



ANALYSIS OF THE SUSTAINABLE PUBLIC TRANSPORTATION PLANS IN POLAND

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Abstract

A sustainable transportation development plan is a strategic document that is created to guarantee convenient conditions in terms of the mobility of users and to ensure all other aspects that aim to improve the quality of life in the city. It is created on the basis of existing planning practices, using documents that already exist in this area and with the participation of various social groups. For this reason, the purpose of this study is to analyze sustainable public transportation development plans for selected 10 municipalities in Poland. The authors will analyze the sustainable development plans of these cities, try to find common features in them, and suggest how a given plan can be expanded to seek better solutions for creating sustainable urban mobility to replace previously developed transportation plans.

Introduction

The concept of sustainability emerged from the rise of the sustainability movement. The Organization for Economic Cooperation and Development (OECD) in 1994 introduced a definition of sustainable transportation that focuses primarily on the need for transportation that does not adversely affect public

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health and the ecosystem, a definition that is still in effect today. Another important aspect is social life, in which sustainable transportation is a system of moving people in such a way that the needs, related to transportation, can be met in a way that does not endanger people's health or affect the functioning of ecosystems. It is affordable and economically efficient for all, and enables a healthy economy to function. It tries to reduce traffic congestion and reduce emissions of harmful exhaust fumes and waste (CHŁAD 2011). In addition to sustainable development plans, it is important to remember sustainable urban mobility plans. These are plans for the development of sustainable urban transportation of a strategic nature, which comprehensively address issues related to transportation, the environment and living conditions in urban areas.

Sustainable development is a political idea of development, according to which there should be a balance between established goals, such as transportation, economic, social, environmental, safety and many others concerning culture or education. We can understand sustainable development from the perspective of transportation, which meets the expectations of its users and residents while maintaining awareness, which means influencing demand and controlling and satisfying it, by reducing motorization, transport intensity, facilitating travel by means other than the car. Nor should the focus be on adjusting the capacity of the road system, road supply or parking lots to meet the demand of motorists (BRZEZIŃSKI 2014, BANISTER 2008).

Sustainability in the context of transportation serves to improve the transportation system while reducing its harmful effects on the environment and living conditions. Over the years, it can be seen that in the city and its periphery, the main objectives set by sustainability are investments in infrastructure development and an emphasis on the development of public transportation. However, other types of measures, namely those that affect mobility, reduce motorization and counteract its negative effects, are used to a small extent (BRZEZIŃSKI 2014).

The topic of sustainability was addressed by Krzysztof GRZELEC and Olgierd WYSZOMIRSKI in the article *Plan for sustainable development of public transport*' (2011). The considerations proposed in it, make clear the importance of creating transport plans. They show what knowledge one should have in order to create them reliably, as well as what skills one should have in order to analyze them correctly and use them to shape the transportation offer. In the article, they focused on the scope and principles of preparing integrated public transport development plans (GRZELEC, WYSZOMIRSKI 2011).

Public transport and sustainability: A review by Patrick MILLER, Alexandre G. DE BARROS, Lina KATTAN and S. Chan WIRASINGHE (2016). It discusses public transportation as a key element in building sustainable cities. The social, economic and environmental impacts of transportation identified as critical issues that can challenge the sustainability of cities and regions are presented. The article presents a critical review of the literature on the relationship between public transportation and sustainability. First, the article reviews the key concepts of sustainable transportation and how public transportation contributes to achieving sustainability goals. Second, the article reviews previous studies that have analyzed sustainable transportation to

develop recommendations for planning, engineering and research on sustainable public transportation. Finally, the article concludes with a proposal for future research on the operation of sustainable public transportation (JANOŠKOVÁ et al. 2018). The topic of sustainability has also been addressed at the global, national or city level, for example: sustainability comparative analysis in Brasil (CAVALCANTI et al. 2017), bridging climate change and equity targets in Portugal (ARSENIO et al. 2016), cost-effectiveness in terms of CO₂ in Burgos, Spain (DIEZ et al. 2018) or Bologna, Italy (NOCERA et al. 2015) or general (HICKMAN et al. 2013), ITS and car sharing (ZAVAGLIA 2016), success cases versus failed cases (LOPEZ-LAMBAS et al. 2013), barriers to implementation (MAY et al. 2008), SUMP in France (MERLE 2013) and sometimes with the focus on political or procedure issues (MARSDEN, GROER 2016) or scoring measures effects (LOPEZ-RUIZ et al. 2013).

