

## PREVENTING URBAN TRANSPORT PROBLEMS THROUGH THE USE OF SUSTAINABLE AND SMART LOGISTICS

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### Abstract

Transport communication problems in cities are becoming more and more frequent phenomenon. The constantly increasing level of congestion in cities negatively affects the natural environment and significantly increases the transport, operating or operating costs of companies providing transport services. Transport problems in cities are its indispensable element, while a rational approach to solving or limiting them affects the efficiency of the work of the city and processes occurring in it. The aim of the work is to identify the causes of transport problems in cities, present their effects and show ways to counteract them through the use of sustainable and intelligent logistics. Research tools such as analysis, synthesis, generalizations and comparisons were used to verify the goal.

**Keywords:** Smart logistics, sustainable logistics, transport problems, urban problems, city logistics

### 1. INTRODUCTION

Transport problems in cities are becoming more and more common. The constantly increasing level of congestion in cities has a negative impact on the environment and significantly increases the transport, operating and operating costs of companies providing transport services. Transport companies are still unable to put in place a uniform system to identify events in cities or to inform users about travel conditions, with the consequent constant loss of travel time. An important factor of improvement of the above-mentioned phenomena is appropriate planning of processes managing urban public transport traffic.

In this paper, the author focuses on the causes of transport problems in cities, pointing out which problems can be identified, showing their effects and ways of counteracting them at the same time. The congestion, which is the main transport problem in cities, is widely described. Due to its effects, every functional aspect of cities is worsened.

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### 2. TRANSPORT COMMUNICATION PROBLEMS

City transport problems can be divided into categories that in a simple and area-like way group negative effects on the functioning of cities:

- problems related to transport in the city (causes) [1,2]:
  - increasing traffic,
  - burden on transport infrastructure, including significantly low capacity of urban road systems and the imposition of transit traffic on internal traffic,
  - commuting from non-urban areas to work,
  - daily truck operations (perceived as an inconvenience rather than a key service for a city,
  - inadequate planning and coordination of vehicle traffic,

- Insufficient integrated transport systems,
- the low potential of transport links with policy and regulatory initiatives,
- small amount of transport performed in the special range,
- Insufficient inventory control, product availability and customer service,
- lack of regulation of relations between suppliers and suppliers,
- complicated structure of road administration,
- operational complexity resulting from different storage and handling requirements for a wide range of products,
- problems caused by transport (effects) [3, 4, 5]:
  - congestion (congestion of urban roads and inlet/outlet roads to urban areas),
  - threat to the safety of traffic participants, including unprotected groups of traffic participants - pedestrians and cyclists (drastic lowering of technical standards of roads and engineering facilities (poor technical condition) and other equipment of land infrastructure built into road lanes;),
  - noise and shocks,
  - negative impact on the environment and society,
  - urban effects:
    - a waste of time in pedestrian traffic,
    - consumption of urban space for cycling,
    - spatial competition between trucks, cars and pedestrians,
    - time competition between passenger cars and commercial vehicles,
  - distortion of the structure and surface of the city,
  - reducing the competitiveness of public transport in relation to individual road transport.

The first group of problems related to transport is caused directly by the functioning and behavior of residents and institutions of enterprises operating in the city. The psychology of the city's functioning indicates the demand, without which the inhabitants and entrepreneurs would not be able to function efficiently today.

The negative impact of transport on cities is not new, but increased with the development of urban systems. This is mainly due to the fact that the development of lorries, which flow goods to and from the city, in or through the city, competes with both private and public passenger transport for limited road infrastructure resources. Their presence on the streets of cities contributes to the increase of air pollution [6].













