The impact of City Logistics on Retailers inventory management: an exploratory analysis

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Abstract: City Logistics (CL) can be defined as a comprehensive solution aimed at "totally optimizing" the logistics and transport activities in urban areas, by considering the environment, the congestion and energy consumption. Many CL initiatives have been implemented to improve the efficiency and the effectiveness of the urban logistics processes. The adoption of such initiatives by logistics service providers implies a reshaping of supply chains configuration in terms of vehicles used as well as consolidation and reception of goods. Therefore, CL initiatives are likely to have an impact on the inventory policy of the retailers, in terms of order frequency, time windows for receiving the deliveries, and batching lots. In this context, there is a lack of studies investigating the influence of CL on retailers' inventory management practices. In order to bridge this research gap, this paper proposes an exploratory analysis of the perception of the CL issues by apparel and grocery store managers and owners. To this end, a survey is submitted to retailers of different sizes and type (e.g. multi-brand vs. mono-brand) located in the limited traffic zone (LTZ) of Turin (Italy). The objective of this analysis is twofold. First, the survey aims at confirming the findings from inventory policy literature and outlining different profiles of retailers based on the factors that characterize their inventory policy. Second, the shopkeepers' perception, both positive and negative, of three different CL innovations is explored. Results show that there is a wide variety of inventory management practices even within an enclosed environment such as the one of a city's LTZ, and that the adoption of CL innovations by retailers might depend strongly on their inventory policy. Therefore, logistics service providers and local administrations need to take into account such diversity if they intend to scale up CL innovations.

Keywords: City Logistics, Inventory Policy, Retailers, Survey, Exploratory Analysis

1. Introduction

City Logistics emerged in the end of the 1990s as a comprehensive concept incorporating both research and practice in the effort for optimizing last-mile activities to achieve operational benefits and reducing the negative externalities that such activities generate (Taniguchi, 2001).

CL fosters the development of integrated logistics systems, where all the stakeholders are coordinated in order to reduce the negative impacts of urban logistics processes on citizens (De Marco, Mangano and Zenezini, 2018). Typically, the main stakeholders are citizens who live, work and shop in urban areas, freight carriers who are in charge of the transportation of goods, administrators who aim at promoting the urban environment and finally retailers that receive and in turn send goods (Taniguchi, 2001). Because of the high complexity of urban distribution processes, information related to the different preferences and perceptions of each stakeholder become crucial especially considering that their interests are often divergent and conflicting (Cagliano *et al.*, 2016).

In this context, the requirements and awareness of a very important CL stakeholder group, such as retailers, regarding the CL issue is still scarcely considered. In particular, in the apparel sector the success is providing customers with fashionable clothes in the shortest time (Cagliano *et al.*, 2013). However, the product variety in terms of size, colour and appearance increases the complexity in managing the inventory with high impacts in logistics operations, turnover and related costs (Park, Velicheti and Kim, 2005).

Similarly, the food supply chain is more complicated than other ones owing to the perishable nature of products (Handayati, Simatupang and Perdana, 2015). Also, food supply chain is particularly vulnerable in terms of inventory and storage (Van Ruth et al., 2018). In such context, food retailers are trying to adjust their supply chain to become more consumer centric, in order to clearly identify customers' needs and consequently reducing wastes (Singh, Shukla and Mishra, 2017). This could be due to the fact that they are interested in receiving goods in the right time and place but they do not control the management strategy of the carriers (Kiba-Janiak, 2016).

In order to bridge this research gap, this paper proposes a study on the awareness associated with the CL issue together with the potential impacts on the inventory management strategy of retailers operating in the Limited

Traffic Zone (LTZ) area of Torino in the food and apparel sector. The city of Torino has implemented a LTZ with a time window (7:30-10:30), and within this time window entrance is allowed to Logistics Service Providers (LSP) by corresponding a fee to the Municipality.

