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Freights distribution solutions in historic cities, in order to reduce traffic jams and pollution - case study: Brasov Municipality

Stelian Tarulescu[a], Radu Tarulescu[a], Dinu Covaciu[a], Remus Szigeti[b]

[a]*Transilvania University of Braşov, Eroilor Boulevard, No. 29, 500036, Brasov, Romania*
[b]*National University of Science and Technology Politehnica Bucharest, Splaiul Independentei no. 313, sector 6, RO-060042, Bucharest, Romania*

Abstract

The paper presents a series of solutions for logistics and distribution of freights in the historic center of Brasov, Romania. The usefulness of the study came from the mobility problems specific to old European cities, with historic centers, but also from the level of air pollution in urban areas. Pollution has increased in recent years, and one of the main reasons is the traffic jams at rush hour in sensitive areas of the city (the historic center, in the area of institutions, in areas with hospitals, in areas with schools, high schools, university buildings). The main problem of the historic center is given by the fact that it functions as a huge dead end, so that at times when the traffic volumes are too the entire road traffic network is blocked. This makes it impossible for emergency services to access or leave the area and limits residents' access to their own households. A series of solutions are analyzed and identified which of them can be implemented in the area of the Historic Center of the Municipality of Brasov. The solutions analyzed are: Initiate a solid partnership between all stakeholders and at least some of the operators, for example, by creating a voluntary charter to agree on concerted and harmonized activities for the delivery of goods to the city; Creation of logistics platforms that integrate companies in the field of sales, trade and industry, logistics, services and freight transport, such as in urban distribution centers, providing logistics terminals, storage space and/or loading docks; Define coherent regulations for access to urban areas for commercial vehicles delivering goods (e.g. only during fixed time slots or access allowed only to vehicles complying with specific emission standards); Creating maps and signs for the transport of goods to indicate the most appropriate transport routes to key areas in a city and highlighting obstacles as well as areas to be avoided, such as low bridges, sharp bends, narrow streets, residential areas, pedestrian areas, etc.; Management of parking spaces for loading and unloading goods in an area; Introduction of technologies such as Intelligent Transport Systems (ITS) and/or web-based logistics coordination systems that allow for more efficient transport planning and an increased load factor; Electric/bicycle mobility solution for supplying economic agents in the historic center. The measures are analyzed and a methodology for selecting them is presented to determine if they are suitable for the Municipality of Brasov and if they can be suitable for other European cities. The study is important for the community in the area of the historic center of Brasov, but also for similar cities in Europe.

Keywords: Freight; Transport logistics; Historic cities; Green transport; Sustainability; Pollution.

1 Introduction

Europe's big cities and metropolises face mobility issues related to accessibility, travel time, traffic congestions, conflicts between infrastructure users and parking issues. A very important component is the mobility of goods in residential, commercial and institutional areas. The problems are more pronounced in the case of old European cities, with historic centers. These areas have specific mobility problems, and the component related to the supply of goods is one of them.

Freight mobility in urban areas belonging to cities in Europe is estimated at 15-20% of total road traffic flows but has a greater impact on noise, air pollution and traffic jams (Romano Alho, 2018). There is a global trend of increasing the volumes of goods that are delivered to the urban areas of European cities. The increase in the number of inhabitants and urban shopping points characterized by smaller stocks and a greater variety of products contribute to this trend. As a result of the research, it was concluded that the shortage of parking places of vehicles delivering goods is related to the rarity or non-existence of loading/unloading areas, inadequate spatial configuration (inappropriate location or size) and the lack of application of the legislation aimed at occupying places intended for loading/unloading by non-cargo vehicles or their long-term occupation by freight vehicles.

The biggest problem is the last part of the travel of freight vehicles, characterized as last mile. "Last Mile" or "Last Kilometer Delivery" refers to the last stretch a vehicle travels before reaching its final destination. The cost of last-mile deliveries is estimated to be about 40% of total transport costs (Lais Wehbi, 2022). Optimizing last-mile deliveries is very important as it helps to improve the efficiency of deliveries. They identified specific challenges for urban planning of the last mile (last mile): complex customer requirements – related to the speed of delivery, at certain time intervals, complications related to the mode of transport related to the size or weight of transport vehicles due to road restrictions in urban areas, space limited by urban parking shocks.

