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THE ROLE OF CITY LOGISTICS IN ACHIEVING SUSTAINABLE URBAN SYSTEMS: THE CASE OF BRUSSELS

ULOGA CITY LOGISTIKE U POSTIZANJU ODRŽIVIH URBANIH SISTEMA: PRIMER BRISELA

JEL CLASSIFICATION: M21, M29

ABSTRACT:

The current trend of rapid development of urban systems has affected the quality of life of population in these areas, in economic and social terms. As the availability of goods is characterized as an essential factor in the lives of people in given environments, population growth has caused problems and complicated logistics flows and activities. Thus,

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the concept of City logistics is getting more important in dealing with this issue, especially due to growing concerns about the negative effects of logistics activities, primarily transport, on economic, environmental and social sustainability of urban areas. The analysis within the paper focuses on the case study of the urban system of Brussels and its sustainability achievement due to managing the city logistics adequately. The aim of this paper is to point out the importance of adequate city logistics management for the sustainability of urban systems, the development of the mentioned environments and the daily functioning of the population within them.

**KEYWORDS:****CITY LOGISTICS, SUSTAINABILITY, URBAN AREAS AND SYSTEMS, BRUSSELS****APSTRAKT:**

Aktuelni trend ubrzanog razvoja urbanih sistema uticao je na kvalitet života stanovništva u ovim sredinama, u ekonomskom i socijalnom smislu. Kako se dostupnost dobara tumači kao suštinski faktor života ljudi u datim sredinama, rast populacije uzrokovao je probleme i usložnjavanje logističkih tokova i aktivnosti. Stoga, koncept City logistike sve više dobija na značaju pri rešavanju pomenutih problema, naročito usled rastućih preokupacija o negativnim efektima logističkih aktivnosti, primarno transporta, na ekonomsku, ekološku i socijalnu održivost urbanih sredina. Analiza u radu fokusira se na primer iz prakse urbanog sistema Brisela i postizanja održivosti u okviru njega, usled adekvatnog upravljanja tokovima City logistike. Cilj ovog rada je da ukaže na značaj adekvatnog upravljanja logističkim sistemima urbanih sredina u cilju njihove održivosti, razvoja pomenutih sredina i svakodnevnog funkcionisanja stanovništva u njima.

**KLJUČNE REČI:****CITY LOGISTIKA, ODRŽIVOST, URBANE SREDINE I SISTEMI, BRISEL**

1. INTRODUCTION

With the increase in the concentration of the population in large and developed cities, the need for efficient logistics has increased in order for the population to be able to perform regular daily life activities without too much effort. The economic development of cities, which implies daily and large flows of goods, and the simultaneous growth of the population, are factors that affect the realization of logistics flows.⁴ Some activities, such as freight transport, are not desirable in cities due to intense traffic jams, gas emissions and loud noise, so national and local authorities are increasingly involved in the process of finding the optimum solution and satisfying the interests of all participants in logistics activities.⁵ Urban environments differ in economic development, demographic structure, level of infrastructure development, cultural factors and the use of different modes of transport (developed cities - hybrid vehicles that reduce emissions; undeveloped cities - rickshaws, horse-drawn carriages, etc.), which will certainly affect the formation of the city logistics system.⁶

Currently, logistics operations in urban areas are mainly carried out by private companies.⁷ These companies often use vans and trucks that increase the carbon dioxide emissions due to the use of internal combustion engines, which is the cause of the problem, taking into account shipments that must be collected and delivered to a large number of customers.⁸ Another factor that affects the complexity of the problem of performing logistics activities in cities is the existence of different groups of stakeholders with contradictory goals.⁹

On the one hand, there are central, regional and local authorities and the population, whose main goal is to maintain a healthy environment, while on the other hand, there are suppliers, consumers and distributors with the aim of reducing costs and increasing efficiency.¹⁰ The authorities do not have staff with sufficient knowledge and skills to solve the exposed problems, neglect the basic principles of logistics and also they have not created a cooperative relationship with participants in logistics activities.¹¹

In order to solve the problem, various restrictions and penalties are usually introduced for the movement of vehicles, as well as for their parking. However, these measures are generally insufficiently effective in reducing the volume of transport in cities.¹² Each shipment, company or vehicle must not be observed individually, but rather as a coordinated system (network) of connected suppliers of goods, their movement and execution of orders to different customers. This will lead to the optimization of the entire process of

