City logistics: a chaos between research and policy making? A review

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Abstract

Although the interest in urban freight transport is growing, it is commonly seen as an area in which there is, for several reasons, a lack of research, especially if you compare it with the amount of research that deals with passenger transport. The attention of governments especially for urban goods movement has increased over recent years and with that the number of studies in the urban goods movement field. However, the practice of city logistics policies is not very often the result of detailed analyses and evaluations. This is reflected in similar types of regulations repeated through the different cities regardless of their characteristics, the same schedules for time windows and load zones, and the failure to recognise different types of urban distribution which require different types of regulations. Apart from copying regulation frameworks, however, cities hardly share information, knowledge or cooperation. The lack of national or regional bodies dealing with city logistics, as there exist for urban passenger traffic, is significant. In this paper we will address the main research contributions in city logistics and try to illustrate how the research contributions are (not) related to the daily practice of policymaking and town planning. Finally we will end with the conclusion that a real gap exists between research and practice and provide some explanations, conditions and directions for setting up new research projects.
Keywords: city logistics, urban freight transport, policy, research.


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1 Introduction

Although the interest in urban freight transport is growing, it is commonly seen as an area in which there is, for several reasons, a lack of research [5], especially compared with the amount of research that deals with passenger transport. The attention of, especially, governments for urban goods movement increased over the last years and with that the number of studies in the urban goods movement field, see for example the BESTUFS-platform. In many European countries as a result, many local authorities have been preparing environmental strategies. A key problem to implementing an achievable sustainable strategy is determining the parameters of measurement (e.g. geographical scale, environmental and social impacts, etc.), and not surprisingly it is extremely difficult to achieve a workable, acceptable set of targets, actions and measures which will result in more sustainable cities, and a more sustainable urban freight transport system within that city.

The aim of a sustainable transport strategy is ''to answer, as far as possible, how society intends to provide the means of opportunity to meet economic, environmental and social needs efficiently and equitably, while minimizing avoidable or unnecessary adverse impacts and their associated costs, over relevant space and time scales'' [6]. Since freight transport is part of the transport system it follows that the issue of sustainability must be addressed with regard to freight transport. The contribution of freight transport to problems of accessibility, congestion, environment, and safety are the common challenges to be tackled [7].

However, there are big differences in research approaches taken and policies implemented in different countries [8]. Also the practice of city logistics policies is not very often the result of detailed analyses and evaluations [9]. This is reflected in similar types of regulations repeated through the different cities regardless their characteristics, the same schedules for time windows and load zones, and the failure to recognise different types of urban distribution which require different types of regulations. Apart from copying regulation frameworks, however, cities hardly share information, knowledge or cooperation. The lack of national or regional bodies dealing with city logistics, as there exist for urban passenger traffic, is significant.

In this paper we will address the main research contributions in city logistics and try to illustrate how the research contributions are (not) related to the daily practice of policymaking and town planning. In this paper the literature survey is not complete since we have restricted our search/work to the proceedings of the International Conferences on City Logistics [1–4]. However we think that most issues addressed in this paper reflect quite well the daily practice of freight problems to be solved in the inner cities.

2 City Logistics: main areas of attention

The main areas of attention in city logistics (research and policy) over the last years can be classified in three categories:

- *Flow improvements (the actual transport)* including cooperation between companies, consolidation centres, transport reorganizing, and routing improvements;
- *Hardware (the means)* including infrastructure, parking and unloading facilities;
- *Policy (the context)* including licensing and regulation.

We do not present all research areas due to lack of space reasons. However we restrict ourselves to the areas with the most attention both in research and policy.

