Impact of micro mobility on curb management and city logistic sustainability

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Abstract

The goal of sustainability is reflected in the cooperation between suppliers, users and public administration. Micromobility represents a new ecological approach to transport and sustainable traffic. It is the result of an increase in the number of vehicles in cities, large traffic jams, an increase in carbon dioxide emissions, need for better mobility etc. The appearance of the concept of micromobility puts the mobility of citizens and the use of green means of transport in the city center in focus. The concept gains even more importance by applying the principle of shared resources, the so-called shared micromobility. The increase in micromobility, but also a increase in number of small city deliveries, need for sustainable traffic, reduction in noise and better utilisation of parking spaces, affects the need to redefine the curb management. In this way, city roads are redefined and individual mobility is increased, which is of great importance for cities that generate a large part of their income from tourism. Citizens, local entrepreneurs, private courier operators, but also the city as a whole benefit from the curb management and shared micromobility.

***Keywords**: City logistics, sustainability, micro mobility, curb management, shared economy.*

1. Introduction

With the increase in the urban population, there is also an increase in traffic congestion, which in turn leads to an increase in noise levels and an increase in the amount of CO_2 emission.

In order to improve the quality of life in cities, many international organizations have focused their attention on sustainable development.

Micromobility represents a new philosophy of urban sustainable traffic directed towards the zero-emission trend. This type of transport offers greater flexibility, favorable economy and is city friendly. Considering their characteristics, using micromobility vehicles is often faster than driving.

In the first chapter, the goals of sustainable development are presented with references to the role of the postal sector in sustainable development. The challenges of urban logistics are presented in the second chapter, and the potential solution to those challenges, called micromobility, is presented in the third chapter. The fourth chapter is devoted to curbside management and the next chapter presents the potential role of micromobility in the field of delivery. Finally, concluding remarks are given.

2. Sustainable development

The growth of the world's population and increased migrations have led to the rapid expansion of cities. The United Nations predicts that by 2050, two-thirds of humanity, or about 6.5 billion people, will live in cities [1].

The development of society should go in a direction that ensures social, economic and environmental sustainability.

Sustainable development implies the development of a society that meets human needs with available resources and at the same time does not endanger natural systems and the environment. It can be said that the concept of sustainable development is the most important modern strategy and philosophy of social

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development. In 2015, the United Nations adopted the Sustainable Development Goals (SDGs), whose basic idea is to stop poverty, protect and preserve the planet, and to insure that all people in the world live in peace and prosperity by the year 2030 [2].

There are seventeen SDGs defined by the UN. Goal number 11. is interesting from the aspect of city logistics because it reads: "*Make cities and human settlements inclusive, safe, resilient and sustainable*". Making cities sustainable means creating career and business opportunities, safe and affordable housing, and building resilient societies and economies. It involves investment in public transport, creating green public spaces, and improving urban planning and management in participatory and inclusive ways [2].

The European Union has already embarked on a transition towards a low-carbon economy that is climate neutral, resource-efficient and circular – while ensuring social equality and inclusiveness. The EU has also put the SDGs at the heart of its external action and has aligned all development activities with the UN 2030 Agenda [3].

Paris has been the first to set remarkable targets: zero diesel cars by 2024 and zero fossil fuel cars by 2030, with Mayor committing to green mobility and 1000 km of cycling lanes across the city with her "15-minute city" plan [4].

2.1 Sustainable development and the postal sector

Sustainable development is an important element of postal operations that contributes to an improvement of efficancy, development of new markets, and strengthening of the relationship with consumers [5].

The Universal Postal Union, , has a key role in achieving these goals through integration, innovation, and inclusion. One of the focuses of the postal sector, which is in line with the EU initiative leading to sustainability, is related to the circular economy.

The circular economy refers to the increased possibility of repeated usage of resources. It is a system that aims to reconcile economic growth with environmental protection, keeping in mind the limitation of resources. The emphasis is put on making resources last as long as possible through a product design that will enable longevity, business models such as sharing, reusing, and repairing, and only eventually recycling [6].

3. Challenges of city logistics

A large number of residents and companies in cities are traffic and transport generators. Various criteria imposed by different type of users further complicates the implementation of city logistics. There is no single solution for solving logistical problems in urban areas.

We define urban logistics as that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and point of consumption in order to meet customers requirements [7].