In the document drafted by CIVITAS - Smart choices for cities, Making urban freight logistics more sustainable, the concepts related to Stakeholders in urban freight logistics (CIVITAS, 2025) are defined. Urban freight transport is characterized by all parties involved. The actors in the supply chain, responsible for sending, transporting and receiving goods are: shippers – manufacturers, wholesalers, retailers, etc.; transport operators – freight carriers, couriers, intermediaries; beneficiaries – traders, offices, institutions, construction sites, residents, etc. There is also a group of actors involved in or affected by urban freight transport but not directly influencing it: other road users – vulnerable road users (cyclists and pedestrians) who share the same infrastructure with freight vehicles; inhabitants of the city and residential areas – people who live, work and shop in the city (disturbed by urban freight transport – smell, noise, vibrations, accessibility); visitors and tourists – who are slightly affected by urban freight transport (however, freight vehicles in the city center cause visual intrusion or decrease the perception of the spatial quality of tourist areas).

Cities need to find a balance in terms of passenger and freight mobility, while adapting to new technologies in the field and changes in urban lifestyles. Street space is a limited resource and it is divided into many categories: pedestrians, cyclists, private vehicles, public transport and freight vehicles. Freight vehicles occupy infrastructure while traveling, as well as parking spaces during loading and unloading. Occupying these spaces can lead to disruption of road flows, reduced safety or the occurrence of traffic jams. It follows the need to study how mobility policies and practices affect the use of street space and the shared responsibility of users, with the objective of urban sustainability (Jimenez, 2025). The use of lockers is an increasingly common practice in urban areas given the increase in online sales volumes. The problem is their location and the parking areas necessary for the vehicles that supply the lockers.

One of the European cities that faces the same problems as those written above is the city of Brasov. The present paper aims to identify the problems caused by the mobility of goods in the historic center areas and to find solutions to improve the negative effects produced.

2 Case study: Brasov city center

The historic center concentrates most of the historical monuments of Brasov and has a special cultural, aesthetic and environmental value. In the last 20 years, the area has been gradually returned to pedestrians through multiple pedestrianization projects, some of which were also carried out after the approval of PMUD Brasov – version 1. Statistics of the historic center (sustainable urban mobility component) are presented through the following data: number of population: about 13,000; number of vehicles registered in the targeted perimeter: 5097 (3748 personal vehicles); public institutions: over 5000 students (kindergarten, school and high school) and 2 hospitals; accommodation units: 334; number of residential parking spaces: 290; number of public parking spaces: 1202; number of road accidents:162 (1 deceased, 43 seriously injured) with a share of 40% by hitting the pedestrian.

The historic center is surrounded by wooded hills and has only two main access points and two exit points. There are streets less than 7 meters wide, without sidewalks with many segments in which two cars cannot pass each other. The main problem of the historic center is given by the fact that it functions as a huge dead end and that the moments when the traffic volumes are too high (over 1500 standard vehicles / hour on Muresenilor Street) the entire road traffic network is blocked. This makes it impossible for emergency services to access or leave the area and limits residents' access to their own households. Moreover, the municipality of Brasov is included in Annex no. 2 to Law no. 104/2011 on ambient air quality, with subsequent amendments and according to the law on sustainable urban mobility 155/30.05.2023 must have a low emission zone operational.

In the most problematical area of the city center the traffic flows are entering throw Intersection 1 (Eroilor Boulevard, Muresenilor Street), Intersection 5 (Nicolae Balcescu Street, Dobrogeanu Gherea Street), Intersection 6 (Castelului Street, Dobrogeanu Gherea Street), Intersection 3 (Poarta Schei Street, Sirul L.v Beehtoven) and Intersection 2 (Muresenilor Street, Cibinului Street, Gheorghe Dima Street). The exit traffic flows uses the same intersections except Intersection 6, and throw Intersection 4 (Castelului Strret) (Figure 1).

