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**The solutions for
improving the urban
transport system based
on resident surveys**

1. Introduction

The aim of this paper is to present solutions to improve the urban transport system based on resident surveys of medium size cities. The research is related to the expectations of residents towards solutions to improve the urban transport system.

The subject of research of city logistics is the issues of intentionally organized and integrated flow of materials, people and information in an agglomeration. These problems include among others: the issue of the city communication accessibility, supplying the commercial objects, supply of water and energy, sewage disposal, waste utilization, construction and maintenance of telecommunication networks and environmental protection - ecological aspects.

Many different definitions of city logistics can be found in literature (Taniguchi, et al. 2001, pp. 14-15; Würdemann 1992, p. 5; Stabenau 1993; Soltysek 2001, p. 17; Szoltysek 2005, p. 93; Ihde 1991, p. 42; Wittenbrink 1992, p. 7; Benjelloun, Crainic 2009, p. 45; Klatte 1992, p. 90; Hesse 1992, pp. 21-22). According to some researchers, the definition of city logistics applies only to freight transport (Benjelloun, Crainic 2009, p. 45; Taniguchi and R.E.C.M. van der Heijden 2000, pp. 65-90; Würdemann 1992,

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p. 5). Increasingly, however, the definitions of city logistics include not only freight but also passenger transport (Klatte 1992, p. 90; Hesse 1992, pp. 21-22; Szoltysek 2005, p. 93; Witkowski, Kiba-Janiak, *Correlation...* 2011, p. 641).

City logistics can be defined as planning, implementation and monitoring of economic efficiency and effectiveness of people, freight and relevant information flows in urban areas in order to improve the citizens quality of life (Witkowski, Kiba-Janiak, *The role...* 2011, p. 2).

One of the most important goals is the consolidation of transport streams, connection into a single controllable whole of business entities and institutions which are concerned with movement and act within the city area, as well as the event network management in a way providing a desired level of life quality and the city management at a minimum cost level in consideration of ecological standards (Szymczak 2006, p. 81). The coordination also includes an appropriate organization of municipal services provided for business entities and the people. Another important goal is the reorganization of in-city relations to achieve a stable balance between space and transport within this space. It may be accomplished by relevant planning, organization and management (Tundys 2008, p. 160). The Process of integration goes beyond a simple linear structure (Vidová, Urdziková, Molnárová 2008). Creating new cooperative agreements, which are also new challenges for logistics management flows, includes flows of people and goods in cities. Extensive cooperative agreements are leading to the transformation of logistics chains into logistics networks (Baňasová, Čagáňová, Čambál 2010). The equivalent of which could be cities or urban areas. Depending on the network, logistics may be operational or strategic, and the network may have different geographical coverage (Jakabova, Hrablik Chovanova, Urdzikova 2010). Management of urban structure in the network system requires significant logistical competence. The experience gained in managing complex logistics chains can also be transferred to other areas of human activity (Lenort, Feliks 2010).

Urban transport infrastructure consists of the following groups of elements that make up the city transport network (Ciesielski, Długosz, Gługiewicz, Wyszomirski 1992):

- streets, including all permanent facilities serving to control traffic and pedestrians,
- subway tracks, trains, trams,
- power supply network for overhead metro, railways, trams and trolleybuses,
- power substations (transformers),
- railway stations and bus stops,
- car parks,

- bus and tram depots,
- garages for local cars and trucks (off the city streets),
- cargo loading facilities.

The development of urban transport networks, especially in city centre areas, faces considerable limitations. This is due to the nature of the construction, which makes it difficult to expand the network, as well as unstructured underground infrastructure connections such as gas networks, water supply, sewerage and telecommunications. Thus, city centre areas are increasingly limited to private car transport, which from the standpoint of the city is an extremely irrational means of communication (Suchorzewski 1975, p. 70), which is the cause of congestion, air pollution, noise, etc. However, in accordance with the principles of sustainable development, logistics should strive to maintain a balance between social, economic and environmental footsteps (Skowrońska 2009). City logistics is becoming particularly important, not only because the concept of sustainability is inextricably linked with the problems of cities, but also because an ever increasing number of people live in cities (Witkowski 2010, p. 334).