The increase in the city's population and the cumulative effect it has on both the economic structure of the city and the overall city infrastructure has brought into focus numerous problems, such as:

- Air quality - Air pollution levels exceed safe levels in many European cities, leading to premature deaths;
- Climate change - Transport is Europe's largest source of GHG emissions, contributing to 27% of the EU's total CO2 emissions;
- Noise - The EU estimates that 40% of Europeans are exposed to dangerous levels of road traffic-related noise, impacting mental health and well-being;
- Congestion - The average person living in Paris spends 65 hours in traffic per year, compared with 49 in Munich and 35 in Stockholm, leading to a loss of productivity. Reduced commuting time is a strong predictor of well-being and has been linked to poverty alleviation;
- Space - Research in Stockholm shows that 50% of the city's space is allocated to roads and car parking;[4]. This also means that there is: lack of attention directed towards the movement of cyclists and pedestrians; lack of inclusion for persons with special needs; lack of urban green zones etc.

As cities grow, so does the need for mobility, which is made possible by the appropriate traffic infrastructure. Incrised awareness for environmental protection, sustainability and the

need for mobility led to a new traffic and transport solution that we know today as micromobility.

4. Micromobility

According to the Institute for Transport and Development Policy, micromobility refers to a group of small, light vehicles whose operating speed is below 25 km/h and which are driven by the users themselves. This group of vehicles includes bicycles, e-bikes, electric scooters, electric skateboards, fleet of shared bikes as well as bikes with auxiliary electric drive [8].

According to the Merriam-Webster dictionary. micromobility is the "transportation over short distances provided by lightweight, usually single-person vehicles (such as bicycles and scooters)".

Micromobility vehicles can be powered by human power as well as by an electric motor. For electric vehicles to be classified as micromobility vehicles, they must not have an internal combustion engine or have a speed greater than 45 km/h [9].

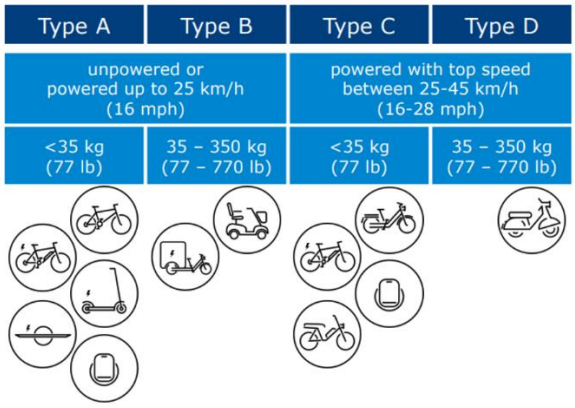

Fig. 1. *Categories of micromobility vehicles proposed by International Transport Forum* [10]

Micromobility offers solutions to many urban challenges:

- Mobility and efficiency - Above all, these vehicles offer users increased flexibility and freedom of movement.
- Reduction of traffic jams - The characteristics of these vehicles are such that users can move easily and quickly on city roads, whereby the effect of city traffic jams is much less felt than in the case of using standard vehicles.
- Air pollution - Since the vehicles are powered by the user's own power or by electric motors, these vehicles do not pollute the environment with exhaust gases.
- Noise level - Micromobility vehicles do not generate noise, which leads to an increase in the quality of life. Also, this feature, along with the fact that they are intended for low speeds, gives them the ability to move in zones that are not intended for motor vehicles.
- Space - Due to their small dimensions, these vehicles occupy a small part of the parking space compared to the parking space of a standard motor vehicle.
- Cost-effectiveness - In many countries, the use of electric vehicles is free, as the batteries can be recharged in predefined urban areas without additional costs.
- Practicality - Micromobility vehicles are suitable for short distances and represent an ideal solution if offered as a complement to the mass transport system in the form of shared micromobility. They are the bond between the first and last mile gap of public transit.
- Health - Indirectly these vehicles affect health because people spend less time behind the wheel or in public transport and more time in free movement on the open.

In the literature, micromobility vehicles are often classified as light electric vehicles (LEVs). (Electric bicycles, electric scooters, electric skateboards, electric unicycle, and onewheel) [11].

Legislation related to light electric vehicles varies from country to country. In most cases, the limiting factor is the maximum permissible speed, total weight of the vehicle and the maximum power output.

Governments worldwide are pushing for walking and cycling as the ideal option for short urban journeys and e-scooters are now opening new opportunities. Electric scooters experienced a monumental rise in popularity in 2018, primarily in the US, but also in major cities across Europe, Latin America and Asia [12].