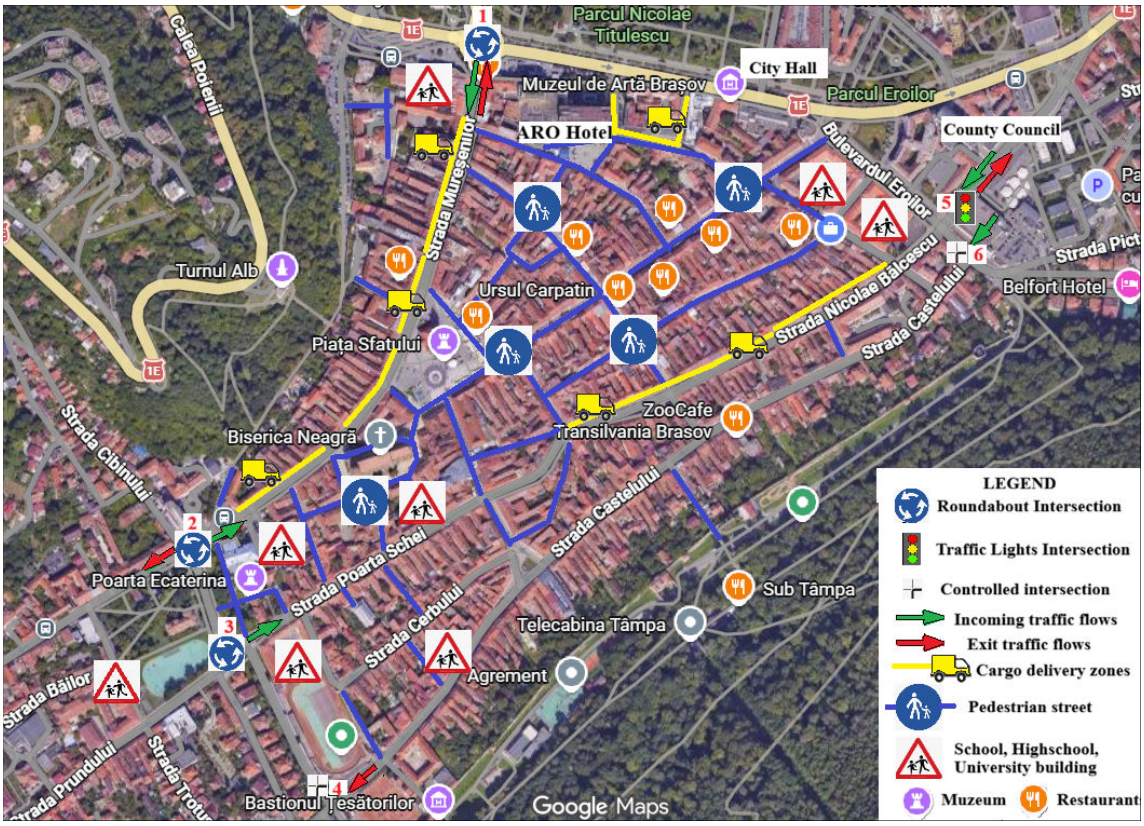


Fig. 1. Brasov City Centre – Traffic flows input and exit; types of intersections; pedestrian streets; education institutions; museums; Cargo and freights delivery zones.

At the local level, there are a number of restrictions on the delivery of goods sized according to the specifics of the area. For example, access to the historic center for cargo vehicles (over 3.5 tons) is restricted, being allowed only after purchasing a free passage permit. On str. Muresenilor, on lane 1 it was allowed to park for refueling only in the time intervals 06:00-07:00 and 10:00-11:00. In order to ensure a better distribution of goods with the exponential increase in home deliveries, the large operators have developed networks of storage spaces such as easy box, fan-box, etc., located in the vicinity of the areas of interest. This network of parcel pick-up points makes an important contribution to reducing traffic jams on the street network.

