LAST MILE LOGISTICS IN THE FRAMEWORK OF SMART CITIES: A TYPOLOGY OF CITY LOGISTICS SCHEMES*

T. M. Özbekler [1], A. Karaman Akgül [2]
[1] Sinop University, Department of Logistics, Sinop, Turkey - tozbekler@sinop.edu.tr
[2] Yıldız Technical University, Department of Business Administration, İstanbul, Turkey - akaraman@yildiz.edu.tr

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ABSTRACT:

As current cities are attributed to particular dynamism consists of population density and increased urbanization, urban areas are facing some challenges for city logistics, both in terms of economic, environmental, and social impact. Especially, the debates over last-mile logistics are arising with inefficiencies in delivery cost (half truckload on delivery) and delivery time per parcel (unnecessary waiting-load periods at multiple stops) while inner-urban areas are especially suffered from traffic congestion, emission, and noise pollution. In this regard, smart cities as a concept with the potential to produce sustainable solutions to urban problems bring along with the need for innovative urban logistics systems to make conventional distribution channels of the city up to date. The key objective tackled in this paper can be defined as the identification of the city logistics schemes with highlighting current approaches in smart cities. The study adopts a systemic approach based on the typology of consolidation-distribution schemes in city logistics to define the feasibility of micro logistics initiatives from the scope of the smart city consisting of mobility, sustainability, and liveability. Thanks to a detailed examination of city logistics dynamics, this study can contribute theoretically to smart city logistics literature as well as practically the logistics sector.

1. INTRODUCTION

The smart city concept promises the idea of creating a more liveable city from perspectives of economically, environmentally, and socially related to interconnected challenges among complex city members (infrastructures, networks, and environments). Especially, with ideas such as solving transportation problems and increasing energy efficiency, the smart city concept symbolizes a new urban utopia driven by IT systems (Pinochet et al., 2019). According to Cohen (2012), instead of highlighting the relationship of the smart city with the technology sector solely, a comprehensive approach should be encouraged. In this line, the idea of smartness should be integrated with six dimensions as people, economy, environment, living, governance, and mobility put together to figure out what a city should look like in the 21st century.

Recently, one of the important topics on the smart city agenda is the necessity for more sustainable processes in urban freight transports as city logistics (macro-level) and last-mile logistics (micro-level) (Mangiaracina et. al, 2019). As city logistics deals with logistics as a whole system (such as actors, infrastructures, policies, etc.) in urban scope, last-mile logistics refers to delivery operations and strategies as the last step of the distribution process in the inner-urban area. Day by day, emerging challenges are rising on behalf of city actors related to the urban freight transport ecosystem in the line with reasons such as:

1. İncreased urbanization (restrictions to mobility in most urban areas)
2. Booming in e-commerce (problems in capacity)
3. Changing customer expectations (demand for a short delivery time, high service quality, and more free shipping)
4. Rising debates over environmental issues (more conscious city actors toward CO_2 emissions, noise pollution, and visual intrusion)
5. Impact on traffic congestion (the high number of delivery vehicles on the road)
6. Deficiencies in urban planning for logistics operations (lack of loading and unloading space in inner-urban areas)
7. High delivery cost per parcel (inefficiencies in operations especially for last-mile delivery)
8. Rising trends through multi-channel distribution (a need for adding value-added business models and strategies such as micro logistics networks)

Concerning the smart city concept, city logistics should be improved in response to the above-mentioned problems according to the vision of the smart city is a merge of ideas to create better urban areas promoting the overall well-being for all city actors (Yigitcanlar et. al., 2018). Especially in the city logistics framework, concepts as mobility, sustainability, and liveability can be handled to design the structure of the distribution network in line with the aims of a smart city (Malindretos et. al., 2018).

2. METHODOLOGY

The consolidation strategy in the distribution network has been broadly adopted because of its alignment with smart logistics solutions. The basic logic of the consolidation facilities is based on finding solutions to problems such as urban traffic congestion and large costs of a low number of shipments with the understanding of scaling up goods to increase the load factors in the final distribution leg.
The study uses a systemic approach based on the typology of consolidation-distribution schemes in city logistics. This

* This study is derived from Türkan Müge Özbekler's doctoral thesis, written in Yıldız Technical University.

approach refers to determine tiers of delivery pattern in which goods are delivered from outside of urban to inner-urban areas based on existing consolidation facilities in the distribution network (Staricco and Brovarone, 2016). According to this approach, city logistics schemes can be classified as:

1. Conventional distribution (without consolidation)
2. Urban consolidation centres
3. Micro consolidation centres
4. Mobile Depots

This paper is handled from two dimensions: Firstly, an overview of consolidation-distribution schemes in line with the last leg of delivery is defined and detailed. Secondly, these schemes are evaluated to explain the last mile delivery ecosystem in compliance with the smart city concept from three aspects: mobility, sustainability, and liveability.