Taking into account the above analysis, the authors reviewed the sustainable public transport plans for the selected 10 municipalities to find common features and to propose how the plan can be extended to seek better solutions for creating sustainable urban mobility, which will translate into more people willing to use public transport and which will lead to a reduction in pollution from individual means of transport.

Research

Subject and conditions of testing

The aim of this paper is to analyse the public transport sustainability plans for a selection of 10 municipalities. For the established cities, the authors analyse the sustainability plans, trying to find commonalities in them and to propose how the given plan can be extended to find better solutions to create sustainable urban mobility.

A sustainable urban mobility plan is increasingly replacing previously developed transportation plans, which have a proper legal basis and are a requirement when applying for European funds. It should be borne in mind at this point that a good transportation plan cannot be developed without taking into account the broader context, i.e. the urban region. To this end, the following criteria were adopted: financial, how to organize the passenger information system, the choice of transport modes, environmental protection, and the transport market. The analysis concludes with the direction and development of public transportation in 10 cities. During the study, the method of document analysis was used. The plans for sustainable development of public mass transportation of selected cities found in the public information bulletin of the analyzed cities were analyzed (Tab. 1).

Table 1

Sustainability plans analyzed	
City	Name of the plan
Poznań	<i>Plan of sustainable development of public mass transport for the city of Poznań for 2014-2025</i>
Gdańsk	<i>Plan for sustainable development of public mass transport for the city of Gdańsk for 2021-2042</i>
Szczecin	<i>Sustainable development plan of public mass transport for the city of Szczecin for 2014-2025</i>
Warszawa	<i>Sustainable public transport development plan for the city of Warsaw</i>
Łódź	<i>Plan of sustainable development of public mass transport for the city of Lodz until 2025</i>
Bydgoszcz	<i>Plan for sustainable development of public mass transportation for the city of Bydgoszcz</i>
Kraków	<i>Plan for sustainable development of public mass transportation for the municipality of Krakow</i>
Katowice	<i>Long-term plan for the development of an integrated transportation system for the city of Katowice</i>
Częstochowa	<i>Plan of sustainable development of public mass transportation for the city of Częstochowa</i>
Wrocław	<i>Plan for sustainable development of public mass transportation of Wrocław for 2023-2027</i>

Source: based on *Sustainable development plan for public collective transport for the city of Bydgoszcz* (2013), *Sustainable development plan for public collective transport for the municipality of Kraków* (2013), NIEDZIELSKI et al. (2014), *Public transport sustainable development plan for the city of Warsaw* (2014), FRANEK et al. (2015), *Plan of sustainable development of public transport in Wrocław* (2016), *Sustainable development plan for public collective transport for the city of Łódź until 2025* (2018), THIEM et al. (2019), *Plan of sustainable development of public collective transport for the city of Częstochowa* (2020), *Plan of sustainable development of public collective transport for the city of Gdańsk for the years 2021-2042* (2021).

Methods and measures for assessing the creation of sustainable development

Urban transportation planning in Poland is important due to the fact that Poland is a member of the European Union, for which transport mobility is of great importance for the socio-economic development of urban areas. On the other hand, the negative impact on the environment, or numerous traffic accidents, is of great importance. It is therefore important to divide transport tasks between public and individual transportation. The prerequisite for sustainable transportation in a city is first and foremost to reduce the travel distance and the number of trips. It is therefore necessary to coordinate urban planning and transportation planning, mainly public transportation, to counteract the excessive use of personal cars at this stage. The construction of a sustainable development plan for public

mass transportation is based on Article 12 (1) of the Law of December 16, 2010 on public mass transportation, according to which the transportation plan should include (2010):

- the transportation network on which public transportation will be provided;
- assessment and forecast of transportation needs;
- anticipated financing of transportation services;
- preferences for the choice of transport modes;
- principles of organization of the transport market;
- the expected standard of transportation services in public transportation;
- how to prepare a passenger information system.