The problem is acute in the area of the historic center where the capacity of the street network is very low and the bypass alternatives are non-existent. That is why, as a rule, during the morning rush hour, the inhabitants of the Schei neighborhood have difficulty leaving the neighborhood because the two roundabouts on Sirul L.v Beehtoven Street are blocked by parents who transport their children to the three schools in the area (A. Saguna, A. Muresanu or J.Honterus).

The municipality of Brasov develops on a radial-concentric street network oriented mainly towards the Civic Center and partially towards the Historic Center. Over 90% of the total length of the streets is modernized. The non-modernized segments are mainly found on the outskirts of the city, in the developing areas.

The high volumes of traffic coming from the peri-urban area, the difficulty of adapting the intersections to the traffic volumes and the poor connectivity (mainly due to the railway) means that during peak hours most of the arteries that provide the connection with the Historic Center and the Civic Center are blocked. Table 1 shows the road traffic volumes recorded at the morning rush hour (7.30 – 8.30) at the intersection of Muresenilor Street + Sirul Beethoven Street + Sirul Gheorghe Dima Street, in the historic center of Brasov. For the calculation of the standard vehicles, multiplication coefficients were used (2 for vans, 3 for buses and 3.5 for trucks). It is observed that the share of transport vans is about 10% of the road flow at the morning rush hour, representing a significant percentage that interferes with other users every day.

Table 1. Traffic flows for Intersection 2, Muresenilor Street + Sirul Beethoven Street + Sirul Gheorghe Dima Street.

Vehicle Type	Cars	Utility Vehicles	Buses	Trucks
Muresenilor Street	713	43	56	6
Cibinului Street	61	2	0	0
Gheorghe Dima Street	168	15	0	0
Ludwig van Beethoven Street	311	21	0	0
Total etalon vehicles	1253	162	168	21
Power of each type of vehicle in total	78,12 (%)	10,10 (%)	10,47 (%)	1,31 (%)

3 Necessary solutions in order to solve the mobility problems of freights in the analyzed area

In order to solve the problems of mobility, accessibility and safety regarding the delivery of freights in hard-to-reach areas, actions and measures must be taken that concern both local authorities and users of transport services. These measures can be administrative, logistical, intelligent transport systems, regulations, parking policies, or alternative transport solutions. The following subchapters present a series of measures applicable to the Municipality of Brasov, the historic center area.

3.1 Initiating a strong partnership between all stakeholders and carriers

Such a solution can work by creating a voluntary agreement to implement concerted and harmonized activities for the delivery of goods to the city. For example, a freight partnership could include food retailers working together on local distribution and deliveries to minimise delivery trips to stores and customers by sharing loads and thereby maximising vehicle capacity. (https://www.etp-logistics.eu/wp-content/uploads/2022/08/Urban-Freight-Roadmap.pdf).

Such actions are common in European cities. There are urban consolidation centres (UCCs) in several European cities. They are a freight initiative aimed at reducing road traffic responsible for freight deliveries and local air pollution. In his article, Allen J. (2012) presents how to organize Urban Consolidation Centres (UCCs) as a means of reducing local environmental and traffic problems in urban areas. These UCCs are associated with the supply of retail products, often food and everyday products. These UCC schemes are often intended to serve a restricted area where there are locations with features such as narrow streets, historic areas, or tourist areas with freight problems (traffic jams, vehicle delays, limited access areas, parking lots). It turned out that the imposed UCCs were successful only if the way of organizing was able to control or strongly influence all users so as to coordinate the delivery activity.

