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The development of mobility in urban areas - examples of good practices

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Abstract

Mobility development in urban centers is crucial to creating a livable and sustainable urban environment. With more and more people moving to cities every year, it is essential to have a safe, efficient, and accessible transport system. The paper examines the concept of sustainable urban mobility and analyzes the differences between traditional and sustainable transportation planning. Additionally, the main goal is to provide nine actionable proposals for developing urban mobility with examples of successful practices. By implementing the suggested actions, an urban environment suitable for living would be created, and the harmful effects of traffic as a crucial element of economic and social development would be reduced. To create a sustainable future for urban environments and lay the foundations for smart cities, it is necessary to develop sustainable concepts for urban development, reduce traditional modes of transportation, and raise awareness of environmental sustainability.

Keywords*: urban mobility, sustainable traffic, sustainable transport, sustainability*

1 Introduction

Intensive technical-technological, economic, and social development, population growth, an accelerated way of life, and many other factors, despite the benefits they bring to the population, have a negative effect on the sustainable development of cities. In this context, traffic plays a special role. In addition to all its positive sides and positive economic and social effects, it is the most important factor that negatively affects the environment of cities. Numerous data on urban traffic indicate an increasing flow of traffic and traffic congestion in cities.

Cities are networks of activity and, as such, represent a key element in the world's production, consumption, and creation of pollution and waste [1]. Today, over 4 billion people live in urban areas, and by the middle of this century, nearly two-thirds of the world's population will live in cities [2].

Traffic greatly affects the sustainability and quality of life in cities. According to the Intergovernmental Panel on Climate Change (IPCC), the transport sector is responsible for 14% of total greenhouse gas emissions globally [3]. However, in urban areas, the share of emissions of harmful gases from traffic can be much higher, due to traffic jams and the frequent stops and starts of vehicles.

Urban areas are faced with air pollution, noise, congestion, public space occupancy with traffic, and mortality rates caused by traffic accidents and pollution [3, 4]. In 2019, direct greenhouse gas (GHG) emissions from the transport sector were 8.7 $GtCO_2$-eq (up from 5.0 $GtCO_2$-eq in 1990) and accounted for 23% of global energy-related CO_2 emissions. 70% of direct transport emissions came from road vehicles, while 1%, 11%, and 12% came from rail, shipping, and aviation, respectively [3]. There is a danger that CO_2 emissions from transportation could grow in the range of 16% and 50% by 2050 [3].

In recent decades, it has become very important to reduce the impact of traffic on the environment, and this can be achieved through the planning of urban areas, taking into account all road users, both passive and active, while bearing

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in mind the ultimate goal of increasing the quality of life while reducing the negative impact.

The development of urban mobility is mentioned in the scientific literature as a solution to the previously analyzed problems in urban areas. Numerous authors deal with this issue from different perspectives [5-9]. In the paper [10], a systematic review of 62 scientific papers was given, describing 52 potential scenarios for urban mobility development until 2030.

This paper presents a proposal for nine actions for urban mobility development, as well as examples of successful practices.

2 The concept of sustainable urban mobility

Sustainable urban mobility refers to the movement of people and goods within urban areas in a way that is environmentally, economically, and socially sustainable. It involves the use of renewable energy sources, reducing pollution and noise, improving transport efficiency, encouraging alternative modes of transport such as cycling, walking, and public transport, as well as improving the infrastructure and organization of urban transport. The authors of papers [11, 12] address various aspects of sustainable urban mobility, such as climate change, integration of transport planning, and urban development, as well as the need for further research in this area. The papers mainly highlight significant challenges and opportunities in implementing sustainable urban mobility in different contexts and emphasize the need for an integrated and holistic approach to urban traffic planning and management.

Urban mobility can be viewed through three basic categories: public transport (buses, trams, trolleybuses, trains), individual transport (cars, bicycles, scooters, walking), and freight transport (trucks, freight trains, etc.) [13]. Each of these categories is a key element of functional urban mobility. As urban environments grow, so does the challenge of effectively organizing and synchronizing these elements. The increase in the number of vehicles on the road does not necessarily mean an increase in mobility. On the contrary, it results in traffic jams, congested public areas, pollution, wasted time, and, in the most extreme cases, loss of life.

Technology development has particularly affected urban mobility [10]. Various factors influence the future paths of urban mobility, including automation, sharing mobility, electric vehicles, congestion, greenhouse gas emissions, and social attitudes [10].

There is a growing demand for mobility services, including passenger and freight transport, which leads to severe problems in larger cities, such as congestion and air pollution [14]. Finding a balance between economic sustainability, environmental regulations, and travelers' needs is a key challenge for future urban mobility [15].