The paper is structured as follows. In Section 2, an overview about inventory management strategies in the apparel and food sectors is proposed. Likewise, the main innovations in the CL arena are herein presented. Section 3 focuses on the methodology of the research and in Section 4 the results of the survey are explained. In Section 5 the enabling factors for CL adoption are addressed. Finally, Discussions and Conclusions are drawn in Section 6.

2. Literature review

2.1 Inventory management in retail

Inventory management in apparel sector

The apparel industry is characterized by a short product life, high demand uncertainty, wide variety of products and a large number of stock keeping units. Also, the development of e-commerce and the desire for trendy clothes is leading retailer to provide on time and available products throughout the whole of the selling season. Therefore, this industry suffers from high stock out costs, markdowns and increased inventory costs (Jakhar, 2015). Fast fashion retailers have to juggle between inventory costs and out-of-stock (OSS) events that hinder their profitability, and need to monitor their inventory level together with their sales velocity in order to prevent OSS events (Bertolini *et al.*, 2017). The inventory level is strictly related to orders. Excessive orders will increase the holding cost and deficient order are likely to determine shortage and in turn lower customer service level (Pan et al., 2009).

Inventory management strategies are often based on frequent replenishment re-orders for reducing the possibility of lost revenues (Bruce and Daly, 2006). One of the most famous approach is related to the Economic Order Quantity (EOQ) that provides the most appropriate amount of good that should be ordered. This method has been progressively refined for instance by addressing with continuous reviews the level of obsolescence (Barron, 2018). However, fast fashion companies usually choose a unique approach to inventory management regardless of contexts with uncertain demand, even though this can lead to prediction errors (Lucci, Schiraldi and Varisco, 2016).

Inventory management in Food sector

Perishables represent a significant portion of supermarket sales. Moreover, demand for fresh items has dramatically increased and perhaps most importantly the quality, variety and availability of perishables have become order-winning criteria for consumers (Axtman, 2006). In this context, effective inventory management for companies producing perishable products improves customer service and provide competitive advantages (Kouki and Jouini, 2015). Thus, the crucial point is how to maintain product availability while avoiding excessive product loss (Ketzenberg, Gaukler and Salin, 2018). The key element is the adoption of real time quality information that could reduce the level of spoiled goods and improve the order management strategies (Bakker, Riezebos and Teunter, 2012). The ordering policy for these kinds of goods should take into account both age information and the inventory quantity (Kara and Dogan, 2018).

Typically, a wide range of products is offered to meet the variety of demand, with a consequent increase of the complexity. This is crucial from a marketing standpoint, since it provides customers with opportunities to choose or substitute their products. However, it is very difficult to keep the inventory level at an effective point for avoiding the waste of perishable products and of the quantity of the substitutable product. Therefore, food stores should aim at finding the optimal inventory management policy that optimizes the quality of the food, in terms of shelf life, and the overall supply chain cost and efficiency (Aiello *et al.*, 2017).

Typically, the inventory management has been focused on periodic review with the integration of the lifetime (Haijema, 2013). With the Vendor Management Inventory (VMI) approach, the vendor is directly responsible to the inventory. In particular, he controls the inventory levels of retailers (based of service level agreements) and so this can be an effective way for dealing with the inventory of perishables (Akbari Kaasgari, Imani and Mahmoodjanloo, 2017).

2.2 Last-mile delivery and CL innovations

Last-mile processes and local retailers

The last-mile can be considered as the last-leg of the supply chain process, where the goods finally reach the final recipient. It is not merely a logistics issue, but a significant urban planning challenge (Ewedairo, Chhetri and Jie, 2018). Many scholars have agreed that last-mile distribution constitute one of the most expensive (Goodman, 2005), least efficient and polluting portion of supply chains (Filippi et al., 2010). This is due to multiple reasons, ranging from the fragmented nature of last-mile deliveries (Edwards, McKinnon and Cullinane, 2010), loss of efficiency from road congestion (Figliozzi, 2010), and the use of polluting vehicles and less than optimal routing optimization by small transportation companies and own-account carriers which account for a large share of last-mile deliveries (Danielis, Rotaris and Marcucci, 2010). The negative effects of this process are economic, social and environmental. In particular, traffic congestion, noise, greenhouse gases and pollutant are caused by the use of heavy vehicles in urban traffic (Pronello, Camusso and Rappazzo, 2017).