2.1 Cooperation

The main objective for emphasizing on cooperation between different, usually competitive, companies, is to increase efficiency in order to improve the accessibility and decrease the pollution (Ashida, et al., [2]; Hayashi, et al., [4]; Ieda, et al., [2]; Kawamura and Lu, [4]; Koehler, [2]; Nemoto, [3]; Qureshi and Hanaoka, [4]; Valentini, et al., [2]; Yamada, et al., [2]; Yamada, et al., [1]; Yoshimoto, [3]). Usually it involves pick-up and delivery operations of parcels in one city. In the majority of the papers the cooperation is between private companies that have an economic incentive to cooperate, namely to increase the efficiency of their operations that consist of multiple drops (or pick-ups) per vehicle roundtrip. Different carriers cooperate by consolidating goods at a terminal, or by using a neutral carrier, to provoke that two half filled vehicles visit the same area of a town. Since, one full truck results in a decrease in the total amount of kilometres. Most of the studies on cooperation are initiated by researchers, whereas the carrier is expected to be the main actor that actually cooperates with its competitors. In all *City Logistics*-contributions the cooperation is based on voluntary bases, with the idea that an increased efficiency is also in favour of the carrier. Except for the feasibility study in which Kawamura and Lu [4] also discuss cooperation, research in this area is carried by researchers from countries suffering from spatial scarcity. These papers are basically theoretical and the cooperation is evaluated by modelling a cooperative and a non-cooperative situation, although in some papers it is a matter of experimenting. Hayashi et al. [4] and Yamada et al. [1] actually use a survey to find the attitude of Japanese carries to cooperation. Studies on cooperation show that cooperation can have a positive effect on the accessibility, on the transport efficiency and on the environment. On the other hand, the logistics costs for a single company might be higher than in a non-cooperative setting.

2.2 Consolidation centres

The use of a consolidation centre is a special type of cooperation, which is considered typical (and sometimes even synonym) to city logistics initiatives. Several types of centres are included, e.g. city distribution centre, urban freight platform, freight village, etc., that have in common that flows from outside the

city are consolidated with the objective to bundle inner-city transportation activities (Boerkamps and Van Binsbergen, [1]; Castro, et al., [1]; Koehler, [1]; Koehler, [3]; Lozano, et al., [4]; Patier, [6]; Takahashi and Hyodo, [1]; Van Duin and Jagtman, [1]; Wang and Chu, [2]; Yamada and Taniguchi, [4]). The main objective to use a consolidation centre is to make urban freight transport more efficient in order to reduce the pollutant emissions and increase the city accessibility (reduce the congestion in urban areas).

- *Practice*

The main actors using consolidation centres are the carriers, either private of for-hire carriers, who (have to) use the centre. They are either obliged by legislation to make use of the centre (involuntarily use), or they are using it for sustainability reasons. The percentage volume transported via the centre of the total transported volume is usually quite low in case there is no legislation that enforces the use of the consolidation centre. Consolidation centres are only considered in countries that suffer from spatial scarcity. Usually it involves deliveries of core goods, however home deliveries and waste transport (Koehler, [3]) could be integrated as well. In most studies mainly simple goods are considered, since complex goods demand extra facilities in the consolidation centre. Major objections of carriers are the obligatory character of some consolidation centres that forces carriers (partly) to rely on others to perform their core business (delivering goods at their clients), and their decreased visibility at their clients, the receivers, since the no longer come there themselves, physically.

- *Research*

The results are not unambiguously; most studies show an improvement in transport efficiency, except for Boerkamps and Van Binsbergen [1] and one experiment in Patier [4], which also show an increase in congestion due to the use of a consolidation centre. The use of a consolidation centre especially in combination with electronic vehicles that deliver in the cities from the centre is beneficial for the environment. Some studies focus mainly on the shippers and receivers, without considering the users of the centres; the carriers (Van Duin and Jagtman, [1]), who might have a negative attitude towards the consolidation centres (Patier, [4]). Some studies conclude that consolidation centres are only useful in specific situations; e.g. touristic and historical centres (Koehler, [3]; Patier, [4]), or in situations that governments are willing to subsidise the centres because of an improvement in the environmental impacts (Boerkamps and Van Binsbergen, [1]; Patier, [4]).

2.3 Transport reorganisation

With respect to transport reorganisation we distinguish three categories:

- *Transport auctions* (Holguin-Veras, [3]; Jonkman, et al., [4]; [10–12]
  The main idea of offering transport orders in an auction setting is to make transport more efficient (e.g. less empty kilometres because carriers can bid on shipments, for example a pick up, at areas where their vehicle already

had to go to make a delivery). The auction initiatives are all evaluated using modelling techniques; the main results are that more competition is possible, and the auction increases the drive for efficiency, with the result that both shippers' cost can decrease and carriers' profits can increase. In practice first initiatives can only be found in the private sector within (intra) large transport companies.

