**PRAKSE PLANIRANJA ODRŽLIVIH TRANSPORTNIH SISTEMA U URBANIM SREDINAMA**

**PRACTICES FROM PLANNING SUSTAINABLE TRANSPORT SYSTEMS IN URBAN ENVIRONMENTS**

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**АПСТРАКТ**

Град је место са највећом концентрацијом привредних и друштвених делатности, а градска логистика је изузетно важна, или међу основним делатностима, за одржив град и за јачање привреде града. Грађанима је потребна адекватна понуда. Гушење, загађење, бука и вибрације узроковане градским теретним транспортом смањују квалитет живота и приступачност у градовима. Савремена транспортна решења морају пре свега бити вођена принципима одрживости како би одговорила изазовима са којима се суочавамо. С једне стране, урбана подручја морају бити атрактивна места за живот, рад, куповину и провођење слободног времена, а са друге стране, урбанисти су веома свесни потребе одржавања или унапређења квалитета животне средине у центру града. Интегрисано управљање доставним возилама или организација, истраживање, анализа и доношење одлука за избор еколошки оптималног доставног возила од посебног је значаја за ефикасност транспортних услуга, за рационализацију избора превозног средства, оптимизацију транспортних задатака, да се минимизирају транспортни трошкови и заштиту животне средине. Сврха овог рада је да покаже предност и примену одрживих транспортних система у урбаним срединама, нарочито за испоруку робе.

*Кључне речи: Одрживост, урбано, транспорт*

ABSTRACT

The city is a place where the greatest concentration of economic and social activities are. And city logistics are extremely important, among the basic activities, for a sustainable city and for strengthening the city's economy. The citizens need adequate support. Pollution, noise, vibration, and suffocation caused by urban freight transport reduce living conditions and accessibility in cities. First, modern transport solutions must be guided by the principles of sustainability to meet the challenges we face. On one hand, urban areas must be attractive places to live, work, shop and spend leisure time, and on the other hand, urban planners are very aware of the need to maintain or improve the quality of the downtown environment. The integrated management of the delivery vehicle fleet or the organization, research, analysis, and decision-making for choosing an environmentally optimal delivery vehicle is of particular importance for the efficiency of transport services, for rationalizing the choice of means of transport, optimization of transport tasks, for minimizing transport costs and environmental protection. The aim of this paper is to present the advantages and applications of sustainable transport systems in urban areas, especially for the delivery of goods.

*Keywords:* *Sustainability, urban, transport*

**Introduction**

A city is not more civilized if it has highways, but when a child on a bicycle with wheels can move everywhere with ease and safety, that is way more important. An efficient transport system is one of the factors that makes urban areas competitive. It allows access to jobs, educational institutions and health care. However, in many cities people suffer from health problems caused by exhaust fumes and noise. Traffic jams waste people's time, which results in significant financial losses for the economy. Urban transportation systems with fossil-fueled automobiles consume vast amounts of energy and contribute significantly to greenhouse gas emissions. Road accidents take their toll, particularly among vulnerable groups such as pedestrians and cyclists. Last but not least, millions of poor people in cities do not have access to safe and efficient transport services – they cannot afford a car, and therefore must rely on inadequate public transport services and poor pedestrian infrastructure and cyclists. Our approach to urban mobility can be described in a few short words: the movement of people, not cars! The goal is to encourage the development of those means of transportation that are ecologically, socially and economically sustainable: public transport, walking and cycling.

**Problems resulting from the delivery of goods in urban areas**

From the beginnings of times the streets have been used for transportation of goods in cities. Road freight vehicles clearly play an important role in the functioning of cities, in distributing goods to numerous locations that are vital to urban life. These vehicles undertake a number of types of urban movement, including delivery of goods within an urban consumption zone, collection operations and delivery within an urban environment. Many goods are also temporarily stored in warehouses and warehouses in the metropolitan area before use or storage. The main goal of urban logistics is the analysis of the problems with cargo flows in cities, on the basis of which appropriate strategies and measures are given. In the cities, we have constant movement of individual passenger vehicles, cargo delivery vehicles, pedestrians, cyclists, public city transport, in order to satisfy the needs of the citizens. Delays, long queues, start-stops, release of harmful emissions from vehicles, nervousness, large number of kilometers traveled, costs for fuel, lubricant, maintenance are frequent problems. The reason for the occurrence of these problems are the superstructure, the poor condition of the infrastructure, insufficient level of integrated land use planning, the urbanization process, population growth, the large number of motor vehicles, the lack of parking, loading and unloading places, disregard of regulations, traffic signs restricting the access of cargo vehicles over 3.5 tons, this means that vehicles of 40 tons cannot be used as delivery vehicles and others.



 Figure 1. Legacy roads, congestion and delivery with heavy goods vehicles

**Proposed solutions for goods delivery in urban areas**

Among the basic solutions for these problems is recommended:

* reduction of the routes along which the freight vehicles will move,
* reducing the number of rides in the downtown area,
* a reduced number of hired freight vehicles,
* increased utilization of the vehicles,
* reduced time for the vehicle to be held at the place for loading/unloading the goods,
* change in the modal distribution of trips in favor of public transport and alternative non-motorized types of transport,
* it is highly recommended to have a goods-transportation center on the outskirts of the city, from where the goods will be distributed to the rest of the zones with smaller, environmentally friendly vehicles. Shown in figure 2.