Retailers compose an important group of last-mile actors. As a matter of fact, last mile criticalities are pushed even further by increasing requests for a wide variety of goods, a noticeable reduction in life cycle of products and a limited capacity in warehouse sales floor (McKinnon et al., 2010). For these reasons retailers are seeking options to

manage their products more efficiently, considering that last mile remains very expensive (Devari, Nikolaev and He, 2017). In fact, from a logistics point of view, retailers are looking for a reliable and smooth delivery process to fulfill their orders at the right time without hindering their daily operations (Macharis, Milan and Verlinde, 2012). In particular, the operations of loading, unloading and controlling inbound goods should take little time and personnel so to devote these resources to the actual selling of those goods (Alho and de Abreu e Silva, 2015). Therefore, retailers usually establish strict delivery time windows for receiving the goods (Den Boer et al., 2017), which has proven to be a tough and expensive logistics challenge (Boyer, Tomas Hult and Frohlich, 2003).

City logistics concept and innovations

Among the city logistics concepts that received the deepest attention from scholars and practitioners we can identify urban consolidation centers (Browne, Allen and Leonardi, 2011), micro-consolidation centres (Crainic et al., 2010), cargo bikes (Gruber, Kihm and Lenz, 2014) and automated parcel lockers station (Iwan, Kijewska and Lemke, 2016).

Urban consolidation centers (UCC) are warehouses where goods are being delivered by different suppliers or 3PLs and are later handled and transshipped onto freight vehicles for the last leg of journey inside the city centre. The objective is to manage the last-mile centrally so to consolidate the deliveries using a smaller number of vehicles and thus reducing the total amount of vehicle trips in urban areas. Most of these UCCs were initially built by municipalities, who later on outsourced operations to specialized 3PL or local branches of international 3PLs. In some cases instead there were independent companies that setup a network of UCCs (Van Rooijen and Quak, 2010). Usually UCCs target local retailers by offering benefits in terms of fewer deliveries per day and a more pleasant business environment, but also by offering buffer storage to decrease inventory costs. To maintain the goods consolidation goal of UCCs while further decrease the negative impacts of freight vehicles, goods are being delivered by traditional or electric vans to smaller warehouses, called terminal satellites or micro-consolidation centers, located inside the city centers. Then, goods are being transshipped to even lighter and smaller vehicles for the final leg of the delivery. In some cases, this two-tier system has proved to be impactful in reducing total distance travelled and CO2 emissions (Schliwa et al., 2015).

The introduction of low-emission or zero-emission delivery vehicles in the last-mile delivery has being investigated by scholars and experimented by vehicle manufacturers in collaboration with 3PLs. The relatively low autonomy of such vehicles makes them more suitable for short distance delivery trips than for long-distance freight transportation. However, these vehicles have still a lower capacity than the traditional ones, and this fact makes their profitability quite difficult to be achieved (Van Duin, Tavasszy and Quak, 2013).

Automated parcel lockers station are composed by modules resembling a locker where parcels are retained until the customers go autonomously to pick them up. They aim at solving the well-known problem of first-delivery failure of B2C deliveries, when the consignee is not home and therefore the driver needs to take the parcel back to the distribution center. Several actors, such as InPost[1], Bringme[2] or MyPUP[3], are thriving in this new market sector. These companies build network of parcel locker stations and rent them out to 3PLs to solve the first-attempt failure or to large employers to consolidate deliveries for their employees. In any case, parcel locker stations are installed in easily accessible and popular places that can be monitored, such as office buildings, service stations or shopping malls (Janjevic, Kaminsky and Ndiaye, 2013).

