key stakeholders. Development in agent based software, multi-objective optimization methods and multi-criteria analysis allow the performance measures for major stakeholders and the interactions between them to be included in City Logistics models (Taniguchi et al., 2012). Investigate and incorporate the specifics of using decision method in urban freight modeling by other stakeholders (shippers, carriers, receivers) (Anand et al., 2012). This study has limitations, mainly due to the fact that we have used only one scientific database to analyze the publication made in the field and it also do not count papers that aren't published in scientific journals.

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