Cities were used to analyze transportation plans in this study, which were analyzed in terms of:

- the legal basis needed to create sustainable development plans;
- the financing of transportation services;
- the way the passenger information system is organized;
- preferences for the choice of transportation modes;
- environmental protection;
- principles of organization of the transport market;
- directions of development of public transport.

Analysis of the use of sustainable plans

For the analysis of transportation plans, 10 cities were selected, which are summarized in Table 2. These 10 cities were chosen in terms of certain criteria, as their size and infrastructure potential allowed the analysis of plans that are similar to each other. The area of the cities is one of the main aspects that were compared, as this determines the size of its resources and the need for infrastructure. Population also affects the need to move, since the larger the population, the greater the need for personal transportation. Therefore, in large cities we encounter the highest number of accidents, or high levels of negative environmental impact. In agglomerations, public transportation plays a special role, so the rate of choice of personal transportation should be reduced as soon as possible, and users should be encouraged to use public transportation by creating an attractive transportation offer.

From the analysis conducted in terms of the documents through which transport plans are created, it appears that the main aspects in the creation of sustainable development plans are the Decree of the Minister of Infrastructure of May 25, 2011. This regulation specifies what should be included in the scope of a sustainable development plan for public mass transportation, so for each city it provides the legal basis for its creation. The Law of December 16, 2010 on public mass transportation lists the organizers of public mass transportation,

Table 2
Characteristics of selected Polish cities

City/ Criterion	Area [km ²]	Popula- tion	Number of railroad lines	Number of streetcar lines	Number of bus lines	Number of public transport vehicles	Number of personal transporta- tion vehicles [thousands]	Average number of people using public transport per year [million]	Length of commu- nication lines [km]	Number of stops	Funds allocated to public transport [mln PLN]	Population density [person/ km ²]
Poznań	261.9	532,048	8	18	115	649	406	255	1,872.7	1,162	480	2,031
Gdańsk	263.5	470,633	5	11	73	404	265	178	1,128.7	1,238	315	1,786
Szczecin	300.55	396,472	6	12	76	588	340	120	800	1,070	231	1,319
Warszawa	517.24	1,794,166	12	25	250	1,900	2,009	1,200	355.3	4,342	2000	3,469
Łódź	293.25	667,923	5	19	58	874	359	no data	124.1	2,028	421	2,278
Bydgoszcz	175.98	344,091	6	11	47	366	200	60	335.9	155	178	1,955
Kraków	326.85	780,796	10	25	172	1,030	525	306	2,267	1,160	520	2,389
Katowice	164.64	290,553	20	13	63	248	233	823	922.25	52	95	1,765
Często- chowa	159.71	217,530	8	3	36	190	114	140	no data	746	58	1,362
Wrocław	292.82	641,928	10	23	125	655	442	203	84	2,308	406	2,192

Source: based on *Sustainable development plan for public collective transport for the city of Bydgoszcz* (2013), *Sustainable development plan for public collective transport for the municipality of Kraków* (2013), NIEDZIELSKI et al. (2014), *Public transport sustainable development plan for the city of Warsaw* (2014), FRANEK et al. (2015), *Plan of sustainable development of public transport in Wrocław* (2016), *Sustainable development plan for public collective transport for the city of Łódź until 2025* (2018), THIEM et al. (2019), *Plan of sustainable development of public collective transport for the city of Częstochowa* (2020), *Plan of sustainable development of public collective transport for the city of Gdańsk for the years 2021-2042* (2021).

assigns them tasks that consist of planning, organizing and managing public mass transportation. The law also lists documents and factors that should be taken into account at the stage of creating a transportation plan, these are: the state of land use, the socio-economic situation of the area, the impact of transportation on the environment, the needs for sustainable development of public mass transportation, and the profitability of transportation lines.