3. Methodology

In order to provide an answer to the objective of this research, a set of structured and semi-structured interviews have been conducted with local retailers located in the LTZ area in Torino (Italy). The survey has been submitted first-hand on a paper-based format to guide the retailers around the questions, in order to reduce the risk of misunderstanding the topic at issue. In order to garner more insights on the topic the choice of respondents accounted for different sizes and type (e.g. multi-brand vs. mono-brand, small vs. big store). Even if the sample size in this preliminary research is relatively small, we have found significant heterogeneity in size. With the aim of considering heterogeneity in the analysis, we use the number of employees, ranging from 2 to 40 across the sample, to identify three size classes: small, medium and big stores. Small retailers are run by the store-owner and 2 employees or less. Medium size stores are run by larger internal staff, up to 10 employees. Big size stores are represented by store chains, with more than 10 employees. A total of 9 retailers operating in the food sector and 15 retailers in the apparel sectors responded to the structured questionnaire.

The survey is divided in two parts. The first part is structured and it aims at profiling the retailers based on their inventory management and ordering policies. In particular, questions revolved around the frequency, size and timing of orders. In particular, we asked the number of weekly orders, the size and type of order (i.e. loading unit) and the main reasons behind a change of ordering policy. Concerning the delivery process, retailers have to state whether they receive their goods from LSPs or their suppliers, or, on the contrary, they collect their orders by themselves. Moreover, they could choose between eight time windows, based on Alho and de Abreu e Silva (2015): i) 6-8; ii) 8-10; iii) 10-12; iv) 12-14, v) 14-16, vi) 16-18; vii) 18-20 and vii) 20-00. Finally, questions about the size of the store and type of goods sold were asked to profile the demographics of the stores.

[1] https://inpost24.com/

[2] https://www.bringme.com/

[3] https://www.mypup.nl/nl-NL

After the structured interview, we inquired through a semi-structured interview whether retailers were aware of the CL innovations outlined in the literature section, namely urban consolidation centers, delivery with alternative vehicles (cargo bikes) and parcel lockers. These innovations were thoroughly explained according to the definitions given in the literature. Furthermore, retailers had to relate how the innovations might affect their ordering policies and consequently chose their favourite alternative among the three ones. Univariate descriptive statistics have been used to analyze the dataset collected through the structured interviews.

4. Findings

4.1. Inventory management and ordering policies

The food shops generally receive deliveries three or six times per week. In particular, six shops receive six deliveries per week, two shops receive three deliveries per week and the last shop receives only one weekly delivery. Moreover, they all prefer to receive their goods in the morning, before 10:30. This confirms the typical operations of LSPs that deliver the goods by the morning to local retailers and gather items to be shipped in the afternoon. Moreover, receiving goods before 10:30 means that LSPs have to pay for entering the LTZ and this cost is consequently borne by the retailer. Figure 1 shows weekly deliveries and time of deliveries for the nine food shops.

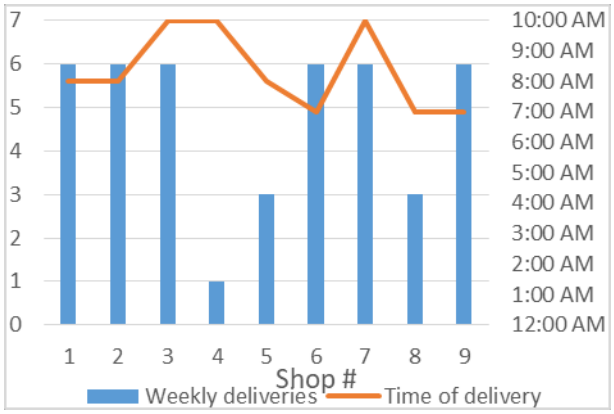

Figure 1 Weekly deliveries and time of delivery for the interviewed food shops

In the apparel, deliveries are organized in different ways. Retailers can receive twice a week, 6 times per week or even once per season in the case of small shops selling very seasonal items. One shop owner stated that he does not receive any items because he picks up the goods himself. Concerning the time of deliveries, most shops have multiple delivery times (shops # 10, 11, 12, 13, 16, 19, 20 and 21) and receive their orders before 14:00.