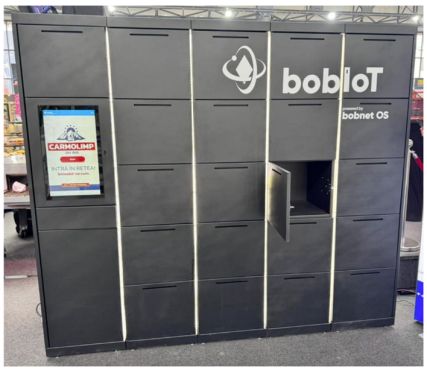
In the Municipality of Brasov, a strategy is being proposed on to achieve such a partnership to solve mobility problems and conflicts between users of the road network in the historic center area. For the success of this solution, a multi-criteria analysis must be made. It will define the factors for achieving distribution: economic, environmental, social, operational and cultural factors. In order to carry out the analysis, it will have to take into account several factors: architectural impact, impact on historic sites, visual pollution, noise level, use of vehicles with alternative propulsion systems, traffic jams, road and passenger safety, legislation, number of parking spaces, size of vehicles, technologies used, economic benefit and level of service of road infrastructure, (Louise de Carvalho, 2020).

3.2 The creation of logistics platforms

Another solution is the creation of logistics platforms that integrate companies in the field of sales, trade and industry, logistics, services and freight transport, such as in urban distribution centers, offering logistics terminals, storage space and/or loading docks.

In order to ensure a better distribution of goods, with the exponential increase in home deliveries, large operators have developed networks of lokere-type storage spaces located in the vicinity of areas of interest. This network of parcel pick-up points makes an important contribution to reducing pressure on the street network (Brasov SUMP, 2025).

A solution for the delivery of perishable food goods in hard-to-reach areas is the project of a Romanian company. It is a concept with refrigerated lockers (mailboxes with refrigerators). Until now, deliveries of prepared food were limited by a courier's journey to customers' addresses. The courier had to hand over the order personally, and any delay meant lost time. With the new system, the courier can leave the products directly in a secure refrigerated locker, and the customer picks them up when it is convenient, safe, and perfectly kept cold. Figure 2 shows the solutions used by delivery people at locator points.

(a) 

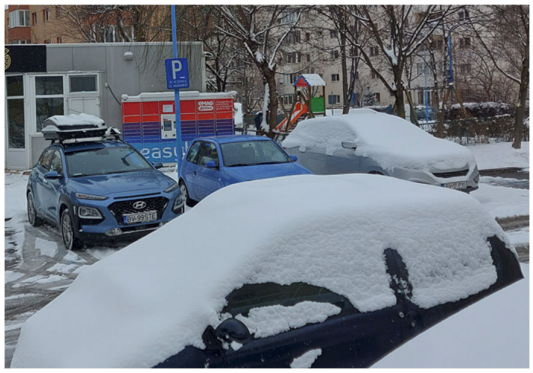
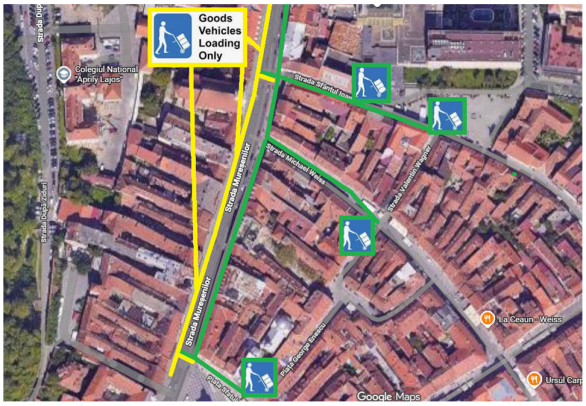
(b) 

Fig. 2. (a) Secure refrigerated locker, as a delivery solution for perishable food goods (https://bizbrasov.ro/2025/11/11/livrari-mancare-carmolimp-easy-box/); (b) Loker for non-perishable goods

3.3 *Defining regulations for commercial vehicle access*

A necessary solution is to define coherent regulations for access into the urban areas for commercial vehicles delivering goods (e.g. only during fixed time slots or access allowed only to vehicles that comply with specific emission standards). Suppliers will no longer be stationed along Mureșenilor Street – one with a much difficult traffic in the morning, when parents take their children with their personal vehicles to school and when public transport has a high frequency. However, the solution is difficult to implement due to road infrastructure limitations. On Muresenilor Street, such a solution was implemented, with two supply time intervals (different from peak hours). The solution worked for a while, but there were big conflicts between carriers and also conflicts with the other users of the road network. Basically, one of the 2 lanes of one-way traffic was completely blocked, the time slots were not exactly respected, and the areas intended for freight deliverers were also occupied by personal vehicles.