For years, European cities have been systematically favoring alternative modes of movement, primarily non-motorized modes of transport, that reduce the use of fossil fuels. These individual efforts of cities, have been translated into the official policy of the European Union and have become part of the so-called "Mobile Package" [16], which was adopted in 2013. The "Mobile Package" is a set of European policies aimed at reducing greenhouse gas emissions from transport and promoting alternative fuels and technologies. This package includes a set of recommendations aimed at reducing CO_2, fuel quality standards, plans for alternative fuels in Europe, and more [16]. The implementation of the "Mobile Package" in the European Union has contributed to reducing emissions of harmful gases in transport and increasing the use of alternative fuels and technologies. However, it is necessary to continue developing and implementing policies that will support sustainable mobility and contribute to the fight against climate change.

3 Difference between traditional and sustainable traffic planning

Traditional traffic planning focuses on improving vehicle flow and the faster movement of people and goods. Such planning usually does not take into account long-term environmental impacts. Traditional urban planning has not accompanied the growth of the population living and working in cities, which causes congestion and pollution in many urban areas. Sustainable traffic planning focuses on the balance between mobility, the environment, and social factors. Table 1 provides an overview of the differences

between traditional and sustainable transport planning [17].

Table 1. Difference between traditional and sustainable traffic planning [17]

Traditional traffic planning	Sustainable traffic planning
Focus on traffic	Focus on people
Primary goals: Motorized traffic flow and speed of movement	Primary goals: Accessibility and quality of life, including social equality, health, environmental quality, and economic sustainability
Infrastructure is the main subject of planning.	Infrastructure is one way to achieve wider goals.
Focus on the development of certain modes of transport (e.g., separate plans for the development of public transport, for encouraging cycling, and for building car parking).	Development of all modes of transport and transition to sustainable mobility.
Project planning	Strategic and coordinated planning
Short and medium-term planning	Short- and medium-term planning is an integral part of the long-term vision and strategy
of traffic engineers	The domain of interdisciplinary planning teams
The plan covers only one territorial unit	The plan covers the entire urban area based on people's movements

4 Action proposals for the successful implementation of urban mobility

The following are proposals for actions to successfully implement sustainable urban mobility in line with the European Commission's recommendations. Examples of successful implementation of urban mobility elements in cities around the world will also be presented.

4.1 Encouraging the use of active transportation, such as walking and cycling, through the creation of dedicated infrastructure and programs

Encouraging the use of active transportation, such as walking and cycling, can have numerous positive effects on society and the environment. Creating dedicated infrastructure and programs can be key in encouraging people to use these modes of transportation more. The reasons for promoting active transportation include reducing traffic congestion, air pollution, and noise, thereby improving the quality of life in urban areas.

Dedicated infrastructure, such as bike lanes and pedestrian zones, can be crucial in encouraging people to use active transportation more. In addition to infrastructure, programs that encourage the use of active transportation can also be helpful. For example, campaigns can be organized to encourage people to walk or bike to work or school, or to use a bike as an alternative to public transportation. Events such as bike races or marathons can also attract people and encourage them to use active transportation more. Several researchers [18, 19] suggest that human-powered micro-mobility (cycling, scootering, and walking) should dominate mobility packages.

The European Union aims to reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels [20]. One way it plans to achieve this is by encouraging people to use active transportation, such as walking and cycling, more. In May 2021, the European Commission published an Action Plan [16] for walking and cycling mobility, which aims to increase the use of these modes of transportation and improve infrastructure for them. European cities known for their well-developed cycling networks include Amsterdam, Copenhagen, Utrecht, Munich, Berlin, and Strasbourg.

4.2 Giving priority to public transportation, in order to reduce traffic congestion and emissions of harmful gases

Giving priority to public transport is an important concept for reducing congestion and harmful gas emissions in cities. This concept refers to giving preference to public transport over private vehicles in transportation. There are several ways in which cities can give priority to public transport. For example, cities can establish

special lanes for buses or trams, that allow them to bypass congestion. It is also possible to install signaling that gives priority to public transport, which speeds up the movement of public transport and improves its reliability.

In some cities, giving priority to public transport is combined with other policies, such as high parking fees or taxes on high-emission vehicles. This approach has been effective in reducing congestion and harmful gas emissions.

European cities that are particularly advanced in giving priority to public transport include Vienna, Zurich, Strasbourg, Copenhagen, Amsterdam, and others. These cities have efficient public transport networks, offer free bike rentals, low prices, or free transport for certain groups of citizens, have special lanes for public transport, and more.

There are numerous initiatives in Europe that emphasize public urban transport. Some of them are European Mobility Week [16], European Smart Cities Initiative [21], Investments in Sustainable Transport Projects [16].