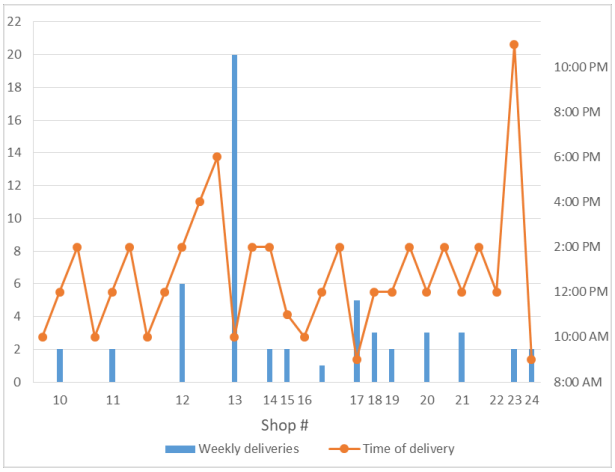

Figure 2 Weekly deliveries and time of delivery for the interviewed apparel shops

From an inventory control point of view, food retailer mostly adopt a continuous review strategy for managing their inventory by fixing a stock point. Likewise, retail chains deal with the inventory issue, through a continuous review. Smaller retailers and luxury shops are based on periodic review with a period that in some cases can be equal to the season. In the food sector, the monitoring of the stock level is mostly conducted without any electronic controls. In fact, only 3 retailers out of 9 use electronic devices to monitor their stock level. On other hand, 11 out of 15 apparel shops respondents adopt automated electronic controls for monitoring their stock level.

These empirical findings confirm the consensus emerged from the literature, that address the inventory management strategies mostly by means of a frequent replenishment reordering policy with a continuous review of the stock levels (Bruce and Daly, 2006; Barron, 2018). Therefore, results integrate the findings from the literature showing the divergence of large retails from a periodic to a continuous review.

4.2. Knowledge of City Logistics issue

Results show a low level of awareness among retailers about the CL issues. For instance, none of the retailers in the sample was aware of the existence of automated locker boxes, and more important they were not interested in using this kind of initiative. Delivery by cargo bikes on the other hand has received more interest by retailers, as 40% of them have stated they would be interested in receiving order with a cargo bike. However, only few retailers actually receive orders by cargo bike (i.e. 10%) and there is still some misconception on the actual type of cargo used by bike messengers: most retailers are not aware that more recent cargo bikes can carry up to

200 kilograms. Urban Consolidation Centres are largely used by retail chains who operate their own distribution centres (i.e. 30% of retailers use an UCC). However, these are not the traditional UCCs described by the CL literature, which are instead warehouses independently operated for a multitude of shippers, retailers and carriers. This misconception is present for small retailers as well, which were against this solution at first, but later turned out to be more interested once the solution was properly explained to them. In particular, retailers with high frequency of orders and high number of suppliers were keen on trying the solution.