Passenger flows are not the only flows occurring in modern cities. In addition to passenger flows there are also many flows connected to all kinds of cargo transportation. Hence the need for research to improve the functioning of urban logistics, including the identification of problems and determination of the directions of development of transport infrastructure (Kiba-Janiak, Cheba 2010, p. 8). The aim of the implementation of logistics functions is to increase the quality of life for residents and businesses, working to improve flows while eliminating unnecessary traffic, reducing the shipment times, reducing inventory and lowering prices for city services (Witkowski, Kiba-Janiak 2011, p. 642).

2. Ways to improve urban transport system infrastructure

Of particular importance for the proper functioning of the urban transport system is the proper organization of traffic in critical points such as intersections. Location of intersections relative to fixed objects must therefore be well thought out and well laid out. The aim should be to ensure that the crossings are tiered and collision-free, but in existing cities that is a complex task because of the widespread lack of space and building conditions. In the case of difficulty in the location of collision free junctions, particularly sensitive places should be equipped with traffic lights regulating the traffic. In planning to improve the operation and modernization of transport infrastructure in the cities, many

elements should be taken into account, especially: (Szołtysek 2007, p. 70):

- selection of major traffic routes, or prioritization of specific transportation arteries,
- balanced and maximum possible use of bandwidth of all the major network elements, ie transportation hubs and arteries,
- construction of a basic network of communication in the form of closed loops,
- obtaining a transparent system of communication networks inside the city, organically bound with the general concept of the city and visual adaptation to the terrain,
- measures to improve access to public transport,
- increasing the frequency of traffic, which will shorten the waiting time for public transport passengers. This can also be obtained by concentrating a sufficient number of so-called. traffic generators, ie, clusters of jobs, services centers and residences along the route,
- increase the speed of travel, which is dependent on the technical condition of transport infrastructure, traffic arrangements on the route and location of stops,
- differences in distribution of sources of transport needs arising from the location of housing estates, factories and service, cultural, scientific or administrative centers,
- focus on the requirements of environmental protection which should be the primary objective, particularly in urban areas.

A very important issue is for public transport to meet the requirements of disabled people. The main tasks required include (Meyer 2004, p. 8-11):

- introduction of low floor vehicles or those that have a platform designed specifically for people with disabilities,
- adjustment of public transport,
- introduction of ISO standards in the handling of people with disabilities,
- aspiration in absolute terms to the enforcement of penalties for improper parking of vehicles in places designated for the disabled,
- providing readable and clear information about each stage of the journey, so that disabled people feel safe and secure.

An equally serious problem in passenger communication infrastructure is the lack of a proper structure of cycle paths, especially in large cities. Many problems are associated with the construction and development of cycling routes, which requires adapting the existing infrastructure (existing roads, sidewalks, alleys, paths, bridges, viaducts, etc.) so as to ensure the safety of all road users.

An example of the use of bicycles in improving movement within the city is Cracow, which was one of the first cities in Poland to organize a self-service bike rental scheme.

In order to cover distances in a city on foot in a comfortable way, it is necessary to modernize the city infrastructure, which includes (Szołtysek 2007, p. 76):

- creating consistent systems of pedestrian precincts,
- installing posts that separate pavements from roads and which secure pavements against being blocked by the parking vehicles,
- eliminating the division of space into roads and pavement on local streets,
- broadening pavements,
- improving night lighting of pedestrian precincts,
- creating the guiding lines for the blind or visually impaired,
- installing devices facilitating the movement of the disabled,
- modernizing pedestrian precincts and squares,
- creating places of transition from pedestrian means of covering distances to the mechanized means of transport,
- providing signposts for pedestrians.

The quest for integration, both in passenger and goods flows, and the desire to achieve integration of the management of these two flows have an effect on their organization, which invariably would seek to optimize them - high level of service, low cost and short time. Achieving integrated management of flows would allow better control of them

3. Results of surveys conducted in Gorzów Wlkp., Jelenia Góra i Zielona Góra

The aim of the research project is to develop a reference model including the real city logistics flows and the sphere of controlling and interaction. The survey included three medium-sized cities: Gorzów Wielkopolski, Jelenia Góra and Zielona Góra. So far within the research project, based on secondary data, the diagnosis of logistics systems in cities and the evaluation of quality of life has been conducted. The surveys were also conducted on a sample of 1600 people in three surveyed cities. The survey was the first part of the second step of the research conducted between January and March 2011. Cities selected for the study are located in the western part of Poland. The sample was a stratified quota sample selected with the following criteria: gender (male, female); age (up to 35, 35-60, 60 plus).

The survey research provides information about the correlation between city logistics and the quality of life and also assesses these both aspects. In this paper author presents only a small part of survey research results.

