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MICROMOBILITY RUSH IN THE REPUBLIC OF SERBIA – EXISTING TRENDS AND FUTURE CHALLENGES

Key Words
Micromobility
Urban design
Transport policy
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Abstract

The expansion of the use of micromobility vehicles has conditioned a number of changes that cities and countries around the world have faced. The lack and inconsistency of the existing regulations and limited infrastructure capacities have been singled out as two central problems that further complicate the process of adequate treatment of this area. On the other hand, the shift of users of traditional modes of transport to the use of new mobility options, at the same time changes their needs, habits and requirements. Some cities and countries have already gone through a period of testing and integration of micromobility into existing urban transport and traffic systems, while a large number of countries are currently in transition. This group of countries also includes the Republic of Serbia, which is actively working on improving the current legislation and examining the existing infrastructure options for the

implementation of micromobility vehicles. Accordingly, the main goal of this paper is to present the current situation and the possibility of using micromobility vehicles in the Republic of Serbia. The results of the research presented in this paper are part of the Study "Micromobility vehicles" conducted for the Republic of Serbia, commissioned by the Road Traffic Safety Agency, which defines the basic technical and operational characteristics, classification of vehicles, how to use the existing infrastructure, as well as general conditions for their regulated and mass application.

1. INTRODUCTION

With the expansion and the development of micromobility during 2018 at the global level, there was a need for additional consideration of this group of vehicles and their inclusion in the existing traffic systems. Although micromobility seems to be an effective concept of efficient mobility for urban areas in the future, the reality indicates potential problems that these changes create, and which the Republic of Serbia faced, in the process of regulation [1]. First of all, micromobility vehicles are characterized by extensive development, which is not accompanied by appropriate legislation. The street profile has its spatial limitations and usually separates non-motorized and motorized users, which could be disrupted by new micromobility options [2]. In that sense, it is not possible to unambiguously take over some of the already implemented solutions in the countries that have regulated the usage of vehicles for micromobility, but it is necessary to give an optimal proposal for their use, taking into account local specifics design elements, users, vehicles, network and environment, as well as regulations on the territory of the Republic of Serbia.

The existing Traffic Regulation provides an adequate basis and legislative structure for regulating these vehicles, their management, defining the infrastructure, and other important aspects. However, certain shortcomings have forced actions and measures to be taken to improve the existing regulations. For example, *The Rulebook on the classification of motor vehicles and trailers* [3] provides a special type K (Other vehicles) which to some extent includes micromobility vehicles, but not in a sufficient way to include all existing (or future) types of electric or self-balancing vehicles. The existing legal acts do not define the infrastructure that can be used by these vehicles. *The Rulebook on Traffic Signalization* [4] includes a set of standard signs and markings that can be partially applied to micromobility vehicles. Certain situations, such as marking parking spaces, infrastructure for these vehicles, defining specific restrictions on movement, etc., require separate signalization, which must be defined by *The Rulebook*. On the other hand, the existing penal provisions defined by *The Road Traffic Safety Law* [5] do not fully cover all categories of micromobility vehicles, which is why this document cannot be used consistently without its amendment and improvement. Based on the above, it can be noticed that, unlike traditional vehicles, micromobility vehicles are not explicitly defined by the Law, nor is their use regulated by the existing Traffic Regulations. Prolonged use of

micromobility vehicles without the necessary legal regulations reduces not only the level of road safety, but also the general level of service and efficiency [6].

The mentioned reasons conditioned the activities and measures on the improvement and regulation of this area on the territory of the Republic of Serbia. In that context, the Traffic Safety Agency decided to, through a systematic analysis and range of professional activities, develop and implement a study that aims to provide the answers to define the place and role of micromobility in the urban mobility system. Accordingly, this paper aims to present the current situation and possibilities of using micromobility vehicles in the Republic of Serbia, by presenting the methodological framework of the Study, and the most important research results that include: minimum structural and technical characteristics of vehicles, movement requirements, available infrastructure capacities for their use, and recommendations for the public use of micromobility vehicles.