4 Kaszubowski, (2019), p. 1535.

5 Van Duin, Wiegman, Tavasszy, Hendriks & He (2019), pp. 565-575.

6 Carmona, (2019), pp. 1-48.

7 Aćimović & Mijušković, (2016), pp. 57-70.

8 Behrends, Lindholm, & Woxenius, (2008), pp. 693-713.

9 Cui, Dodson & Hall, (2015), pp. 583-598.

10 Aćimović, Mijušković & Todorović, (2019), pp. 29-42.

11 Tobey, Binder, Chang, Yoshida, Yamagata & Yang, (2019), p. 532.

12 Leonardi, Browne, Allen & Bohne, (2014), pp. 234-249.

transporting goods and executing orders with the least possible environmental damage and without slowing down traffic in cities.¹³

The aim of this paper is to emphasize the importance of adequate city logistics management for the sustainability of urban systems using the case study analysis of the city of Brussels. The analysis indicates the involvement of the city authorities and the introduction of various restrictions on the movement of vehicles, the increase in the use of light trucks, the introduction of lockers, etc. as a means to achieve a sustainable urban system.

2. IMPACT OF FREIGHT TRANSPORT IN BRUSSELS ON ROAD TRAFFIC

Road transport is one of the biggest problems facing sustainable development within the Brussels region. While the debate over car use in the city is important, pollution and noise caused by freight vehicles are mentioned less frequently. Freight vehicles cause 25% of CO₂ emissions, 33% of PM 2.5 emissions and up to 32% of PM 10 particulate emissions caused in the capital.¹⁴

Heavy trucks cause particularly high levels of pollution in terms of nitrogen oxide emissions and lighter trucks in terms of particulate emissions (PM 10 and PM 2.5), from which it can be concluded that vehicles used in the logistics sector have a significant impact on urban sustainability. It is estimated that urban logistics activities generate approximately 30 to 50 tons of goods per capita per year.¹⁵

These estimates are confirmed for Brussels by a study conducted by STRATEC [2002], which mentions quantities of just over 40 million tonnes for a population that was below one million inhabitants at the time.¹⁶ However, the existing data on freight transport in Brussels indicate much lower quantities, which can be seen within Figure 1, which shows the evolution of goods flows (in tons) according to the type of transport.

This widening gap in observations within Figure 1 illustrates the tendency towards fragmentation of the flow of goods. The amount of cargo transported by vehicles with a carrying capacity of more than one ton is declining, while the population is increasing, which is explained by the fact that an increasing part of those goods are transported by vehicles with a carrying capacity of less than one tone, i.e. vans, and as vans have less transport capacity, the number of trucks on the roads is increasing.

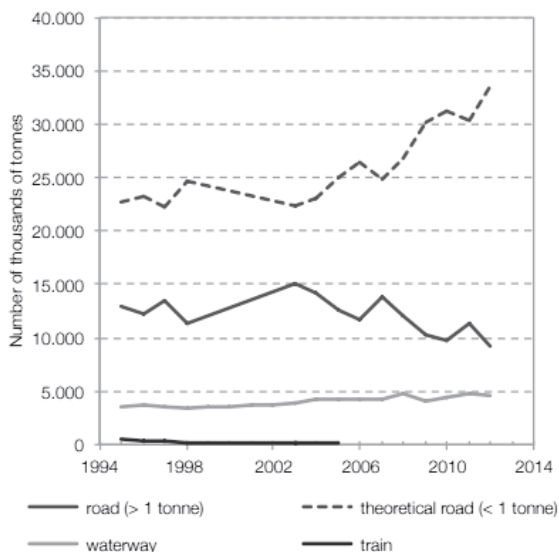
13 Dablanc, (2009), pp. 280-285.

14 Lebeau & Macharis, (2014), pp. 45-59.

15 Lebeau & Macharis, (2014), pp. 45-59.

16 Dablanc, (2009), p. 9.

► FIGURE 1. THE EVOLUTION OF GOODS FLOWS (IN TONS) ACCORDING TO THE TYPE OF TRANSPORT (1994-2014)



Source: Lebeau, P., Macharis, C. (2014), "Freight transport in Brussels and its impact on road traffic" Brussels Studies, Vol. 3, No.80, p. 45-59.