Living in large urban agglomerations is comfortable and beneficial. Residents, however, also face many problems, such as the provision of housing and social buildings, urban transport and its effects, the heating of housing, the provision of water to residents, wastewater treatment plants, the disposal of waste and street cleaning, as well as the provision of adequate air quality. Urban problems are mainly related to development, creating undesirable phenomena such as the transport congestion [7], which is a chronic phenomenon of increased traffic density in infrastructure with insufficient road capacity [8]. The congestion is difficult to eliminate due to spatial limitations of infrastructure in cities, or a significant increase in traffic after the modernization of sections affected by the congestion [9].

The most common causes of congestion are: underinvestment in transport and its infrastructure, differences between social and private transport costs, road maintenance or modernization. Therefore, most often the congestion occurs in places with insufficient capacity called "bottlenecks" or in places which are not "bottlenecks" but which, as a result of the primary congestion, are congested secondary to congestion because the traffic bypassing the critical section is directed to other places causing the capacity to be exceeded there

as well, this type of congestion can be called secondary [3]. The factors that intensify the congestion effect may include a number of factors, i.e.: an increase in the number of people living in cities, an increase in the number of vehicles in cities, an increase in the number of shops for residents, a tendency to reduce warehouse space at the store, an increase in the popularity of local shops, a lack of unloading and loading infrastructure, the development of e-commerce contributing to an increase in the number of deliveries to individual customers' homes, modernization and expansion of transport infrastructure [10].

The following types of congestion are present in urban infrastructure (see **Table 1** for an illustration of the types of congestion) [11,12]: a single interaction where two vehicles cannot run smoothly over a given road section; multiple interactions arise between multiple vehicles and occur at a higher traffic level when at least 50 % of the capacity is used; bottleneck, causes congestion at points or sections of the road network where infrastructure capacity is lower than on the surrounding network. A condition for this type of congestion is the condition in which the number of vehicles intending to drive a given section, where there is a bottleneck, exceeds its capacity; triggerneck, a situation where a congestion or congestion caused by bottlenecks begins to hinder traffic on other sections, usually on sections crossing a fragment of infrastructure where a bottleneck congestion is already present; gridlock, means stopping the traffic of the entire road network in a given area, e.g. in the city centre; congestion caused by the operation of traffic control equipment including traffic lights, level crossings with barriers, etc.

**Table 1** Types of congestion occurring in cities [own study based on graphics.google]

Type of congestion	Scheme	Graphical representation
a single interaction		
multiple interactions		
bottleneck		
triggerneck		
gridlock		
congestion caused by the operation of traffic control equipment including traffic lights		

The impact of the congestion on the city is mainly cost-related. Increasing congestion in the cities causes an increase in the costs of city services, as well as consequences in the emergence of other transport problems [13]. The solution to some consequences of congestion is e.g. introduction of telematics systems which, through the use of appropriate algorithms, manage traffic lights [14].

Another problem, which is caused by transport in the city, is the threat to widely understood safety [15]. This includes numerous accidents and their consequences, and pedestrians and cyclists are particularly exposed to hazards [16].

The consequences of increased demand for transport are noise and shocks in cities. They are particularly burdensome for residents on major streets and inner-city sections leading to expressways, motorways, discomfort for residents, deterioration of their quality of life and accelerated destruction of buildings and structures in the city. Noise perceptible from 40 to 60 decibels, typical for average traffic, is harmful to health [17]. The origin of noise depends not only on the type and technical condition of vehicles, but also on the roads on which they move. Road transport contributes significantly to the emergence of environmental threats. In road traffic, harmful substances are released into the environment. As well as the use of brakes, clutches and tires. These factors have a negative impact on human health and local natural environment and cause deterioration of the quality of life in a given area [3,18].

The next problem is spatial intruding of the area development, distortion of the structure and surface of cities. This is manifested by the need to provide infrastructural space for the construction of appropriate wide transport routes, parking lots, as well as places for transshipment, storage and parking. This often destroys the image of the city. Moreover, the harmful impact of transport on urban infrastructure is expressed in the fact that the elements of the city's transport infrastructure (bridges and streets) are highly burdened by the weight of vehicles. As a result, biodiversity is lost by occupying valuable natural areas and cutting their continuity with newly built roadways [19].