- *Intermodal transportation* (Kawamura and Lu, [4]; Kunadhamraks and Hanaoka, [4]; Van Duin and Van Ham, [2])
  Intermodal transport is a totally different way of reorganising transportation. The discussed initiatives are very dissimilar; Kunadhamraks and Hanaoka [4] introduce fuzzy logic to make a mode choice at an intermodal terminal. Kawamura and Lu [4] discuss intermodal centres in the USA that are used for long distance shipments of especially bulk and automotive products. Only Van Duin and Van Ham [2] emphasis on regional rather than long distance transport. In this contribution the authors look for niches in which intermodal transport is also feasible on a relative short distance. They find that waste collection in cities might be possible using intermodal transport (combination of road and barge), and results in (although really small) improvement of accessibility and an increase in both logistics and transportation efficiency. In some special cases, such as the Dutch context with many waterways, intermodal might be useful in some niches in urban freight transport. Dependent on the infrastructure availability (e.g. railway and waterway) it might also be an environmental friendly (and even economical) way of transport for long distances of some product groups. Nemoto et al [4] describe intermodal transport examples in the EU, US and Japan and focus on the similarities and relationship between city logistics and intermodal transport.

  The policy practice shows a high interest in intermodal transportation. The Dutch government has stimulated transport by train and/or barge over the last 15 years and inland terminals have been emerging all over the country. Nowadays both train and barge transport have occupied a large proportion of the local container transportation market in the Netherlands the inland market shares of road, train and barge are respectively 44,9%, 4,4 % and 44,2% [13]. Most inland barge terminals have been setup with governmental financial support according to the 'Landlord'- principle. This principle implies that the municipality will finance cost for construction and maintenance of quays and related (ground) infrastructure. Since the new terminals are operating more and more in urban sceneries allows a shake-hand between research and policy in order to find a balance between the operational issues and the environmental effects of the designs of (new) terminals and to evaluate them on performances and noise emission.

- *Network strategies* (Hassall, [3], Groothedde [14])
  The transport reorganization by network strategies; these studies have a regional or even national scope. Hassall [3] shows examples of improving efficiency by changing a company's private distribution network, which

leads to more sustainable transportation. Groothedde [14] has developed network models which are capable of dealing with intermodal flows, which implies that freight can be transferred from one mode to another in the model via transfer points. Overall, the transportation reorganizing initiatives have only little in common, except that their scope is usually much broader than the city context only. By making the transportation more efficient (network strategies and auctions) it has also value for the cities. This is also true for intermodal transportation in the case it really results in an environmental improvement.

2.4 Routing improvements

Traditionally the research attention for vehicle routing problems is enormous. Many *City Logistics* contributions have discussed possibilities for routing improvements (Kunze, [3]; Marquez, et al., [3]; Samanta and Jha, [4]; Taniguchi and Ando, [4]; Taniguchi, et al., [2]; Taniguchi, et al., [1]; Taniguchi, et al., [2]; Thompson, [3]; Thompson and Taniguchi, [1]; Wild and Gluecker, [4]; Yamada and Taniguchi, [4]; Yamada, et al., [3]). The general nucleus of this type of research is that they all use a modelling paradigm to evaluate their improvements in the routings and that they have mainly theoretical point of analysis. Most papers have something included in the regular roundtrip planning in order to make a planning reflecting reality better. We can observe papers having included historical data, variations in travel times, real-time travel time (traffic information), congestion estimates, or multiple depots, all with the focus on solving the traditional VRPTW. Basically it comes down to the idea that a vehicle routing plan that is not feasible in reality (due to factors that were not considered during the design of the vehicle routing plan) is very costly, e.g. due to penalty costs for arriving outside time-window periods. The main objective for improving routing and scheduling is economic; i.e. the improved plan (higher feasibility in practice) should lead to a decrease in costs, due to increased efficiency, less penalty costs, and less rerouting activities during the planning's execution. All papers in this category are initiated by researchers themselves and only consider road transport. The majority of the routing improvements are tested by modelling it on a test road network. Usually these studies assume multiple pickups and/or drops combined in one vehicle. Most studies show successful results in which (at least one of) the following factors are reduced: the total travel time, the costs, the number of kilometres, pollutant emissions, and congestion. The vast majority of the studies find an increase in transport efficiency. Several of these studies also report a decrease in environmental impacts, due to the improved (better feasibility in reality) vehicle routing. The improvements are usually not tested in real world problems, whereas they focus on reducing the gap between a theoretical planning and the reality on which this planning is subjected to. Only Allen at al. [3] and Quak and de Koster [4], [15] use empirical data to find impacts of time-windows; governmental time-windows have a negative impact on the environment, on the transport efficiency, and the logistics costs. Very strict time-window regulations make efficient distribution in urban areas almost impossible.