Thus, the solution was abandoned and access areas for cargo vehicles were identified on streets where the circulation of personal vehicles is prohibited. Figure 3 shows a map of a part of the historic center of Brasov. Yellow is defined as the old strategy with time intervals for the delivery of goods, along Muresenilor Street. The solution practically completely occupies lane 1 of traffic at the specified intervals. The current strategy is presented in green, in which freight vehicles have access to pedestrian streets (St. John Street, Michael Weiss Street, Council Square), streets restricted to road traffic through barriers.

(a) 

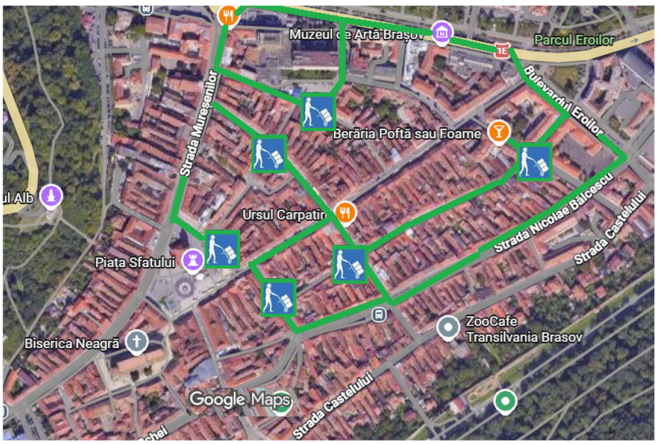
(b) 

Fig. 3. (a) Area in the historic center of Brasov where hourly intervals for the supply of goods to stores were introduced; (b) Access area for the delivery of goods on the pedestrian Michael Weiss Street

3.4 *Management of parking spaces for loading and unloading freights*

The solution presented in the previous point produces an additional need – the creation of parking points for freight vehicles. The municipality has created several points in the area of the historic center, unloading stations, so as to eliminate the current bottlenecks. A supply area is in St. John Square, with access from Eroilor Boulevard, on the street between the Aro Hotel and Romtelecom, with an access control system. The exit is towards Muresenilor Street. Another supply point is on str. Postavarului, in the area where the former Ciucas brewery is supplied, with an access control system. Other supply points with an access control system are also on Diaconu

Coresi Street, Michael Weiss Street, in Council Square, Apollonia Hirscher Street. Also, such a supply area was set up on Nicolae Balcescu Street, in the area of the former taxi station (between the intersection with Diaconu Coresi Street and the one with M. Weiss Street, on the right side). Another supply area is set up in the bus stop area for students on Beethoven Row. Here the program is between 8.30 – 11.00. Supply on str. It will be done during the day between 6.00 – 7.30 and 9.30 – 11.00, and at night between 23.00 – 6.00, provided that the driver of the supply vehicle is close to him. These defined areas are shown in Figure 4.

(a) 

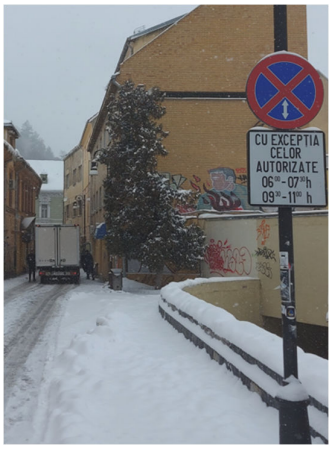
(b) 

Fig. 4. (a) Areas for goods deliveries in the historic center of Brasov; (b) Example of delivery area (M. Weiss Street)

3.5 Maps and indicators development in order to improve the transport of freights

An alternative is to create maps and signs for the transport of goods to indicate the most appropriate transport routes to key areas in a city and to highlight obstacles as well as areas to be avoided, such as low bridges, sharp bends, narrow streets, residential areas and pedestrian areas.