### 3. SUSTAINABLE AND INTELLIGENT LOGISTICS

The above-mentioned communication problems of cities are constantly growing through the continuous development of many social, technical and organizational aspects. It is therefore necessary to implement appropriate solutions available on the market to optimize and improve the processes in cities. **Table 2** shows the causes of the problem and, at the same time, indicates the effect of the problem and proposes measures for effective logistics as a means of preventing the emergence of specific transport problems. Municipal representatives should take appropriate measures to reduce or eliminate the undesirable effects of transport problems in cities.

**Table 2** Specification of problems caused by transport in cities [own study]

Problem	Cause	Effect	Solution
congestion	<ul style="list-style-type: none"> <li>increased urban congestion</li> <li>increase in the number of vehicles</li> <li>increase in the number of accidents</li> <li>Numerous road upgrades</li> <li>increasing the number of pedestrians (pedestrian crossings)</li> <li>increase in the share of individual transport at the collective cost</li> <li>uneven distribution of daily traffic and weekly traffic (weekend peak)</li> </ul>	<ul style="list-style-type: none"> <li>loss of travel time</li> <li>urban congestion</li> <li>increased pollution of the environment</li> <li>increasing the number of road accidents</li> </ul>	<ul style="list-style-type: none"> <li>reduction of car traffic in cities</li> <li>modernization of transport infrastructure</li> <li>more efficient use of existing infrastructure (ITS)</li> <li>the introduction of the car pooling and car-sharing concept</li> <li>effective management of traffic lights (SCATS, green wave)</li> <li>Intelligent lanes</li> <li>changing the driving culture of drivers</li> <li>improving the functioning of urban transport</li> <li>reduction of the number of parking spaces in the city centre (Park&amp;Ride)</li> <li>construction of interchanges</li> </ul>
safety emergency	<ul style="list-style-type: none"> <li>increase in the number of vehicles</li> <li>reckless driving</li> <li>bad road signs</li> <li>inadequate light signaling</li> <li>permanent obstructions to traffic</li> <li>lack of sufficient concentration of drivers</li> </ul>	<ul style="list-style-type: none"> <li>increase in the number of road collisions</li> <li>increase in the number of accidents in the city</li> <li>congestion</li> </ul>	<ul style="list-style-type: none"> <li>the introduction of urban traffic restriction zones</li> <li>the introduction of ITS systems</li> <li>improving the labelling of cities</li> <li>community actions</li> <li>restrictive rules as to the technical condition of the vehicle</li> </ul>