2. METHODOLOGICAL FRAMEWORK OF THE STUDY

The general methodological procedure of the Study consists of five main phases: first, preparatory phase, second phase which includes presentation of micromobility vehicle characteristics, and literature review, third phase which represents the analysis of the current situation, fourth phase in which the legal framework and recommendations for implementation are defined, and fifth phase involves the dissemination of the results. The sequence and structure of phases within the Study are shown in Figure 1.

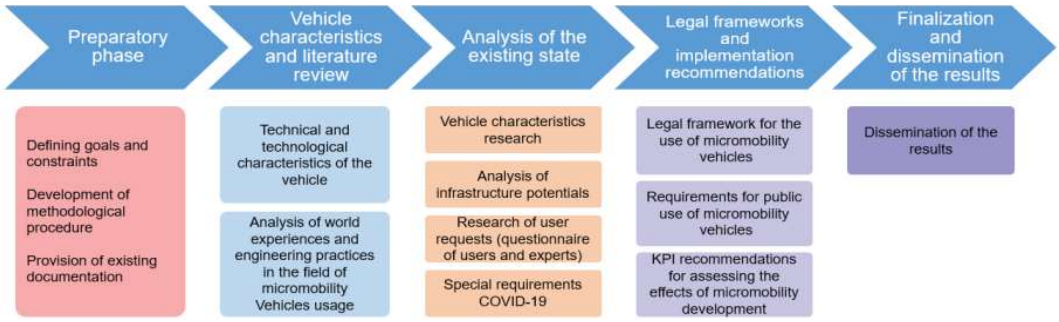

Figure 1. Study methodological framework

Further in the paper, the activities in the process of data collection will be explained in more detail, as well as:

- the analysis of the minimum requirements for structural and technical characteristics that must be met by micromobility vehicles, as well as general requirements for their use,
- the analysis of requirements and availability of existing infrastructure capacities,
- conditions for public use of micromobility vehicles on the territory of the Republic of Serbia.

3. CHARACTERISTICS REQUIREMENTS FOR MICROMOBILITY VEHICLES

Micromobility vehicles include a whole range of modes of transport that differ significantly in their technical and technological characteristics, the purpose of use, safety aspects, but also other elements. For this reason, it is necessary to standardize and define the minimum requirements that every vehicle for micromobility must meet, to enable its functional and safe use in traffic.

Although, there is still no universally defined classification of vehicles for micromobility, some countries and organizations have given their suggestions as to which vehicles should be classified in the group of micromobility. Figure 2 shows the classification and basic characteristics of a vehicle for micromobility, given by the Society of Automotive Engineers (SAE) [7].

	Powered Bicycle	Powered Standing Scooter	Powered Seated Scooter	Powered Self-Balancing Board	Powered Non-Self-Balancing Board	Powered Skates
Seat	Y	N	Y	N	N	N
Operable pedals	Y	N	N	N	N	N
Floorboard / foot pegs	Possible	Y	Y	Y	Y	Y
Self-balancing[2]	N	N	N	Y	N	Possible

Figure 2. SAE micromobility vehicles classification

The classification and guidelines of the EU Directive no. 168/2013 [8], served to form the proposal of the national classification of micromobility vehicles in the Republic of Serbia.

The results of the conducted expert survey, experiences of the best world practice, EU legislation and recommendations, i.e. standards, were used as a starting point for defining the proposals of minimum requirements related to vehicles for micromobility. Figure 3 summarizes the 11 most important structural and technical characteristics and the 11 most important requirements that have been considered from the aspect of micromobility vehicles usage.