The policy practice influences severely the route performances. By the enforcement of time-windows and vehicle restrictions the municipalities try to improve their environmental quality in the inner cities. Time windows are widely implemented in the Netherlands. More than 50% of the cities have this kind of measure. Five working days plus Saturday are the most frequent days. The main reason is the shops are open on Saturday. People go to the downtown to make shopping and they don't want to be disturbed by trucks. However, more than a quarter of the cities also restrict the freight traffic on Sunday. The range of the time period is widely diversified which is from one and half hours to more than 20 hours. However, the time windows in the morning period from 6:00 to 12:00 count for 43.6% of the total cities. Two third of the cities have time range from three hours to six hours.

The other measure that influences the route performances severely are the vehicle restrictions**.** The vehicle restrictions are also very popular in the Netherlands. Many aspects have regulated the movement of lorries in the downtown. 138 in 280 cities have at least one kind of vehicle restriction. As different cities may have their own unique characteristics related to historical center, transport infrastructure and economic situation, the difference of the same regulation varies considerably for each individual town. The limitation of height ranges from two meters to values of 4.5 meters. The differences observed here are also largely attributable to the local structure. Especially in the inner cities, some historical buildings limit the height of trucks. The most frequently used limitation is three or four meters high, i.e. more than 50% of the total cities. In big cities, the height limitation is higher than the small cities, ranging from three meters to 4.4 meters. The height of three meters (17%) and four meters (46%) are the top two, respectively. The width restriction ranges from two meters to four meters. Small cities use this regulation more often, i.e. 82% of the total small cities. Two or three meters limitations are used intensively, combining 76% of the total number. The length limitation is equally distributed between big and small cities. Ten and twelve meters are used more frequently, which have proportion of 23% and 31% respectively.

2.5 Infrastructure, parking and unloading facilities

Three main topics can be distinguished in this area:

- *Infrastructural changes* (Jha, et al., [4]; Kawamura, et al., [3]; Marquez, et al., [3]; Russ, et al., [4])
  Jha et al [4] has developed two models for transportation infrastructure maintenance; the first one is to minimize the inspection travel time and the other one is developed for obtaining an optimal maintenance schedule over a planning horizon. Kawamura et al. [3] and Marquez et al. [3] discuss the effects of improvements in infrastructure on urban freight transport: an extra lane on a crowded freight corridor, or the completion of an orbital route. Although the studies for these improvements are initiated by the researchers, the main actors are the authorities. The impacts are evaluated by using modelling techniques, which show that these infrastructure improvements

lead to an increase in transport efficiency. Russ et al. [4]) show that a mixed approach with several infrastructural projects, e.g. road widening and new links, gives substantial benefits. Debauche [3] and Giannakodakis and Lawes [1] discuss dedicated infrastructure, with the objective to increase social sustainability (e.g. increase safety and reduce nuisance). The advantages are that this allows for a reduction in the negative effects for residents (since trucks are only allowed on the freight network) and the possibility for efficient and safe urban goods movement (since these routes are equipped for freight transportation). By guiding all heavy vehicles over the same routes, the rest of the network will be free of these vehicles. Another positive impact is that investments to make infrastructure suitable for large and heavy vehicles only have to be made at a limited part of the network. Dedicated freight routes, including the special investments for it, result in an increase in transport efficiency. Important enablers are clear signalling and enforcement.