Table 3 shows the main sources and forms of financing for transportation services. The main sources of funding are funds from the city budget, as well as from the state treasury. Funds for the development and modernization of rolling stock or infrastructure can come from European Union aid programs. There are also funds that are raised from ticket sales, but this method of financing

Table 3

Analysis of transport plans in terms of financing of transport services		
City / Criterion	Financing of transportation services	
	joint initiatives	initiatives for individual cities
Poznań	– proceeds raised from ticket sales	– funds raised from public-private partnerships
	– funds obtained from the city budget	– funds raised from the commercialization of public space
Gdańsk	– subsidies obtained from the state budget	–
Szczecin	– EU funds obtained from aid programs	– proceeds from contractual penalties for the failure of transport operators to comply with the terms of transport contracts
	– funds raised directly by transport operators: equity (including retained earnings), bank loans, leasing	– proceeds from VAT refunds
Warszawa		–
Łódź		–
Bydgoszcz		–
Kraków		–
Katowice		– fees paid by carriers for the use of transportation stops
Częstochowa		–
Wrocław		– from companies ordering transportation services (e.g. extension of line 133 to Auchan and Bielany Avenue) – from organizers of various sporting or cultural events – special transportation, e.g. football matches, zu2lowe, concerts e.g. Dawid Podsiadło, Kings of Leon, etc.

Source: based on *Sustainable development plan for public collective transport for the city of Bydgoszcz* (2013), *Sustainable development plan for public collective transport for the municipality of Kraków* (2013), NIEDZIELSKI et al. (2014), *Public transport sustainable development plan for the city of Warsaw* (2014), FRANEK et al. (2015), *Plan of sustainable development of public transport in Wrocław* (2016), *Sustainable development plan for public collective transport for the city of Łódź until 2025* (2018), THIEM et al. (2019), *Plan of sustainable development of public collective transport for the city of Częstochowa (2020)*, *Plan of sustainable development of public collective transport for the city of Gdańsk for the years 2021-2042* (2021).

Table 4

Analysis of transportation projects under the influence of how the passenger information system is organized		
City / Criterion	How to organize passenger information system	
	joint initiatives	initiatives for individual cities
Poznań	<ul style="list-style-type: none"> – integrated information at bus stops: timetables – integrated information on the Internet, timetables, information in paper form or on a digital display, announcements of obstructions and delays, audio information, stop information, electronic boards, maps and diagrams of the transportation network – hotline information, – information at bus stops: timetables on special boards, diagrams of specific lines, information on changes 	<ul style="list-style-type: none"> – information in vehicles: outdoor monitors – and interior monitors – timetables are prepared in the AGC BusMan program, in which stops are defined – travel times, lengths of inter-stop connections, etc. The individual lines are then routed
Gdańsk	<ul style="list-style-type: none"> – information at bus stops: timetables on special boards, diagrams of specific lines, information on changes 	<ul style="list-style-type: none"> – integrated information on the Internet: timetables, GPS information about the location of the means of transport, the ability to plan a trip, announcements about any changes and difficulties – in-vehicle information: line number and record of all stops, electronic boards, voice information
Szczecin	<ul style="list-style-type: none"> – information at bus stops: timetables on special boards, diagrams of specific lines, information on changes 	<ul style="list-style-type: none"> – passenger information organized through: timetables at bus stops, website, apps, Dynamic Passenger Information System, in-vehicle information, online search engines, – additionally, electronic boards, electronic ticketing system, ticket machines in transport vehicles, info kiosks have been introduced
Warszawa		<ul style="list-style-type: none"> – information on the Internet: timetables, connection diagrams, trip planning, announcements about introduced changes
Łódź		<ul style="list-style-type: none"> – information on the Internet: website, MPK maintains accounts with information on social networks
Bydgoszcz		<ul style="list-style-type: none"> – passenger information system includes: marking of means of transport, information at bus stops (graphical diagram of the transport network, websites, applications for smart phones, dynamic passenger information, infokiosks, voice system
Kraków		<ul style="list-style-type: none"> – integrated information on the Internet: search for convenient connections, timetables, price list, maps of transport networks
Katowice		<ul style="list-style-type: none"> – a contribution is paid to the Upper Silesian Metropolis, which – is the organizer of public mass transport and performs tasks related to public transportation – through its budget unit: Metropolitan Transport Authority (ZTM)
Częstochowa		–
Wrocław		<ul style="list-style-type: none"> – dynamic bus stop information, Internet, leaflets, paper form