The introduction of free public transport is becoming a more important part of traffic policies. For example, in the Republic of Serbia, in the cities of Knjaževac, Jagodina, and Zaječar, public transport is free for users, i.e., fully financed from the public budget. The administration of Knjaževac introduced this measure in 2015 to improve the connectivity of suburban settlements and villages with the city and to enable better access to urban functions and services for the entire municipality's population. In Jagodina, since 2019, public transport has been free for all citizens of Jagodina, visitors from other parts of Serbia, as well as foreign tourists. Since April 2019, Zaječar has been providing free public transport on local lines for all residents of that city. In all of these cities, passenger transport is provided by private companies, which are paid for their services from the local budget.

4.3 Develop comprehensive transportation plans that take into account the needs of all users, including pedestrians, cyclists, and drivers

Developing comprehensive transportation plans that take into account the needs of all users, including pedestrians, cyclists, and drivers, as well as people with disabilities and older people, means developing plans that focus on creating a balanced, efficient, and sustainable transportation system. This involves considering the needs of all transportation users and ensuring that their needs are met, not only in terms of safety and efficiency but also in terms of inclusion and accessibility.

The development of comprehensive transportation plans usually involves an analysis of existing transportation systems, population needs, strategic goals, and sustainable development objectives, as well as the development of action plans for implementation.

Comprehensive transportation plans also involve the design and implementation of physical infrastructure projects, such as the construction of bicycle lanes, pedestrian zones, public transportation, parking, and other similar facilities. These projects are designed to create a more sustainable and efficient transportation system that will be accessible and safe for all users.

When comprehensive transportation plans are successfully implemented, they can bring numerous benefits, including reducing traffic congestion, reducing air pollution, improving connectivity and mobility, increasing transportation efficiency, and increasing traffic safety. In addition, such plans can be crucial in supporting sustainable development and reducing the negative impacts of transportation on the environment.

European cities that have developed comprehensive transportation plans that take into account the needs of all users include Copenhagen, Amsterdam, Barcelona, Vienna, Stockholm, Berlin, Paris, London, and others.

4.4 Incentives for using shared mobility, such as carpooling and bike-sharing

Incentives for using shared mobility, such as carpooling and bike-sharing, can have many benefits for individuals, communities, and the environment. To reduce negative externalities and raise user satisfaction, shared mobility is identified as one of the most promising solutions for urban mobility [22]. These options allow people to share a car or bike instead of owning one, reducing the need for parking and the amount of exhaust emissions.

To encourage the use of shared mobility, various programs, and initiatives can help, such as subsidies for public transportation, discounts for

using carpooling, and bike-sharing. Another useful option is making decisions that facilitate carpooling or bike-sharing, such as designating parking spaces and using yellow lanes.

Examples of bike-sharing and car-sharing services include Uber, Lyft, BlaBla Car etc.

4.5 Promoting the use of electric and low-emission vehicles through infrastructure development

Urban mobility can be reduced by switching to low- and zero-emission modes, enhancing the role of electric vehicles [23, 24]. The use of electric vehicles directly contributes to reducing air pollution in cities. Electric vehicles do not produce exhaust gases such as carbon monoxide, nitrogen oxides, particles, and other pollutants produced by internal combustion engine vehicles such as gasoline and diesel cars. Additionally, electric vehicles can be charged from renewable sources of energy such as solar and wind energy, further reducing greenhouse gas emissions. However, there are challenges and disadvantages that still need to be addressed to achieve the wider success of this system: cost, charging infrastructure, range of electric vehicles, battery production, energy use, and recycling.

There are European initiatives to promote the use of electric and low-emission vehicles through infrastructure development. One of the main initiatives in this regard is the European Strategy for Sustainable Mobility, which was adopted in 2018 [16]. This strategy aims to develop infrastructure for electric and low-emission vehicles. The European Union has also adopted several other similar initiatives:

- The European Plan for Investment in Trans-European Energy Infrastructure (TEN-E), which includes the development of charging infrastructure for electric vehicles along European highways [16];
- The Clean Energy for EU Cities initiative, supports cities in developing sustainable transport systems, including infrastructure for electric vehicles [16];
- The Connecting Europe Facility program (CEF), finances projects in the field of transport infrastructure, including projects for the development of infrastructure for electric and low-emission vehicles [16].

To promote the use of electric and low-emission vehicles, some cities offer incentives, tax breaks, loans, and leases.

By using AVs, the transport system is expected to perform better, for example, by distributing routes efficiently [25] providing safer transportation, offering individuals without driving licenses individual travel options, boosting energy efficiency, and improving land use [26].