This trend can be partly explained by structural changes in urban economies, which are evolving in favor of services, at the expense of industry. As service activities rely more on light goods vehicles, as opposed to industrial activities,¹⁷ freight transport is expected to increase in the Brussels-Capital Region. On the one hand, the increase in population expected in the Brussels region should cause an increase in the amount of transported goods that is proportional to the number of inhabitants, i.e. an increase of 25% between 2010 and 2060.¹⁸ The sector will increase the use of light trucks, and the combined effects of these two trends greatly intensify the impact of logistics due to the increase in truck traffic. The regulations also encourage the use of light trucks, such as banning heavy trucks from accessing tunnels for fire protection.¹⁹

Between 1997 and 2011, the number of smaller delivery vehicles grew by an average of 6.5% per year, the number of trucks remained stable, and the growth in the number of cars was limited to 1.5%.²⁰ Hence, the number of trucks, with an emphasis on smaller vans, is growing faster than the number of cars. The share of trucks in traffic varies depending on the time of day. The peak for trucks entering the region is at 6 AM, when the traffic intensity reaches its busiest level, and then gradually decreases during the day.

The movement of trucks leaving the region remains stable between 6 and 16 hours (approximately 3,000-3,500 vehicles per hour). So, the biggest conflict between passenger

17 DG MOVE European Commission - Study on Urban Freight Transport, (2012), pp. 33-41.

18 Fasquelle, Hendrickx, Joyeux & Lebrun, (2012), p. 6.

19 European review of regional logistics, (2020).

20 Lebeau & Macharis, (2014), pp. 45-59.

and cargo transportation takes place during the morning hours, which is due to the fact that deliveries are picked up during the night and must be delivered in the morning, before the first customers arrive. The intensity of freight traffic also varies depending on the location. The main entry and exit points for trucks are *Boulevard Industriel* in the south of the region, A12 in the northeast and A3 in the northwest. By comparing the share of freight traffic with the level of congestion, it is possible to identify the roads on which freight traffic has the greatest impact on traffic jams during the rush hour.

Given that trucks account for 17% of traffic, *Boulevard Industriel* can be considered the road where freight transport contributes the most to congestion of inbound traffic in the morning.²¹

3. SOLUTIONS FOR RELIEVING THE TRAFFIC NETWORK AND IMPROVING BRUSSELS URBAN LOGISTICS

The trend of relocating urban logistics activities to the outskirts of Brussels has caused an increase in kilometers traveled, an increase in the intensity of freight traffic in the transport network and thus an increase in harmful emissions caused by road transport. Carriers regularly face a lack of delivery space, which forces them to increase delivery frequencies, which disrupts the traffic flow, and so the initiative has been taken to implement a new category of delivery parking spaces: yellow areas.²² The use of these parking spaces must be paid for, they are clearly marked, strictly controlled by certain agents and integrated into regional parking policy. In addition, the Brussels-Capital Region has published a guide to help municipalities develop street delivery areas.²³

New technologies can also offer a solution to the problem of freight transport, especially in terms of air quality and CO²-related targets.²⁴ Urban logistics, according to the European Commission, must be fully 'decarbonized' by 2030 in larger cities, and the use of electric vehicles seems particularly interesting in this regard, as these vehicles do not cause emissions in the urban environment and also use engines that produce less noise compared to traditional vehicles.²⁵

However, several obstacles limit the development of electric vehicles, and the main one is the high purchase price, but, this shortcoming is compensated by lower operating costs: electricity is cheaper, less maintenance is required and insurance premiums are lower. In addition, the Brussels-Capital Region and the federal government offer incentives for the use of electric vehicles in logistics operations (customers can benefit from exemptions from registration fees). Also, companies that have their own parking space with a charging station for electric vehicles can save 75 euros in taxes per car per year.²⁶