3. CITY LOGISTICS SCHEMES

Conventional distribution refers to distribute goods directly from point A to point B. This strategy can be beneficial according to characteristics of goods (freight deliveries as a bulk), consumers (commercial), or place (close-range delivery). Especially in B2B marketing, it is clear that vehicles are already full because of the volume of goods delivered and also the delivery point is stable and sole. In this case, goods origin from factories through commercial customers can be distributed without the necessity of any consolidation facility. Nevertheless, this strategy can lead to ineffective mobility operations and resource utilization in case of parcel deliveries are distributed to multi located end consumers. From the perspectives of sustainability and liveability, various types of vehicles on roads (generally with high emission rates), high frequency in delivery trips (traffic congestion), and focusing on profit more than benefits of society force this system to be transformed into a smart layout.

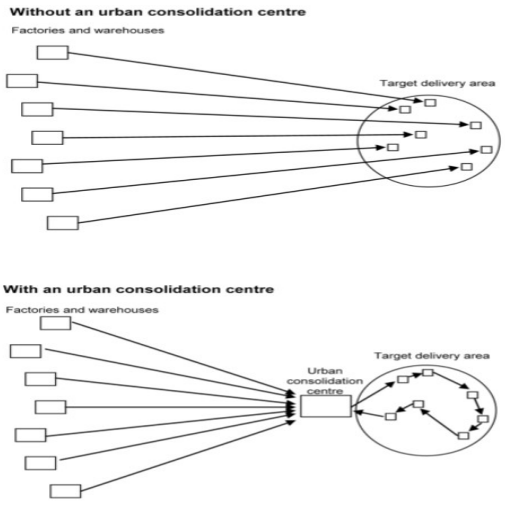

Figure 1. Conventional distribution (without consolidation) versus distribution from urban consolidation center, adopted from Allen et al., (2014)

Urban consolidation centers are facilities that are located relatively closer to the city center and function as a distribution channel by creating an integrated logistics system for different companies, providing storage, classification, consolidation, and deconsolidation as well as several value-added services such as accounting, legal consultancy, and brokerage. This facility's main purpose is the achievement of a high level of load utilization while vehicles are distributing goods to the target area. By bundling goods in vehicles efficiently, challenges like distance traveled per unit of parcel delivered, environmental issues resulted from numerous vehicles on-road or the negative impact of freight operations on traffic congestion can be reduced in city logistics.

Studies about urban consolidation centers show that these facilities can be beneficial from a sustainability manner, but they are mostly not financially viable for a long period. This can be thought that running this giant facility costs more than benefits for its users. At this point, initiatives of micro consolidation centers are started to get more attention from the perspective of feasibility. Micro consolidation centers can be defined as the smaller scale of the urban consolidation centers. The specific features about these centers are:

1. Mostly suitable for the last leg of the delivery (facilities are setting-up in very central urban areas to be close to reception points)
2. Usually involve a light freight (in opposition to the heavy urban freight, deliveries include smaller scale packages)
3. Opportunity to deliver with sustainable vehicles (such as using cargo cycles from a central point to anywhere)
4. Easiness to operate loading/unloading activities in the urban area (using small vehicles lead to reduce negativities of urban planning)
5. Integration with innovative business models (such as click and collect model)

Figure 2. TNT Express Mobile Depot, adopted from Verlinde et. al., (2014)

Mobile depots can be seen as an innovative solution both of city logistics from the macro aspect and last-mile delivery from the micro aspect. A Mobile depot is a vehicle consisting of a trailer fitted with a loading dock, warehousing facilities, and an office. Thanks to being capable to serve multi-channel distribution, this vehicle can be a pick-up point in the central parking location as well as parcels are delivered from this point by electrically supported cycle cargos. As seen in figure 2, TNT Express

tested this innovative concept in Brussels as part of the European project STRAIGHTSOL. As one of the important smart logistics solutions, integration of mobile depots into city logistics operations are expected to widen in the coming years.

		butionConventional	ConsolidationUrban	ConsolidationMicro	Mobile Depot
Mobility		Poor	Good	Good	Good
Sustainability	Environment	Poor	Good	Good	Good
	Social	Poor	Good	Good	Good
	Economic	Fair	Fair	Good	Good
Liveability		Poor	Fair	Good	Good

Table 1. The Evaluation of City Logistics Schemes

City logistics schemes from a smart perspective can be evaluated mainly in three aspects: mobility (smooth delivery operations in the inner-urban area), sustainability (decreasing negative impacts on economic, social, and environmental issues), and liveability (aiming respond to expectations of all city actors such as logistics service provider, manufacturer, government and city resident) (He,2020). According to the effects on mobility, sustainability, and liveability, the evaluation of city logistics schemes within the range of poor/fair/good can be seen in table 1.

4. CONCLUSION

Based on conducted researches in literature and sectoral improvements recently, this study highlights the last mile delivery ecosystem in the line with adopting a systemic approach based on the typology of consolidation-distribution schemes. From the perspective of micro logistics networks, facilities that serving the inner urban area smoothly can be urban consolidation centers, micro consolidation centers, or mobile depots.

While all facilities present different features in terms of cost/benefit, service quality, or operational process, the important point is improving the mobility, sustainability, and liveability of cities in the line with goals of smart city logistics. As a result of this study, it is found that within last-mile logistics initiatives, the applicability of both micro consolidation center and micro depot is more compliant with the aims of the smart city concept.

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