3.6 Introduction of technologies such as intelligent transport systems

In addition to administrative measures, it is necessary to introduce technologies such as intelligent transport systems (ITS) and/or web-based logistics coordination systems that allow for more efficient transport planning and an increased load factor.

At the moment, the level of digitalization of mobility services in the Municipality of Brasov and the metropolitan area is still quite low. The public transport lines are integrated into Google Maps but without real-time display of the location of public transport, in some of the stations there is a digital display and public parking can be paid via SMS or with the TPark application. Starting from the existing data layers, it will be important to develop a MaaS platform and application in stages.

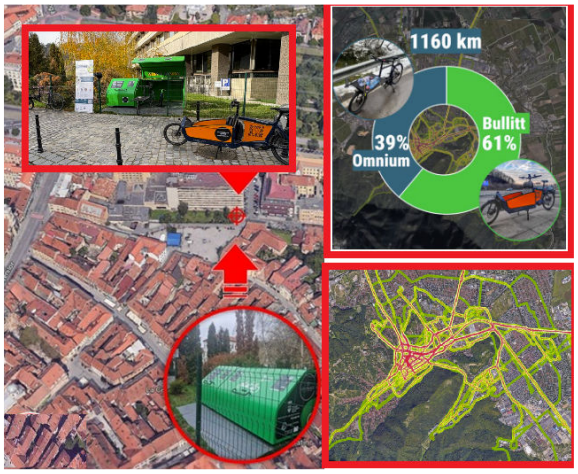
To choose smart solutions for the delivery of goods, a system for simulating and optimizing alternative solutions must be used. An ITS strategy would make it possible to reduce freight flows, taking advantage of the availability of alternative transport to cover the main distance of travel in the city and the use of bicycles as a last mile (Veličković, 2025). A strategy outline is the integrated platform for sustainable urban Last-Mile logistics (Teixeira, 2023).

3.7 Bicycle mobility solution for supplying economic agents

The companies that ensure the supply of economic agents in the area of the historic center, couriers and citizens living in this area can transport their products and packages by means of two electric cargo bikes, thus avoiding entering the pedestrian area by car or parking in undeveloped places. Through this project, E-CargoCicleta, the municipality wants to test, in the next 6 months, an environmentally friendly supply solution in the area of the historic center. The E-CargoCicleta project is funded by EIT Urban Mobility, the value of the project being 40,000 euros, and is implemented by local autorities and several economic partners.

In December 2024, the E-CargoCicleta project was launched in Brasov, through which the companies that ensure the supply of economic agents in the historic center area, couriers and residents of this area can transport their products and packages by means of two electric cargo bikes, thus avoiding entering the pedestrian area by car or parking in unarranged places. The usefulness of the solution can be assessed by the indicators: the two electric cargo bikes traveled over 1160 kilometers between December 20, 2024 and April 12, 2025; resulted in 230

fewer car trips; 284 kg less carbon dioxide was produced. Figure 8 shows the freight bicycle rental service currently used in the historic center of Brasov.

(a) 

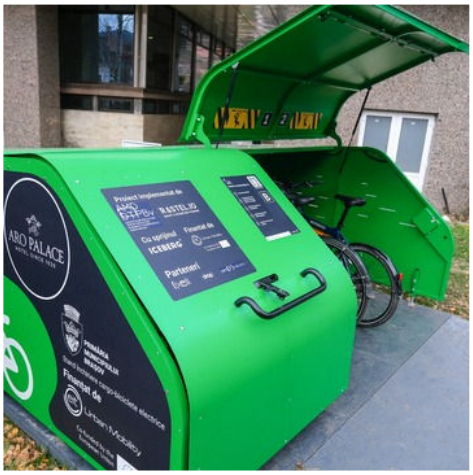
(b) 

Fig. 5. (a) The location area of the cargo bicycle rental service, with the share of their use by 2 local distribution companies – Omnium and Bullit, and the map of kilometers traveled in 2025 by delivery drivers in Brasov; (b) Parking for cargo bicycles for hire (source - https://www.facebook.com/p/CargoCicleta-61565307156574/)

4 Conclusions

Old European cities have some similar characteristics, which distinguish them from new cities. They have historical centers, and medieval cities have historical areas framed by the walls of the former fortresses. The architecture of these complex areas has produced challenges in the field of urban mobility, passenger and freight transport.