21 Lebeau & Macharis, (2014), pp. 45-59.

22 Aifandopoulou & Xenou, (2019), pp. 13-29.

23 Fasquelle, Hendrickx, Joyeux & Lebrun, (2012), pp. 12-15.

24 Fahimnia, Bell, Hensher & Sarkis, (2015), p.133.

25 Russo & Pellicano, (2019), pp. 59-72.

26 Hall & Lutsey (2020), p. 6.

Certain delivery companies develop green distribution solutions (Ecopostale, TNT Express) and deliver packages using electric vehicles and electric bicycles and tricycles. Another alternative to improve the logistics system of this urban environment is to change delivery times. By making deliveries before 6 AM, trucks can perform distribution while the road network is less congested. However, in order for this type of delivery to be possible, carriers must adjust their deliveries in order to limit noise. On the other hand, the authorities need to adapt to the current regulations. In order to assess the feasibility of this concept, a pilot test was conducted in Brussels with Colruyt and Delhaize.

During the pilot program, 42 deliveries were monitored (which took place at different times of the day), noise measurements were performed and stakeholder interviews were conducted. The data enabled a comparison of different delivery time intervals - morning (6:00 - 8:00), day (8:00 - 20:00), late evening (20:00 - 22:00) and night (22:00 - 6:00) delivery. The obtained results indicate that the average speed during the night was almost 50% higher than during the day, and drivers needed more time to unload during the night. Also, the average fuel consumption during the day was 14% higher than during night trips. Noise measurements revealed that the noise produced during the unloading operations met the standards prescribed by the Law on Noise Reduction in the Brussels Capital Region, however, the noise produced during the handling of the truck exceeded the permitted limits.²⁷

Finally, interviews with different types of employees revealed that drivers have a clear propensity for night deliveries, while market employees preferred morning delivery.²⁸ The average citizen would enjoy the benefits of safer traffic, cleaner air and relaxed traffic, however, there are also concerns that out-of-hours deliveries could disrupt the sleep of people living near the recipient's location. Together, these observations make it difficult to assess whether it is preferable to switch deliveries outside business hours in a given situation, but in general, the main lesson is that there is the potential to switch deliveries before 6 AM.

Given the increasing relocation of logistics activities to the periphery, one solution is to transport goods by train or waterway, given that Brussels really has the advantage of using highly developed multimodal accessibility. The railway is a possible alternative to road traffic. The region has 163 kilometers of railway infrastructure, which makes Brussels one of the regions with the densest network in Europe. In addition, the stellar configuration of the national network concentrated around Brussels offers access to many different destinations. However, despite the favorable tendencies, the gradual disappearance of this mode of transport in Brussels is currently in force. When CERES stopped using the railways, Audi was the only remaining company to use this mode of transport. This tendency is caused by the commitment to the priority of passenger transport and the poor efficiency of this service (trains are often late).

The future of rail transport lies in the Schaerbeek project. Located in the north of the Brussels region, regional interest zone no. 11 - The Schaerbeek Formation has a unique accessibility and potential and is an ideal place to develop a multimodal logistics platform. This zone can be accessed in three ways - by water, through the external port and

²⁷ Hall & Lutsey (2020), p. 9.

²⁸ Verlinde & Macharis, (2020), pp. 522-532.

its container terminal; by rail, connecting the place of activity with the entire Belgian railway network and the road network. Like other railway locations in the city, this territory got a chance for development potential by adopting a master plan, which was approved by the regional government in 2013.²⁹

4. CONCLUSION

Population growth in cities caused an increase in goods flows and intensified the process of providing services, which resulted in an increase in the impact of negative effects of transport (noise, traffic congestion, air pollution, traffic accidents) on the quality of life of the population in cities.

The need to apply the concept of City logistics, which is a process of full optimization of logistics and transport activities, arose in response to this challenge.

The example of Brussels determines the way in which the characteristics of the city influence the formation of the city's logistics system. Brussels is one of the busiest cities in Europe, a large economic center and a rich consumer market, which, along with the growth of multi-channel sales, has led to finding ways to create an efficient logistics system.

This tendency meant the involvement of the city authorities and the introduction of various restrictions on the movement of vehicles, the increase in the use of light trucks, the introduction of lockers, etc. Also, this city has a good geostrategic position and great connections with key regions in Europe, and the use of existing river canals, the port of Brussels and railway infrastructure has enabled the relocation of logistics activities to the outskirts of the city and the development and improvement of Urban Consolidation Centres. Based on the potential provided by this city, with the cooperation of various interest groups, it is possible to build an efficient logistics system.

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