Almost half of respondents in Zielona Góra (46.4%) and more than half of the population of Poznan (59.30%) believe that access to public transport had

an impact on the choice of location of a flat/house. For the inhabitants of Jelenia Gora, access to public transport was also an important element in the choice of residence (table 1).

Table 1. Was access to public transportation an important aspect for you in the selection of the current location of your flat/house?

Town	Jelenia Góra	Gorzów Wlkp.	Zielona Góra
Response	Percentage	Percentage	Percentage
Quite important or very important	35,70%	59,30%	46,40%
Not very important or not important at all	39,20%	24,80%	28,60%
Hard to say	25,10%	15,80%	25,00%

Source: own study based on the research

The next question concerned the evaluation of travel time by city public transport in comparison to travel by car. According to the vast majority of respondents in all three cities, public transport travel time is longer than the collective travel time through the city by car (table 2).

Table 2. According to you, how does the journey time by city public transport compare to travel by car?

Town	Jelenia Góra	Gorzów Wlkp.	Zielona Góra
Response	Percentage	Percentage	Percentage
Significantly slower	47,40%	46,20%	53,10%
A little slower	38,30%	40,50%	34,20%
The same	8,80%	8,90%	9,30%
A little faster	4,80%	4,00%	2,00%
Significantly faster	0,80%	0,30%	1,40%

Source: own study based on the research

When asked: Why don't you regularly use public transport? Over 60% in Zielona Gora- two thirds of respondents- said they prefer to travel by car (for both private and business travel). This indicates a dangerous trend in the

number of private vehicles, which in future will increase congestion and traffic problems. Other responses are presented in table 3.

Table 3. Why don't you regularly use public transport?

Town	Jelenia Góra	Gorzów Wlkp.	Zielona Góra
Response	Percentage	Percentage	Percentage
1. Prefer private transport for personal / work travel	64,6%	64,4%	66,7%
2. Prefer walking / cycling	18,9%	11,5%	13,9%
3. Public transport is not convenient, ie no regular connections	13,4%	16,4%	11,7%
4. Public transport is too slow	15,9%	14,4%	11,4%
5. Travelling with a load	11,0%	10,3%	6,8%
6. Public transport is expensive	5,5%	8,9%	4,4%

Source: own study based on the research

There is not a clear answer for the reasons for avoiding public transport, although several percent of respondents indicated a lack of regular service. A similar number of people pointed out the long travel time. It appears that residents of medium-sized cities with a relatively small scale of congestion and not experiencing problems with the level of private car mobility in the city is not inclined to seek alternatives. According to respondents, lower ticket prices could motivate them to make greater use of public transport. This was the most frequently indicated response in each of the surveyed cities. Similarly, faster journey times and better connections would contribute to the intensification of the use of public transport. Many of the respondents (about 25% - 28%) highlighted the problems with the frequency of the trips and the problem of delays in transport in Zielona Góra (table 4).

Table 4. What factors could encourage you to make greater use of public transport?

Town	Jelenia Góra	Gorzów Wlkp.	Zielona Góra
Response	Percentage	Percentage	Percentage
1. Lower ticket prices	27,3%	36,8%	30,2%
2. Faster journey times	27,0%	21,6%	29,6%

3. Better connections (more direct)	23,0%	24,4%	26,2%
4. Increased frequency	24,8%	28,0%	25,1%
5. Increased reliability (no delays)	19,4%	18,4%	21,6%
6. Could / Would occasionally make use of public transport in case of a problem with the car	21,2%	19,6%	15,3%
7. Better integration between transport modes	9,1%	19,4%	12,7%
8. Nothing would encourage me to make greater use of public transport	18,8%	14,0%	11,8%

Source: own study based on the research

The next question illustrated problems with access to infrastructure. Respondents pointed out the difficulty in finding parking as the greatest inconvenience of travelling by car in terms of available infrastructure (from 47.5% to 54.7% of respondents), and the occurrence of traffic jams (table 5), Which confirms the fact that problems related to the growing number of private means of transport are emerging. This may mean that the initial signal inducing residents to take advantage of public transport will be difficulties with parking, traffic jams and the recently ever-faster growing fuel costs.

Table 5. What do you think are the biggest drawbacks / obstacles to travel by car?