- *Initiatives on parking and unloading areas* (Aiura and Taniguchi, [4]; Ishida, et al., [4]; Larraneta, et al., [1]; Ma, [2]; Mizutani, [1]; Munuzuri, et al., [4]; Odani and Tsuji, [2]; Patier, [4])
  Research and policy are closely related in this area since for the majority the research is based on real-life experiments. Two problems are discussed; problems that are caused by (un)loading vehicles (e.g. double parking which hinders the other traffic) and problems of shortage in unloading areas (either due to a too low number of available areas, or due to illegal parked passenger cars on the unloading areas, which make it difficult to find unloading areas for commercial vehicles, resulting in, for example, double parked vehicles). The experiments here vary from increasing the number of unloading areas by using (parts of) the bus bays or specific areas for common use (Ishida, et al., [4]; Mizutani, [1]; Odani and Tsuji, [2]), to web-based reservation or dynamic load zones (Larraneta, et al., [1]; Munuzuri, et al., [4]), to an unloading centre from where the final deliveries can be made by foot (Patier, [4]).

  The use of loading and unloading zones is an important policy measure for local authorities. Sixty three percent of the cities have this policy in general. The big cities have stronger tendency to support this policy that 92% of big cities have. The difference is probably attributable to the higher frequency of social and economic activities in the big cities. The more people live there, the larger the amount of shipments. The design of a loading and unloading zone could regulate the traffic flow in and out the downtown.

- *Initiatives on parking and public transport* (Ishida, et al., [4]; Marquez, et al., [3]).
  Reduction of illegal parking by passenger cars is also possible by reducing the number of cars that visit the city center, by improving public transport to the center from a parking area elsewhere (Ishida, et al., [4]), if this leads to a

significant reduction in passengers cars it also reduces the congestion and pollution (Marquez, et al., [3]).

2.6 Licensing and regulation

There are several licensing and regulation initiatives discussed in the *City Logistics* conferences. We distinguish pricing (Allen, et al., [3]; Baybars and Browne, [3]; Misui and Nemoto, [4]; Taniguchi and Tamagawa, [4]; Yamada and Taniguchi, [4]), low emission zones [15] (Baybars and Browne, [3]), off-peak deliveries (Browne, et al., [4]; Holguin-Veras, et al., [4]), and land use initiatives (Ishida, et al., [4]). Other measures such as vehicle weight restrictions, vehicle load factor controls, and time-windows have already been discussed in route improvement.

Pricing initiatives are considered more recently. The main idea of pricing the use of infrastructure by governmental parties is either to earn back the investments and maintenance costs (see Misui and Nemoto, [4] who calculate what the appropriate tax level is to be paid by highway users from the social welfare perspective), or to make the scarce road capacity subject to market functioning [15] (Baybars and Browne, [3]; Taniguchi and Tamagawa, [4]; Yamada and Taniguchi, [4]) in order to reduce congestion and pollution. The main actors are the local authorities that initiate the pricing scheme and the users that are obliged (by legislation) to pay the charge. The focus of these schemes is on a part of the city. The success of the congestion charging depends on several aspects; the type of charge, the amount charged, the alternatives, the enforcement, and so on. These aspects could lead to a change in congestion, travel speed, travelled time, etc. Overall, if the aspects are chosen right, then the pricing leads to an increase in the transport efficiency, an improved accessibility, and most likely to a social support for this measure. However, these positive results mainly follow from a decrease in passenger transport. Freight transport operations are less sensitive to pricing; receivers are not always willing to receive in off-peak hours, or carrier can on charge the receivers. In both situations, there is no incentive to change behaviour because of authorities' pricing strategies [16]. However, in case there are no clear improvements, the social support will be low, and the pricing will be seen as an extra tax, without anything in return. The use of gains for improving alternatives for road transport increases support.