Minimum technical characteristics requirements

- Maximum designed speed
- Maximum nominal power
- Maximum vehicle width
- Maximum vehicle length
- Minimum wheels dimension
- Maximum deceleration
- Minimum clearance
- Possession of devices for giving sound signals
- Possession of lighting system
- Pedestrian mode
- Possession of steering wheel

Vehicle use requirements

- Usage approval
- Vehicle registration
- Periodical vehicle check
- Driver licence
- User training
- Knowledge of regulations
- Insurance
- Usage of safety helmet
- Usage of retroreflective clothes
- Minimum age for vehicle use
- Speed limit

Figure 3. Technical and usage requirements analyzed in the Study

Structural and technical characteristics and requirements were analyzed concerning the following four general categories: e-bikes "pedelecs", "fast" e-bikes, e-scooters and other micromobility vehicles which include: segways, hoverboards, e-skateboards, e-rollers, unicycles, etc. The proposed constructive and technical characteristics for the micromobility vehicles are presented in Table 1.

Table 1. The proposed constructive-technical characteristics for the micromobility vehicles

Construction	Vehicle category			
	E-bike „pedelec"	„Fast" e-bike	E-scooter	Other micromobility vehicles
Maximum speed	25 km/h	45 km/h	25 km/h	25 km/h
Maximum nominal power	250 W	4000 W	600 W	500 W per wheel
Maximum vehicle width	1.00 m	1.00 m	0.70 m	1.00 m
Maximum vehicle deceleration	1.68 – 4.25 m/s²	✓	1.5 – 2 m/s²	1.5 – 2 m/s²
Sound signals	✓	✓	✓	✓
Lighting	✓	✓	✓	✓
Pedestrian mode	N/A	N/A	✓	✓

✓ - required; N/A – Not applicable

4. AVAILABILITY AND INFRASTRUCTURE REQUIREMENTS

Within this step of the Study, a comparative analysis of the attitudes of experts, users and potential users was performed based on the results of the survey, as well as the analysis of the experiences and best practices of five selected European countries: Italy, Austria, United Kingdom, Slovenia and Germany. The survey included 36 experts whose task was to propose the infrastructure for the use of micromobility vehicles. A special survey was conducted among both users and potential users. Users commented on the infrastructure they currently use for micromobility vehicles. On the other hand, the survey of potential users aimed to determine what type of infrastructure this group of respondents would use in case of the potential use of micromobility vehicles. The total sample collected for the needs of this phase of the research is 1002 respondents.

Existing infrastructural capacities were considered through six categories, shown in Figure 4. Having in mind that each city is arranged and functions in accordance with the planning documentation prepared for the needs of the specific subject area, it was noticed that there are significant differences in the road classification. Accordingly, for this Study, the available infrastructure is classified to cover all network capacities, bearing in mind the large differences in the network characteristics on the territory of the Republic of Serbia.

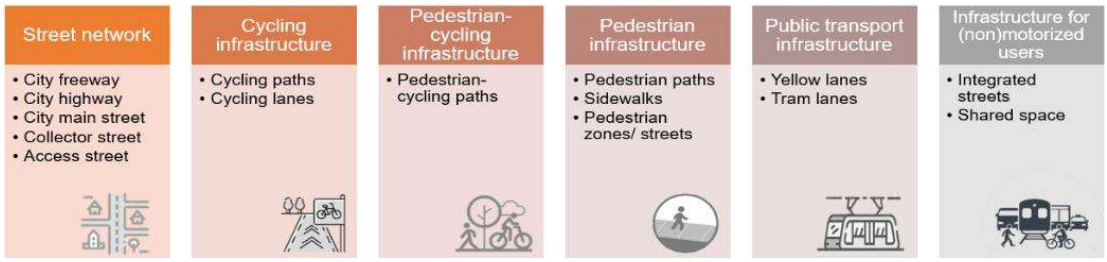

Figure 4. Analyzed infrastructure capacities defined for the Study

Based on the analysis of the current situation, expert recommendations and user attitudes, guidelines are given for the use of the presented infrastructure capacities by micromobility vehicles (Table 2). In general, it can be noticed that vehicles for micromobility can primarily be used on bicycle infrastructure, while e.g. secondary roads can be used by e-bikes, and conditionally (subject to legal restrictions) by e-scooters. It is recommended that shared spaces and integrated streets can be conditionally used by micromobility vehicles, as well as pedestrian infrastructure except for "fast" e-bikes. Infrastructure for public transport is generally not recommended for the use of these vehicles, while some areas are conditionally prohibited (city highways and yellow lanes). This leaves the possibility of changing mentioned recommendation, if the existing regulations are improved and supplemented.