Town	Jelenia Góra	Gorzów Wlkp.	Zielona Góra
Description	Percentage	Percentage	Percentage
1. Difficulty in finding parking	54,7%	51,1%	47,5%
2. Uncertainty of journey time due to traffic congestion	48,6%	37,8%	40,8%
3. Excessive cost of travel	36,0%	23,1%	30,6%
4. Excessive cost of parking	33,8%	29,3%	24,1%
5. Risk of theft or damage to vehicle	15,1%	11,5%	14,4%
6. There is no inconvenience to travelling by private car	10,3%	15,6%	12,5%

Source: own study based on the research

This confirms the need to invest in improving the functioning of public transport and solve problems associated with the use of public transport as indicated by the respondents in the study.

According to respondents, the following solutions would improve the quality of life: separation of traffic lanes for buses and emergency vehicles, the introduction of fees for entry to the city center and the reduction traffic in the city center during peak hours (table 6).

Table 6. Which of the following solutions would have an effect / impact on improving the quality of life of residents in the area of urban logistics?

Description	Agree	No opinion	Disagree	Discrepancy
1. Separation of lanes for buses and emergency vehicles, priorities at traffic signals	76,7%	18,5%	4,8%	+ - 4,0%
2. Introduction of fees for entry to the city center	75,5%	16,3%	8,2%	+ - 4,0%
3. Reduction of car traffic in the city center (eg, during peak hours between 5:30-8:30 and 13:30-18:30)	74,7%	14,8%	10,5%	+ - 4,0%
4. Closure of the city center to trucks	72,50%	21,3%	6,1%	+ - 3,9%
5. Closure of the center to all cars	71,5%	19,2%	9,4%	+ - 4,0%
6. Appointment of restricted hours for truck deliveries (off-peak)	65,0%	21,8%	13,2%	+ - 3,9%
7. Organising the supply of goods to companies located in the city at night	15,5%	22,7%	61,9%	+ - 3,9%
8. Creation of a cycle hire networks	30,2%	27,8%	42,0%	+ - 3,7%
9. Introduction of mini buses for public transport, which would move with greater frequency than standard buses	13,6%	18,3%	68,0%	+ - 4,0%
10. Introduction of passenger information systems in real time	63,5%	28,7%	7,9%	+ - 3,9%
11. Introduction of traffic light control systems (based on traffic information traffic lights can be dynamically controlled, lengthening or shortening the duration of green lights)	60,8%	28,2%	11,0%	+ - 3,9%

12. Greater promotion of environmentally friendly behaviour among residents	72,2%	23,0%	4,9%	+ - 4,0%
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Source: own study based on the research

The responses in the expectations and evaluation of public transport were calculated relatively and actually for the three cities. The relative quality gap was calculated as the difference between actual preferences and evaluations. The absolute quality gap was calculated as the difference between the maximum, possible ideally, expectations of service and the actual assessments. Table 7 shows differences in the quality of public transport.

Table 7. Quality gaps in the area of public transport

Quality feature	Jelenia Góra		Zielona Góra		Gorzów Wlkp.	
	Relative quality gap	Absolute quality gap	Relative quality gap	Absolute quality gap	Relative quality gap	Absolute quality gap
Punctuality of vehicles	-1,22	-1,7	-0,78	-1,27	-1,0	-1,67
Frequency of circulation of vehicles	-1,25	-1,88	-0,87	-1,59	-1,08	-1,89
Travel safety	-0,82	-1,55	-0,84	-1,51	-0,93	-1,67
Travel conditions in vehicles	-0,84	-1,74	-0,79	-1,8	-1,05	-2,02
Waiting conditions at bus stops	-1,01	-2,08	-0,71	-1,83	-1,02	-2,12
Accessibility to public transport	-0,94	-1,7	-0,59	-1,55	-0,80	-1,79
Fares	-1,13	-2,12	-0,79	-1,77	-1,16	-2,22
Directness of connections	-1,11	-1,88	-0,9	-1,76	-0,99	-1,94
Management culture	-0,86	-1,85	-0,41	-1,48	-0,73	-1,72
Information (at bus stops and in/on vehicles)	-0,93	-1,81	-0,41	-1,4	-0,60	-1,61
Readability and ease of memorization of schedules	-0,93	-1,98	-0,28	-1,53	-0,51	-1,65
Opportunity to provide feedback about public transport	-0,41	-2,39	-0,11	-1,97	-0,44	-2,07

Source: own study based on the research

The largest relative quality gap related to characteristics such as: punctuality of vehicles, the frequency of the circulation of vehicles and ticket prices. The smallest quality gap related to legibility and ease of retention schedules and the ability to speak about public transport.