5. Potential enabling factors for CL adoption by retailers

First of all, as previously mentioned the specific category of a retailer is a determinant for her/his ordering policy strategy, and thus can also be considered as an antecedent of adoption of one of the CL projects taken into in this paper. For instance, grocery stores and other small food shops usually order 3 to 6 times per week and have different suppliers, and might use the services of an Urban consolidation centre. Moreover, they need to lose as less time as possible for inbound operations and therefore may benefit from cargo bikes. However, the order size can be quite consistent (e.g. around 200 kilograms) and cargo bikes would need to cope with that in order to be attractive to this type of retailers. Moreover, all the retailers interviewed were very keen on the need to keep their standardized loading unit. One retailer noted that in case of the introduction of cargo bikes: *"Our company cannot afford to lose time handling goods in inbound, so goods need be dispatched at the same pace. Therefore, they should arrive with the same loading unit used until now"*. Concerning the fashion industry, retailers have different ordering policies and therefore different attitudes towards CL initiatives. Small, family-owned high-end boutiques have variable order's sizes and most of all usually purchase different items from few suppliers. Moreover, these storeowners like to look at the clothes they are buying first-hand, and consequently pick up the goods by themselves. For this reason, they are not subjected to issues related to traffic congestion and they would not benefit significantly from bundling items through an UCC. On the contrary, larger multi-brand fashion stores have more suppliers and much more inventory turnover. They receive orders from LSPs, and cargo bikes can be suitable to reduce the problem of parking in front of the store that has to be faced with traditional vehicles. However, speed is a major issue for these retailers, as they need the items shipped as soon as they arrive on the market. Hence, a UCC should deliver the goods without any delay to what is the standard in the industry. Concerning fashion retail chains, there is a split attitude between large chains such as ZARA, who have enough volumes to operate their own distribution centers, and medium-sized chains who might benefit from the economy of scale of an urban UCC that may reduce their logistics costs.

From these considerations, we can draw a preliminary mapping of the attributes that might drive retailers to adopt certain CL initiatives. In particular, we focus on ordering frequency, number of suppliers and order volume (Table 1).

Table 1 Enabling factors for CL initiatives

	Ordering frequency		Number of suppliers		Order volume	
	High	Low	High	Low	High	Low
Cargo Bikes	X		X	X		X
UCC		X	X		X	X
Locker boxes		X	X	X		X

Cargo bikes are better off with high frequency of orders and low volumes, given their weight constraints. Usually, low volumes can be the consequence of high frequency of orders and thus we consider high frequency as an enabling factor.

Retailers with low frequency of orders and high number of suppliers might benefit from the economy of scale of a centralized UCC; moreover, retailers with low frequency of orders usually do not need to receive their items on a specific day and UCC operators can optimize their operations accordingly.

Low frequency of orders is also an enabling factor for the usage of automated locker boxes. In fact, retailers are asked to collect their goods themselves, and it is doubtful that they would do it should they receive multiple orders during the week. Finally, low volumes are fundamental for the uptake of automated locker boxes because of their size that cannot accommodate larger items.

6. Discussions and conclusions

The aim of this paper is to investigate the impacts of CL initiatives on the inventory strategies of urban retailers. To this end, a questionnaire was handed out in person to retailers operating in the LTZ area of the city of Torino. This choice was addressed since CL effects and actions are more tangible in the enclosed area of the city centre.

Results show that a variety of inventory strategies, based on the retailer's characteristics (e.g. size, business model), are adopted by retailers. In addition, retailers consider the CL projects proposed with different levels of awareness and interest. In particular, automated locker boxes do not raise the attention of retailers because they are not willing to leave the premises to pick their orders up. On the other hand, cargo bikes are seen as a feasible and beneficial delivery configuration even though their level of adoption is still quite low. Finally, the awareness about UCCs is very poor, and often retailers associate this concept with a more traditional distribution centre that is not shared among different supply chains.

This paper originates some implications. From a theoretical point of view, it contributes to increase the knowledge about the retailers' perspective on city logistics projects. In particular, it focuses on the operational impacts of such projects on inventory strategies, which are key to a retailer's business. From a practical perspective, this study can be considered a support to policy makers

and private promoters of CL in designing new delivery systems that take into account the acceptability by retailers based on their requirements. In this way, by identifying similar groups of retailers it is easier to implement CL initiatives that fit more precisely to their different needs. Moreover, this work stresses the need for higher level of coordination between the retailers and the other stakeholders of CL systems. This appears to be very important, since retailers could fully exploit the benefits related to a CL initiative.

However, this study has some limitations. First, the sample size does not allow performing statistical multivariate analysis that would identify more robust relationships between inventory strategies and CL awareness. Furthermore, the sample is limited to two retail sectors, namely Food and Fashion, and one city centre. Thus, future research will be addressed at enlarging the sample size in terms of both retail sectors, geographic areas, and number of respondents.

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