Several factors dictate why micro-mobility has experienced such paramount success in the last year. The urban population has increased from 3.4 billion to 4.2 billion since 2008 and so has mobile phone ownership, growing from 1 in 100 people to 1 in 5 in the same time period. This means that all riders have a smartphone to locate, unlock and pay for the e-scooter directly within the app. Parallel to this, battery prices dropped by 86 percent between 2010 and 2016, making electric mobility solutions more affordable. Moreover, significant improvements to range mean that e-

scooters can cover 30 to 50 kilometers and can often be used for an entire day before needing to be recharged [12].

4.1 Shared micromobility

Micromobility vehicles can be privately owned but can also be available within a shared mobility system. Shared micromobility is a type of transport based on the rental of micromobility vehicles for personal needs and for short-term transport within the city's urban zone.

As defined by the Society of Automotive Engineers, shared mobility is *the shared use of a vehicle, motorcycle, scooter, bicycle, or other travel mode. Shared mobility provides users with short-term access to one of these modes of travel as they are needed*. [13]

Shared mobility has the potential to create affordable, reliable, equitable and sustainable mobility options for everyone.

Within two years of the first service's launch by Bird, in Santa Monica, California, in September 2017, e-scooter sharing services have reached 626 cities across 53 countries [4].

5. Curbside management

The degree of urbanization, the development of traffic and transport infrastructure from the aspect of regulation and safety, as well as the city's logistics solutions should be directed towards:

- Citizens. Efficient mobility should be offered, as well as good traffic connections through a diverse mass transport system, a satisfactory number of parking spaces, mobility for both pedestrians and cyclists, an increased sense of safety in traffic, inclusion of people with special needs, etc.
- Business entities. Considering that they carry out economic and transport-logistics activities in densely populated urban areas, it is necessary to focus action on regulating the movement of delivery vehicles, enabling a sufficient number of zones for loading and unloading, securing locations for the construction of logistics centers satisfying the spatial and traffic restrictions, motivating the transition to hybrid vehicles, green vehicles through city and state subsidies.

Looking at city logistics, it can be concluded that the most valuable resource is space, which is limited. It is almost impossible to increase the size of the space, so one of the logical solutions is the repurposing of the space, considering all the restrictions and requirements set by the citizens, the businesses and the city government. This process is also known in the literature as curbside management. Demands for redefining the existing space, i.e., repurposing certain parts of roads, are on the rise. There are many reasons for this. With the growth of deliveries in cities, the need for reserved delivery areas is growing. It is similar with shared mobility services, which are on the rise and for which a reserved zone is necessary for the entry and exit of passengers. If we look at the area of micromobility, we are talking about zones where these vehicles will be parked, refilled, etc.

The challenge facing most of today's cities is how to make roads (intended for both passenger and commercial vehicles as well as cyclists and pedestrians) as safe, productive and efficient as possible.

Fehr & Peers has developed an index called the Curb Productivity Index. The purpose of this index is to calculate the amount of passenger activity, i.e., the number of people using the sidewalk per hour per defined length of sidewalk that represents the size of a typical parking space on the street [14].

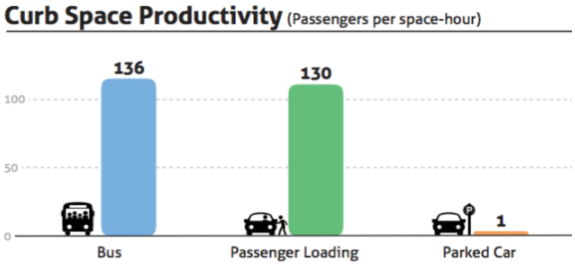

Fig. 2. *Example of Curb space productivity* [14]

This index shows the level of productivity for a certain type of vehicle or curbside space, which serves as a clear indicator for the necessity of repurposing the space.

Fehr & Peers has developed three broad strategies for improving curbside productivity and efficiency based on their observations and analysis:

- Relocation
- Conversion
- Flexibility.

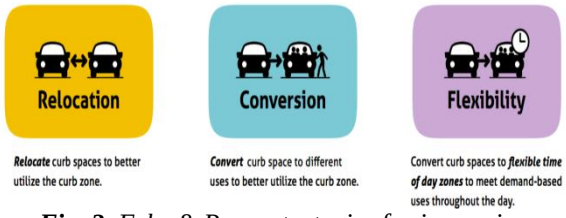

Fig. 3. *Fehr & Peers strategies for improving productivity and efficiency of curb space* [14]

If current infrastructure in certain city zones, districts and even streets favor and leads to an increase in the number of deliveries, the use of bicycles, pedestrians or other micro-mobile vehicles, then the repurposing of space is imposed as a solution.