Table 2. The proposed infrastructure capacities for the micromobility vehicles

Infrastructure	Vehicle category			
	E-bike „pedelec"	„Fast" e-bike	E-scooter	Other micromobility vehicles
City highway	✓	✓	✗	✗
Main city street	✓	✓	✗	✗
Collector street	✓	✓	✓	✗
Access streets	✓	✓	✓	✗
Bicycle paths, bicycle lanes	✓	✓	✓	✓
Pedestrian-cycling infrastructure	✓	✗	✓	✓
Pedestrian paths	✓	✗	✓	✓
Sidewalks	✓	✗	✓	✓
Pedestrian zones/streets	✓	✗	✓	✓
Yellow lanes	✗	✓	✗	✗
Tram lanes	✗	✗	✗	✗
Integrated spaces, shared streets	✓	✓	✓	✓

✓ - allowed use; ✗ - prohibited use; ✓ - conditionally permitted use; ✓ - conditionally prohibited use;

5. PUBLIC USE OF MICROMOBILITY VEHICLES

The public micromobility system is a subsystem of flexible public transport available to users as a public service, in which the user realizes or supplements his transport needs using the micromobility vehicles, and thus optimizing the transport process. Accordingly, in this part of the Study, proposals and recommendations related to the implementation of the micromobility system as a public service are given. In this context, several important elements considering: vehicles, stations, system organization and management and data sharing are considered.

The basic characteristics considered within the “vehicle” element include: standard vehicle dimensions and comfort, durability, attractiveness, the practicality of vehicles, safety and security and "pedestrian mode" primarily for electric scooters.

When it comes to the general characteristics of public micromobility systems, they can be divided into two groups: 1) station systems, and 2) flexible systems, where there is no network of stations but users pick up and/or leave vehicles at the locations that suit them. Following the need to provide cellular infrastructure in the case of the implementation of the first group of public systems, the Study provides important

recommendations for their installation and maintenance. Also, managing any system is unthinkable without reliable and timely information. For all actors in the system at all levels of management to have access to such information, it is necessary to clearly define the method of data management and exchange, following applicable national and international legal frameworks governing the protection of personal data.

6. CONCLUSION

The development and improvement of current regulations is a basic step in the process of integrating micromobility vehicles into urban traffic systems. It is important to note that the Republic of Serbia has a very detailed traffic-legal framework that refers to traditional modes of transport, which does not sufficiently cover and treat the area of micromobility. However, well-established legislative bases can be used as adequate support for its further improvements and additions. This step was recognized by the Traffic Safety Agency, which initiated the preparation of the Study "Micromobility Vehicles", whose methodological framework and the most important results, relating to the structural and technical characteristics of vehicles, infrastructure, and requirements for public use, are presented in this paper.

Although there are many similarities in terms of infrastructure use and regulation for micromobility vehicles in the world, each country has its local specifics in addressing this issue. The situation is further complicated because within each state, cities and local governments have the authority to adjust their regulation. For that reason, experts are facing a great challenge which is how to incorporate these vehicles into the existing transport and traffic system. The formation of precise and clear goals, harmonized with the postulates of sustainable development can greatly facilitate and guide all actors in this process, especially the decision-makers, in defining the place and role of these vehicles in traffic. The next steps include the final phase and the integration of micromobility vehicles, their management and control in the transport and traffic system of the Republic of Serbia.

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