Responses regarding expectations and evaluation of individual transport in the surveyed cities were analysed. Results - quality differences - are presented in table 8.

Table 8. Quality gaps in the area of individual transport

Quality feature	Jelenia Góra		Zielona Góra		Gorzów Wlkp.	
	Relative quality gap	Absolute quality gap	Relative quality gap	Absolute quality gap	Relative quality gap	Absolute quality gap
Quality of roads	-2,48	-2,87	-1,9	-2,53	-2,26	-3,16
Journey time through the city	-1,59	-2,27	-1,28	-2,11	-1,41	-2,38
Road markings	-0,83	-1,82	-0,97	-1,87	-0,96	-2,02
Diversions for trucks and HGV's	-1,88	-2,68	-1,24	-2,2	-1,27	-2,35
Number of parking spaces	-2,03	-2,67	-1,59	-2,44	-1,87	-2,78
Quality of parking facilities	-1,49	-2,48	-1,14	-2,25	-1,37	-2,54
Convenient payment methods for parking (machines/ card/ sms etc)	-1,02	-2,17	-0,93	-2,1	-1,15	-2,29
Low price of parking	-1,88	-2,63	-1,33	-2,35	-1,42	-2,56
Convenient solutions for fees for exceeding parking time	-1,76	-2,75	-1,16	-2,43	-1,37	-2,58

Source: own study based on the research

The largest relative quality gap related to features such as: quality of roads and the number of parking spaces. The widest absolute quality gaps also related to road quality and the number of parking spaces. Studies have shown that for individual transport, the quality gaps, both relative and absolute, are greater than public transport. This means that the expectations of respondents about

the factors affecting the quality of individual transport are much higher than the current level of satisfaction.

4. Summary

The results of this study confirm the awareness among residents of the city's communication problems and their impact on quality of life. On the one hand, people are aware of the problem of the growing number of motor vehicles and their impact on quality of life in the city, but on the other hand, see no alternative to private transport. Many reasons are suggested to discourage people from using public transport, which is a strong signal that it is necessary to carry out changes in the infrastructure and organization of public and freight transport in the city.

One of the main objectives of city logistics infrastructure management must be to limit the number of vehicles in the city center and residential areas. This goal may be achieved by optimizing the flow of people and goods and by reducing the flow time of vehicles in the city, the organization of transit, better use of space cargo vehicles, and by better motivating residents to abandon the use of private means of transport.

Within the assumptions of city logistics is the coordination of the transportation aspects of the city, and the pursuit of optimizing these activities. In this case, integrated traffic management systems that operate on the principle of centralized control, the focusing power in the least amount of decision-makers (Szymczak 2008, p. 187) are important. An integrated system of managing inflows of people and cargo in order to be able to function best should therefore be based on the principle of centralization, and strictly speaking a team should be designated to address these tasks.

Abstract

The solutions for improving the urban transport system

The urban transport system is one of the key components affecting the improvement of human communication, especially in terms of availability and organization of the resources of the transport infrastructure of the city. The author concerns an impact of urban transport infrastructure on the perception of the quality of life for residents of mid-sized city. The article has been given to factors affecting the level of utilization of the urban transport system by the inhabitants and their expectations in terms of

shaping conditions for the development of urban infrastructure. This article is part of a research project "Referential model of city logistics versus quality of life of citizens" funded by funds for science in the years 2010-2013 as a research project.

Streszczenie

Rozwiązania usprawniające system transportu miejskiego

System transportu miejskiego jest jednym z kluczowych elementów wpływających na usprawnienie komunikacji ludzkiej, szczególnie w zakresie dostępności i organizacji zasobów infrastruktury transportowej miasta. Autor podejmuje problematykę wpływu infrastruktury transportu miejskiego na odczucia jakości życia mieszkańców średniej wielkości miasta. W artykule zwrócono szczególną uwagę na czynniki mające wpływ na poziom wykorzystania systemu transportu miejskiego przez mieszkańców oraz ich oczekiwania w zakresie kształtowania warunków rozwoju infrastruktury miejskiej. Artykuł jest częścią projektu badawczego pt. „Model referencyjny logistyki miejskiej a jakość życia mieszkańców” finansowanego ze środków Ministerstwa Nauki i Szkolnictwa Wyższego w latach 2010-2013.

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