Figure 2. Proposed solution for goods delivery in urban areas

**Selection of vehicles for goods delivery in urban areas**

To choose an optimal delivery vehicle, means that one or more of its properties allow appropriate constructional and technical - operational requirements:

* Construction properties of the vehicles: dimensions (length, width, height, wheelbases), engine power, number of revolutions per minute, maximum torque, maximum speed, etc.)
* Technical - operational properties such as: load capacity, dynamic properties, stability, etc.
* Safety,
* Fuel Efficiency,
* Clean and quiet vehicle.

**Safe urban delivery vehicles**

The Citan Mixto is a complete hit in terms of safety. An urban delivery vehicle with compact dimensions and a large cargo space, which perfectly meets the various challenges of the city. Its efficient engines with Blue EFFICIENCY technology and a consumption of 4.3 l/100 km, long service intervals as well as attractive conditions. On the limited city street network you benefit from its compact maneuverability, and on regional roads or on the highway its traction can be fully enjoyed. One of the diesel engines with a strong torque of 55 kW (75 PS), 66 kW (90 PS ) and 81 kW (110 PS) or a modern petrol engine with 84 kW. Easy loading and unloading is also its advantage, as is the flexible use of its high transport capacity. Also in terms of safety, the Citan vehicle is a leader: with ADAPTIVE ESP, brake assist and the ABS braking system impresses with short braking distances - even in wet conditions. The suspension with independent damping maintains a reliable contact with the road. When it matters, the three-height adjustable seat belts with pretensioners and belt force limiters give you very good back support. In the case of sudden braking, the turn signals are automatically activated. As standard, the Citan vehicle is equipped with an airbag for the driver, daytime running lights and hill start assistance. Passenger airbag and thorax airbag options can significantly reduce the risk of injury in accidents. Therefore, assistance such as a light and rain sensor, a tire pressure monitoring system and a reversing camera, which displays the area behind the vehicle on the rearview mirror, are available on request. Despite the great appeal of the Citan vehicle, with the optional anti-burglary and anti-theft system, you can be sure that your vehicle will not fall into the wrong hands.

Table 1.

|  |  |
| --- | --- |
| Length of the body [mm] | 3937 |
| Vehicle turning radius Ø [m] Wheel turning radius Ø [m] | 10,13 / 9,6 |
| Capacity of the cargo space [m3] | 2,4 |
| Length of the cargo area [mm]1 | 1369 |
| Allowed total towing weight [kg] | 2860 |



Figure 3. Choice of safe urban delivery vehicle – Citan Mixto

**Clean Urban Vehicles: Environmentally Friendly**

It is known that the largest number of identified air pollutants originate from the transportation system. Motorized vehicles require energy generated from a fuel (e.g petrol, diesel, electricity, natural gas, biofuels) to move. But the high temperature burning of fossil fuels in engines releases air pollutants and CO2 into the atmosphere. The impacts of transport on human health, the environment and climate change are closely linked to fuel choices. Clean alternative fuels, including electricity, are already available and can represent sustainable options for gasoline and diesel. The length of the trip plays a role in determining the appropriateness of the fuel type. For example, electric power may be more suitable for passenger cars in urban areas or for those making shorter journeys, while for goods delivery trucks they should be of suitable overall dimensions, small, economical and clean, which will use non-polluting fuels, electric or bicycles. Small autonomous electric delivery vehicles are expected to transform freight transport in the first and last mile. The demand for delivery of goods in cities is increasing rapidly, especially because of growing e-commerce. An increase of 78% is expected from today until 2030. Without action, shipping-related carbon dioxide emissions could increase from 19 to 25 million tons over the next ten years. Recent advances in electrification and automation are expected to reduce emissions by up to 67% by 2030. Small autonomous electric delivery vehicles, which are the focus of the GLAD project, are expected to transform freight transport during the first and last mile. The benefits are increased transport and energy efficiency, but it's also important that these vehicles are safe and accepted in society. Re:volt , a compact, strong and modular delivery van, developed to meet the demand for sustainable last mile transportation in cities. A new roof of solar panels makes it energy efficient enough to eliminate the need to charge when the sun comes out. The Re:volt's clean, functional and modular construction design means that the vehicle can be easily configured to the customer's wishes. The range will be up to 400 km with 100 km per day from just the sun with the roof made of solar panels.