One of the (less popular) solutions is the repurposing of the parking spaces (intended for cars) to accommodate other modes of transportation that may be more in line with the goals of the urban area and the present community in terms of the environment, health and safety.

The conversion of space opens the possibility of urban and traffic planning aimed at the creation of zones for parking bicycles, LEV vehicles, parklets or aimed at mobility sharing vehicles and their pickup/drop off zones.

The growth of e-commerce has led to an increase in city deliveries. If we add to that the increase in the number of micromobility vehicles, urban planners and traffic engineers have a difficult task, which is reflected in the need to adapt parts of roads to the newly created traffic and transport requirements.

The increase in traffic congestion and at the same time the growth of people's awareness towards environmental protection represented an impulse towards new mobility solutions that were put into practical use with the development and improvement of technological innovations.

It is necessary to find a balance for all traffic participants, i.e., road users, both vehicles for individual and commercial use, as well as for pedestrians and users of micro-mobility means of transport.

The main objectives of curbside management are [15]:

- Traffic congestion management.
- Supporting economic activity.
- Meet stakeholder needs for various curbside functions while respecting corridor type and alignment with existing city plans and policies.

Practice has shown that the basic principles that should be followed when redefining the purpose of roads are [15]:

- Focus on mobility:
  - Manage general congestion.
  - Minimize curbside use on surface transit corridors.
  - Reduce curbside use at peak periods.
  - Encourage off-street curbside use.
- Secure and reliable access
  - The safety of road users is the most important.
  - The right of way has different roles at different times.
- Communicate Value to All
  - Simple solutions are preferred.
  - The curb is a scarce resource - user charges apply where appropriate.
  - Transparent and responsible decisions are necessary.

6. Micromobility and the last mile

From the commuter's point of view, the biggest challenge is the first and last mile, which we define as the space between the station and work, or the transfer between buses or any distance that is too close to drive, but too far to walk.

Micro-mobility is a solution to the last-mile problem. This typically encompasses all passenger trips of less than 8 kilometers, which accounts for up to 50 to 60 percent of passenger trips in urban spaces. These car trips, short public transport stretches and first and last-mile gaps can be replaced with bikes, electric scooters, mopeds and other micro-mobility solutions [12].

When talking about commercial aspect the last mile refers to the final step of the delivery process from a distribution center or facility to the end-user.

When looking at delivery in urban areas, the criterion of on-time delivery gains weight when considering the influence of narrow streets in the historic city center, remote residential areas as well as dense pedestrian areas.

One solution for delivery in urban areas is cargo bikes. They offer high flexibility, zero emission, they are easy to park and recharge and they gain more functionality with IT advance solution. With all that it said before, these means of transportation can offer users just-in-time delivery.

6.1 Micro-depots

The development of micro depots can be one of the solutions for improving delivery in cooperation with micromobility vehicles. Classic delivery involves vehicles that must follow a pre-defined route. In most cases, traffic jams or free parking spaces cannot be predicted, so it is difficult to accurately estimate the delivery time. Microdepots would serve the purpose of local depots with smaller delivery areas. Microdepots would be set up in areas of increased delivery. Micromobile vehicles would be an ideal solution for the last mile delivery with their flexibility, ease of parking and the ability to quickly reach any address.

In Berlin, five largest parcel delivery companies tested delivery by cargo bike for one year. They tested cooperative use of micro depots by the courier, express and parcel sector for the sustainable deployment of cargo bikes.The aim was to trial an alternative concept for urban delivery traffic. In mid-2019 the participating companies concluded that above all areas with a high drop density and suitable packages (number of items, volume and weight) were predestined for this approach. It requires suitable cooperative micro-depots in central locations [16].