Problem	Cause	Effect	Solution
	<ul style="list-style-type: none"> <li>failure of the vehicle braking system</li> <li>malfunctioning light signaling</li> <li>Incorrect road lighting</li> </ul>		<ul style="list-style-type: none"> <li>improvement of linear infrastructure of cities</li> <li>the creation of lanes for bicycles and special vehicles</li> <li>promoting walking and cycling</li> </ul>
noise and vibration	<ul style="list-style-type: none"> <li>poor technical condition of vehicles</li> <li>the absence of specific noise checks on vehicles</li> <li>poor road infrastructure</li> <li>absence of noise abatement devices</li> </ul>	<ul style="list-style-type: none"> <li>decrease in residents' satisfaction</li> <li>restrictions on the establishment of recreational parks</li> <li>impact on the construction of buildings</li> </ul>	<ul style="list-style-type: none"> <li>the introduction of electric vehicles</li> <li>the introduction of noise abatement curtains</li> <li>Restricting the movement of vehicles</li> <li>improving the condition of road surfaces</li> <li>modernization of vehicles (introduction of noise abatement devices)</li> <li>introduction of communication lines in tunnels or excavations (natural sound barriers)</li> </ul>
negative impact on the environment	<ul style="list-style-type: none"> <li>above-average concentration of exhaust gases in the air</li> <li>greenhouse gas emissions</li> <li>vehicle waste</li> <li>Car leaks (petrol, oil, grease)</li> </ul>	<ul style="list-style-type: none"> <li>increasing the number of poisonings of inhabitants</li> <li>water pollution</li> <li>soil contamination</li> <li>air pollution (smog)</li> </ul>	<ul style="list-style-type: none"> <li>the introduction of electronic vehicles</li> <li>limiting access of combustion vehicles to the city centre</li> <li>rational urban planning</li> <li>construction of exhaust gas emission absorbers</li> </ul>
urban effects	<ul style="list-style-type: none"> <li>urban fragmentation</li> <li>lack of accessible cycling and walking infrastructure</li> <li>the growth of heavy goods vehicles in cities</li> <li>temporal and spatial competition between heavy goods vehicles and passenger cars</li> </ul>	<ul style="list-style-type: none"> <li>decrease in attractiveness of cities</li> <li>more congestion in cities</li> <li>increase in travel time through the city</li> <li>increased number of accidents involving pedestrians and cyclists</li> </ul>	<ul style="list-style-type: none"> <li>rational design of bicycle and pedestrian paths</li> <li>the introduction of a night-time delivery system</li> <li>the introduction of telematics solutions</li> <li>development of appropriate algorithms for managing urban transport vehicles traffic</li> </ul>
distortion of the city	<ul style="list-style-type: none"> <li>bad spatial infrastructure of the city</li> <li>poorly located manufacturing and service companies</li> <li>loading of bridges and streets</li> </ul>	<ul style="list-style-type: none"> <li>decrease in attractiveness of cities</li> <li>limiting the development of the city</li> <li>limiting urban development</li> </ul>	<ul style="list-style-type: none"> <li>rationalization of investment activities</li> <li>designing cities in accordance with the relevant concepts</li> <li>reconstruction or modernization of line infrastructure</li> <li>rational development of the city</li> </ul>
reducing the competition of public transport	<ul style="list-style-type: none"> <li>increase in demand for passenger cars</li> <li>increased transport needs (choice of individual means of transport)</li> <li>lack of adequate bus infrastructure in cities</li> <li>inadequate timetables for passengers to meet the needs of residents</li> </ul>	<ul style="list-style-type: none"> <li>the increase in congestion in the city</li> <li>higher transport costs</li> <li>congestion in urban bus transport</li> <li>decrease in the number of passengers</li> </ul>	<ul style="list-style-type: none"> <li>Introduction of bus lanes</li> <li>the introduction of bus traffic optimization systems</li> <li>the introduction of bus traffic control systems</li> <li>periodic surveys of the facts with regard to the planned bus journeys</li> <li>actions promoting public communication</li> </ul>

Transport problems in cities are its indispensable element, while rational approach to solving or limiting them affects the effectiveness of city work and processes taking place in the city. The **Table 2** shows only possible solutions that can be used to eliminate particular problems.

#### 4. CONCLUSION

The article presents transport problems of cities, which have a negative impact on their inhabitants. Daily functioning in urban areas is becoming more and more difficult every year. City problems are also related to



public transport, where vehicles travel hundreds of kilometers on the streets every day in order to transport residents from the starting point to the end point of their travel destinations. From the point of view of intelligent and sustainable logistics, the proposed solutions to the problems should be flexible and mobile enough to bring tangible benefits. The restrictive measures visible in the article are in most cases repeated in many of the problems that arise. Thanks to the analysis it can be stated that the key aspects are: introduction of additional lanes (bus lanes), use of alternative (electric) drives, introduction of telematic solutions (algorithms, intelligent traffic lights), investment in pedestrian and bicycle traffic, reduction of goods delivery during the day and modernization of road infrastructure. The presented solutions are only a proposal for effective counteraction of undesirable phenomena. Through the use of sustainable and intelligent logistics, there is an appropriate opportunity to effectively reduce transport problems in cities.

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