Figure 4. Small Autonomous Electric Vehicles

**Quiet vehicles**

Modern cities also embrace a more diverse mix of land uses, manufacturing, commercial and residential areas/neighbourhoods. These changes are making the neighborhoods more sensitive to noise. Activities associated with moving goods - diesel truck gaps and the act of loading and unloading goods - are usually major sources of noise. Because excessive noise can impair the overall quality of life for city dwellers, noise impacts also constrain goods movement strategies that attempt to shift deliveries to overnight periods. Noise is an integral characteristic of transportation. Noise is basically unwanted sound. An acoustic measure of the intensity of noise is the decibel (db) ranked on a scale of 1db to 120db. 0 db can hardly be felt by a person, while 120 db leads to a feeling of pain. Measurements are most often given as db or Leq when a time period is involved. Leq is the average noise level in db, over a given time period. That noise level is from 6 a.m. to 10 p.m., which corresponds to a period of the day when most of the activities take place. The use of electric drive will allow the trucks to be quieter and do not pollute the air, which will contribute to their being able to be used in the center of the cities, where conventional tow trucks are often forbidden to access. These means of transport will be able to be used during periods of the day when there is no traffic congestion – for example, late in the evening or during the night. Alke electric commercial vehicles are road approved, very small and incredibly maneuverable on narrow roads and on hills. A perfect solution for those who will deliver goods while respecting the environment. This type of vehicle can be used widely within residential areas, tourist structures, parks and golf clubs, as well as in airports and civic or commercial structures without disturbing visitors or those working there. Its performance is: extremely compact, approach, zero CO2 emissions and noise emissions, load capacity up to 1630 kg, vehicle width 127 cm.



Figure 5. „Alke" Electric Delivery Vehicle

**Use of bicycles for delivery of goods in urban environments**

As can be concluded from the analysis above, cargo bikes are used in a large number of metropolises for the transportation of cargo in the central city areas. Their features are:

*Benefits:*

 - Healthy for the environment - reduction of the negative impact of transportation on the environment;

- Low cost of transportation;

- Economically and professionally most acceptable for transportation;

- Practical-slim, fast and able to slip through the narrowest passage, the bicycle will turn into an ally that saves you time, and you will avoid expensive parking lots;

- Cost savings in comparison to fuel, maintenance and insurance of cars; - Made of high quality materials, which ensure the necessary safety and comfort during driving;

- Intended loading of the traffic roads;

- Low costs for maintenance and repairs of bicycles;

- Mobility for everyone, regardless of age and income, there is no need to have a driver's license, apart from knowing the rules and regulations for driving;

- The bicycle as a means of transporting goods or for recreation is good for health, reduces stress, kilograms, blood circulation;

- Integration with electronic ordering, instead of trucks, cargo bicycles can be used for short distances and small loads;

- Transportation from door to door;

- Comparatively low investments;

- It is environmentally friendly, it does not create noise and does not require large areas for movement and parking;

- Simplicity of information systems when moving goods by bicycle;

- The lack of sophisticated technologies when using a bicycle significantly reduces the costs of handling cargo;

 *Disadvantages:*

- Due to the lack of infrastructure, it makes impossible the widespread use of cycling;

- Unfavorable conditions for the work of the bicycle drivers;

- Absence of protection on the cyclists' market from unfair competition;

- With electric bicycles, we have battery discharge, with other bicycles, driver fatigue appears;

- Adverse weather conditions (ice, snow, mist, rain, wind);

- Unfavorable road conditions - hills;

- The setting up of various urban designs that are an obstacle for cycling; - Reduced security due to the sharing of the infrastructure with other types of traffic;

- Reduced accessibility due to incorrectly parked vehicles;

- Transportation of a small amount of cargo in comparison with other vehicles;



Figure 6. Cargo bicycle

**Practices from around the world for choosing the optimal means of transport in urban environments, the bicycle**

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Figure 7. Practices from around the world for choosing the optimal means of transport in urban environments, the bicycle

**CONCLUSION**

Increasing urbanization and high population growth, combined with complex demand, create constant pressure on urban areas around the world. Although the subject is often neglected, it is at the heart of numerous urban challenges, such as traffic safety, congestion, air pollution, noise and the contribution to CO2 emissions. A realistic and influential goal is to start solving legal challenges, with a focus on zero air pollution, for this purpose, the development of alternative ways to deal with, solve and implement sustainable solutions is needed. Transportation is one of the most difficult and complex sectors for transformation. It's not just about replacing fossil fuel-powered trucks and vans with a zero-emission alternative. A deep re-design of the system is required that will influence and involve all stakeholders. Of particular importance when choosing an optimal delivery vehicle are its maneuverability, overall dimensions, age, being quiet, clean for the environment, having good sensors for increased safety, and others. An urban, safe and green city with attractive streets for social activities, quality surroundings and surroundings and healthy and active citizens for whom walking, cycling and using public transport is the first choice for their daily trips in the city with an efficient, safe transport system, without barriers and supplemented with environmentally friendly urban logistics, freight transport and private cars. As solutions can be applied: grouping of orders, optimization of the route and night deliveries, drones that will work better in widespread cities where there is a lot of space to land, electric vehicles because they are quieter and do not cause emissions, goods from multiple suppliers can be divided into fewer shipments, because it is possible to optimize the loads and truck sizes, night deliveries will reduce congestion during the day and allow suppliers to use larger trucks, reducing the number of deliveries and reduce costs up to 50%, the introduction of "inter" urban independent systems for transporting goods. Vehicles that are small, light, silent, safe, with low emissions can be used in cities, such as bicycles, Citan Maxto, Piaggio Commercial and others.

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