The paper presented 7 strategies for freight logistics in the historic center of Brasov: initiating a solid partnership between all stakeholders and transport operators; creation of logistics platforms; defining regulations for the access of commercial vehicles; management of parking spaces for loading and unloading goods; creation of maps and signs for the transport of goods; the introduction of technologies such as intelligent transport systems; bicycle mobility solutions to supply economic agents. These solutions are complementary and can work in parallel to increase the delivery capacity of goods and to reduce the flows represented by commercial vehicles in the analyzed area. As an effect, these solutions aim to reduce air and noise pollution in the historic center, reduce traffic jams at peak hours and increase pedestrian safety in the analyzed area.

Table 2. Advantages and challenges associated with each of the 7 strategies for freight logistics in Brasov City Center

Strategies for freight logistics	Advantages	Challenges
1. Initiating a strong partnership between all stakeholders and carriers	Harmonisation of delivery activities for operators; reducing conflicts between operators; reduction of the spaces required for delivery.	The difficulty of getting most of the transport operators operating in the area to agree; the lack of a legislative framework; the deficient involvement of authorities.
2.The creation of logistics platforms	Reducing the need for delivery spaces (parking spaces); centralization of delivery areas in very crowded areas.	Additional costs for logistics platforms; difficulty in identifying the optimal locations; the problem of the delivery person's access to the platforms.
3. Defining regulations for commercial vehicle access	Organizing delivery activities based on well-established schedules; the use of restrictive measures based on regulations; effective control of delivery activities.	The lack of a regulation at national level for the delivery of goods in sensitive areas; the lack of initiatives at city and regional level in the implementation of a regulation.
4. Management of parking spaces for loading and unloading freights	Centralization of delivery areas in very crowded areas; reducing the need for delivery spaces (parking spaces); increasing operator safety in loading/unloading areas.	Use of delivery premises by unauthorised persons other than transport operators; creating drawings at certain time slots; conflicts with pedestrians.
5. Maps and indicators development in order to improve the transport of freights	Quick identification of areas available for parking; management of logistics activities for a specific area.	Substantial investments in GIS applications; limited access to the data necessary for the operation of this type of tool.

6. Introduction of technologies such as intelligent transport systems	Reducing the need for delivery spaces (parking spaces); the possibility of continuous optimization of the logistics process.	Major investments in infrastructure but also in software tools; conflicts with residents; access problems in tourist areas.
7. Bicycle mobility solution for supplying economic agents	Increased accessibility in crowded areas; accessibility in pedestrian areas; cheap financial solution.	Use of the solution according to the season; risks of conflicts with road vehicles; the need for specific skills for users.

Of the solutions presented, some of them have already been implemented, and others are planned for implementation in the near future. It is worth noting the openness of local authorities to alternative solutions, such as the use of bicycles, the use of lokeres for perishable goods, the definition of delivery zones, but also the integration of complementary mobility measures. The present paper stands out for presenting solutions that can be generalized within several European cities facing freight mobility problems. In the future, a multi-criteria analysis of these and other solutions (resulting from good practice projects) will be carried out to assess their impact on reducing flows from the historic centres of European cities.

Some of the analyzed measures cannot be implemented until a coherent legislative framework is ensured. Other measures, even if implemented, must be enforce, in order to be respected by all users. Ensuring compliance with regulations and regulations regarding the transport and delivery of goods is essential for safety, sustainability and the environment. Regular checks by the authorities, cooperation with local and traffic police, fines for non-compliance with the rules (timetables, access to zones) should be applied to both transport operators and users of personal vehicles. The collaboration between the City Hall, infrastructure managers, environmental agencies, transport operators, beneficiaries, residents, institutions (schools, high schools, university), economic agents and those responsible for tourist attractions is essential.

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