7. Challenges of micromobility

In addition to numerous advantages, we must also be aware of numerous challenges that the use of micromobility vehicles brings with it. This primarily refers to:

- Safety - The development of technology, as well as the need for a small, light and economical form of transportation, led to their rapid acceptance and use of e-scooters and similar electric vehicles. As a result of the rapid expansion of these vehicles, there was a lack of regulation to ensure the safety of users. In addition, there is lack of clearly defined traffic zones for micromobility vehicles.
- Logistics - Like other vehicles, the efficiency of the use of micromobility vehicles depends on the supply chain, on responsiveness for maintenance, service, spare parts, as well as accompanying economic investments in the form of charging stations, vehicle storage, etc.
- Asset Regulation - In the case of micromobility, numerous legal issues arise regarding the ownership of assets in the chain of use (where to store vehicles when they are not on the streets, where to park them, liability and insurance in case of theft, injuries, etc.).
- Communication - The issue of regulating communication through mobile applications. [17].

8. Conclusion

Logistic challenges in cities have led to an increase in noise, pollution and traffic congestion. Movement in cities is difficult so micromobility vehicles appear as a solution. They provide a flexible mode of transportation that is, in many cases, faster than driving. The increasing interest in sustainability puts micromobility vehicles in focus, given that they are environmentally friendly and with zero emission.

Micromobility vehicles offer numerous advantages for both citizens and businesses. The development of technology largely affects the expansion of these vehicles. Lower battery prices and increased capacity enable greater vehicle autonomy, and development of mobile application makes renting, paying, finding parking areas and charging easier, which contributes to the popularity of shared mobility.

We expect to see increased application of these vehicles in the field of delivery because they enable greater mobility in urban areas and do not require large parking spaces. Micromobility represents a new ecological approach to transport and sustainable traffic.

9. References

[1] United Nations and S. A. P. D. Department of Economic, “World Urbanization Prospects The 2018 Revision,” 2018.

[2] United Nations: Department of Economic and Social Affairs Sustainable Development, “Transforming Our World: The 2030 Agenda for Sustainable Development,” 2015.

[3] European Commission, “A Green Deal Industrial Plan for the Net-Zero Age,” Brussels, 2023.

[4] Thomas Holm Møller and John Simlett, “Micromobility: moving cities into a sustainable future,” 2020. Accessed: Apr. 27, 2023. [Online]. Available: https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/automotive-and-transportation/automotive-transportation-pdfs/ey-micromobility-moving-cities-into-a-sustainable-future.pdf

[5] Milutinovic J., Grgurovic B., Velickovic S., and Radosavljevic S., “The Development of the Concept of Consolidation Centers in Using the Sharing Economy in Postal Services / Logistics, I,” in *nternational Conference on Advances in Traffic and Communication Technologies – ATCT 2022*, Sarajevo: University of Sarajevo, Faculty of Traffic and Communications, May 2022, pp. 85–91.

[6] Tepić J., Tanackov I., Stojić G., and Sremac S, *Transportno-logističke osobine i tokovi robe*. Novi Sad: FTN Izdavaštvo, 2013.

[7] W. J. Rose, J. E. Bell, C. W. Autry, and C. R. Cherry, “Urban logistics: Establishing key concepts and building a conceptual framework for future research,” *Transportation Journal*, vol. 56, no. 4, pp. 357–394, 2017, doi: 10.5325/transportationj.56.4.0357.

[8] D. Yanocha, M. Allan, V. Krishna, S. Bakker, J. F. Lyft, and S. Goodwillie, “The Electric Assist: Leveraging E-bikes and E-scooters for More Livable Cities,” 2019. [Online]. Available: www.itdp.org

[9] S. O’hern and N. Estgfaeller, “A scientometric review of powered micromobility,” *Sustainability (Switzerland)*, vol. 12, no. 22, pp. 1–21, Nov. 2020, doi: 10.3390/su12229505.

[10] Corporate Partnership Board, “Safe Micromobility,” Paris, 2020. Accessed: Apr. 28, 2023. [Online]. Available: https://www.itf-oecd.org/

[11] https://swov.nl/en/fact-sheet/light-electric-vehicles-levs

[12] https://www.alphabet.com/en-ww/micro-mobility-and-last-mile-trend

[13] https://www.sae.org/shared-mobility/

[14] https://medium.com/uber-under-the-hood/sharing-the-curb-b5fde02b97dd

[15] https://www.toronto.ca/legdocs/mmis/2017/pw/bgrd/backgroundfile-109540.pdf

[16] https://www.iaa-transportation.com/en/visitors/trends-and-topics/Micromobility--cargo-bikes-for-the-last-mile

[17] https://hellotracks.com/blog/Five-Issues-Facing-The-Micro-Mobility-Industry/