Local authorities use low emission zones to lower the pollution. The idea is that in a certain area, the low emission zone, only vehicles are allowed that fulfil engine demands [15] (Baybars and Browne, [3]). Once again, especially the carriers face the results of this measure; they have to renew their vehicle fleet (faster), to make sure clean vehicles are available to visit the zones. Overall, this measure has a positive impact on the (local) environment. Depending on the carrier, e.g. the number of clean vehicles available in its vehicle fleet, it increases costs if the carrier has to buy new vehicles.

Browne et al. [4] and Holguin-Veras et al. [4] discuss the possibilities of off-peak deliveries. It is included in this section, since it is, only possible if the regulations for the allowed times to visit the stores are relaxed. That makes off-

peak deliveries only possible in case of deregulation. The main idea to promote off-peak deliveries is to reduce congestion, or at least reduce the impact of congestion on deliveries by making them in non-congested periods. The main actor is the carrier. However, it is the receiver, who determines the delivery conditions, that has to change its behaviour. The incentive for the carriers is that it is possible to make more deliveries if it travels during period in which only little congestion occurs. This is only possible if the receiver is willing and able to receive the goods in off-peak hours. Overall, it might increase receivers' costs, and at the same time decrease carriers' cost. The efficiency increases, as does the accessibility and the environment. Deliveries during the night might increase nuisance for residents living above or nearby the stores

3 Conclusions

Overviewing the field of research city logistics we can state that there is a gap between research and policy practice. Issues on cooperation, consolidation, transport reorganisation and routing improvement are typical academic playing fields. A lot of these studies can be useful to the practice. However most of the research contributions remain in reviewed articles and books and transition to policy practice is seldom realised. The private sector has certainly interest in bundling concepts to gain efficiencies. Still researcher should realise that these companies operate in very highly competitive markets with a short-term focus on quick-wins.

Along this line, we could also conclude that city logistics policies based on regulation are not very often the result of detailed analyses and evaluations. This is reflected in similar types of regulations repeated through the different cities regardless their characteristics, the same schedules for time windows and load zones, and the failure to recognise different types of urban distribution which require different types of regulations. Apart from copying regulation frameworks, however, cities do not share information, knowledge or cooperation, and the lack of national or regional bodies dealing with city logistics, as there exist for urban passenger traffic, is significant.

For the issues such as infrastructure, parking and unloading areas we can observe a better coherence between research and policy practice. The main reason for this can be found that decisions in these areas have a long term effect and therefore should be studied over more dedicated. Especially the issue 'pricing' forms an important issue nowadays and should be implemented with strategy in order to avoid all obstacles. However, as an exception the opposite could be brought forward here remembering the case of Mayor Ken Livingstone introducing the congestion charge in London at the 11th of August 2003. Many researchers are still learning from this shocking event.

In the Netherlands, it should be mentioned that knowledge and experience on city logistics had been institutionalised into one platform, i.e. PSD. The commitment of the members and the information sharing among their members have led to a good common thinking for making city logistics policies. Sixty percent of the municipalities (out of 278) knew what the platform stood for.

Three years ago the platform ceased to exist and divided itself among four geographical zones in the country, in order to get more insight into the processes of supplying the inner cities with goods and the effects of measures taken by the municipalities. The platforms have more discussions in detail since not only union members will join these platforms but also the real companies operating in the city.

Therefore we argue that new research should focus on a cooperative approach, which not only incorporates researchers, but also governments and private parties. After all, one of the lessons that we have learned over the last years is that solutions or initiatives that were not market-based and in which a real incentive for the private parties (that are supposed to cooperate or even to be the main actor that should change its behaviour) are lacking. This is also true for policy measures that do not rely on sufficient social support (either by not making clear why such a policy is imposed, or because it does not affect the stakeholders proportionally, resulting in feelings of inequity for some stakeholders). In these cases it has turned out to be quite difficult to enforce the policy measures. An important issue here is the difference in scope between on the one side the researchers (long term) and on the other side the attention for short term wins of companies. If there are no real gains in the near future, the chances are limited that it turns out to be a sustainable development on the long run. For us as city logistics researchers it is our challenge to bridge this gap.

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