4.6 Formulating parking management strategies

Parking management strategies, including pricing and time restrictions, are important tools for regulating the use of public parking spaces in cities. This approach is usually applied in densely populated urban areas to reduce congestion and increase parking availability for residents and visitors. There are several different parking management strategies, with the two most common being paid parking and time restrictions. Many cities in Europe have successfully implemented parking management strategies to reduce pollution. Some of the most advanced European cities in this regard are Amsterdam, Barcelona, Stockholm, and Copenhagen. Each of these cities also implements other actions and incentives listed in this paper to reduce pollution.

By implementing strategies such as high prices and time restrictions for parking, cities can encourage the use of alternative modes of transportation, such as public transit, cycling, and walking. Cities are also increasingly considering the introduction of dynamic pricing for parking, which adjusts parking prices based on demand.

4.7 Network of safe and accessible sidewalks and bicycle paths

A network of safe and accessible sidewalks and bike paths is a system of connected sidewalks and bike paths that allow people to move through cities and towns safely and efficiently by walking or by bicycle. This network can include lanes, paths, bridges, and tunnels, and provides connectivity to key destinations in the city, such as business, educational, and residential areas, public transport, parks, and other places.

Safety and accessibility are key elements of this network, which means ensuring that sidewalks and bike paths are accessible and safe

for all users, especially children, the elderly, and people with disabilities.

A network of safe and accessible sidewalks and bike lanes can reduce travel time and costs, and improve productivity, and economic development. Also, it must be continuously maintained and expanded to ensure sustainable and safe mobility for all people in cities and towns. The cities that stand out in this regard are Copenhagen (with about 400 km of bicycle paths), Amsterdam (about 500 km of bicycle paths), Barcelona (180 km), and Portland, USA (550 km).

In the period from 2006 to 2016, through sustainable urban mobility planning, Ljubljana managed to move traffic from the city center and thus encourage the development of the center as a tourist, trade, and hospitality zone; to introduce measures to encourage the use of bicycles as a means of transportation, primarily by investing in the construction of quality bicycle infrastructure and the introduction of a public bicycle system that currently has 32,000 registered users; to improve public transport by introducing ecological buses, and to receive the title of Green Capital of Europe for 2016, in recognition of the successful management of sustainable development policy in the field of transport. The city administration claims that careful planning of the traffic policy, with ambitious goals and a clear, persistently implemented strategy, was of key importance for the success of this strategy.

4.8 Encourage a culture of active transportation and sustainable mobility through education and information programs

Education and information programs can help inform the public about the benefits of sustainable mobility and also encourage people to use alternative modes of transportation. What is even more important, these kinds of programs prepare the youngest to use the city and its resources more intelligently. Programs that target specific groups, such as school-aged children, adults, and people with disabilities, are extremely important.

4.9 Cooperation with organizations and agencies, to develop a cohesive and integrated approach to transport

Cooperation at the intercity level can lead to useful exchanges of experience. It would be useful for cities to review the needs of their users and listen to the public. Dialogue with transportation companies, transporters, and organizations can bring positive ideas. This can help improve coordination between different modes of transport, as well as increase the effectiveness of transportation policies and programs. The development of mobility in the city center is a complex and continuous process that requires the active participation of the community, government organizations, and the private sector.

Organizations and agencies that can be involved in the development of a cohesive and integrated approach to transport can be City and local authorities; transportation agencies; private companies and others. This cooperation can be achieved through various activities, such as the development of common goals; exchange of information; development of partnerships.

5 Conclusion

Observing the European cities that work intensively to change the approach in urban traffic planning, it is possible to see good practices to plan sustainable urban mobility in our environment as well. As already mentioned, there are a large number of examples of cities that have successfully implemented urban mobility policies, which has led to visible results in improving the quality of life. The positive example of Ljubljana contributed to this city winning the prestigious title of the Green Capital of Europe, and hundreds of thousands of tourists testify to the increased activity of this city for both residents and visitors. For cities that want to seriously deal with urban mobility, networking is recommended, at the level of states, regions, and beyond. As sustainable urban mobility is a concept strongly supported by the European Commission, there are a large number of European networks and initiatives that help in the exchange of experience and knowledge. In order for each of the proposed actions to be improved, researchers must direct their focus to a more detailed examination of them in order to find potential shortcomings and obstacles to their

implementation. Also, states, in line with their capabilities, should adjust their sustainability policies and propose initiatives to improve the quality of life in cities through the gradual development of urban mobility.

Acknowledgement

This research has been supported by the project "Development and application of modern methods and technologies in education and research in traffic and transportation", founded by the Department of Traffic Engineering, Faculty of Technical Sciences in Novi Sad, University of Novi Sad, Republic of Serbia.

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