Source: based on *Sustainable development plan for public collective transport for the city of Bydgoszcz* (2013), *Sustainable development plan for public collective transport for the municipality of Kraków* (2013), NIEDZIELSKI et al. (2014), *Public transport sustainable development plan for the city of Warsaw* (2014), FRANEK et al. (2015), *Plan of sustainable development of public transport in Wrocław* (2016), *Sustainable development plan for public collective transport for the city of Łódź until 2025* (2018), THIEM et al. (2019), *Plan of sustainable development of public collective transport for the city of Częstochowa* (2020), *Plan of sustainable development of public collective transport for the city of Gdańsk for the years 2021-2042* (2021).

is not sufficient to cover all costs associated with public transportation. Public transport organizers often seek private sources of funding by finding outside investors, commercialization of public space is also one of the sources of raising funds, it is obvious that there are numerous advertisements on most vehicles, for which fees are charged.

An important aspect in any transportation plan is how the passenger information system is organized. It has a significant impact on the number of people using public transportation. It allows for efficient use of the transportation network and orientation of vehicle routing. The most common passenger information system is integrated information at bus stops, i.e. timetables in paper form or on a digital display, as well as audible information that notifies of obstructions and delays. Increasingly, information is being introduced in vehicles through the installation of monitors displaying, for example, maps that provide information about the current location. A major convenience is the placement of ticket machines inside vehicles. For those using smartphones, the way the information system is organized tends to be easier, as it is possible to buy a ticket online using a phone or determine the most convenient route in terms of time (Tab. 4). Analysis of transportation projects influenced by the way the passenger information system is organized in *Sustainable development plan for public collective transport for the city of Bydgoszcz* (2013), *Sustainable development plan for public collective transport for the municipality of Kraków* (2013), NIEDZIELSKI et al. (2014), *Public transport sustainable development plan for the city of Warsaw* (2014), FRANEK et al. (2015), *Plan of sustainable development of public transport in Wrocław* (2016), *Sustainable development plan for public collective transport for the city of Łódź until 2025* (2018), THIEM et al. (2019), *Plan of sustainable development of public collective transport for the city of Częstochowa* (2020), *Plan of sustainable development of public collective transport for the city of Gdańsk for the years 2021-2042* (2021).

As shown in Table 5, we can see that in every city analyzed, car transportation remains at the highest level. In Warsaw, car transportation takes the upper hand over public transportation, but there is still a very high rate of choosing public transportation. In terms of infrastructure development, available transportation options and sheer area, Warsaw is the most developed city in Poland. In the other cities analyzed, we can see that they are not as developed cities in terms of available infrastructure, and therefore individual transportation is still more often chosen than public transportation. As role models, we can point to Krakow and Czestochowa, where most j people use public transportation.

One of the main causes of air pollution is transport (*Physical and chemical properties of natural gas. Natural gas* 2019). Emissions of harmful compounds arise from the combustion of fuels in vehicles and from sources associated with vehicle traffic (abrasion of road surfaces, tires, carpets) and dust from roads. That is why it is so important for sustainable development to protect the environment,

Table 5

Preferences for choice of mode of transport in the analyzed cities

City / Criterion	Public transport [%]	Car transport [%]	Bike [%]	Walking [%]
Poznań	36.5	58.3	2.9	2.3
Gdańsk	32.1	41.2	5.9	20.8
Szczecin	34.53	42.99	3.41	19.07
Warszawa	42.4	45.7	6.6	5.3
Łódź	40	30	3	27
Bydgoszcz	28.9	29.6	10.70	30.8
Kraków	50.6	25.8	2.8	20.8
Katowice	33.7	31	1.4	33.9
Częstochowa	77	17	3	3
Wrocław	28	41	7	24

Source: based on *Sustainable development plan for public collective transport for the city of Bydgoszcz* (2013), *Sustainable development plan for public collective transport for the municipality of Kraków* (2013), NIEDZIELSKI et al. (2014), *Public transport sustainable development plan for the city of Warsaw* (2014), FRANEK et al. (2015), *Plan of sustainable development of public transport in Wrocław* (2016), *Sustainable development plan for public collective transport for the city of Łódź until 2025* (2018), THIEM et al. (2019), *Plan of sustainable development of public collective transport for the city of Częstochowa* (2020), *Plan of sustainable development of public collective transport for the city of Gdańsk for the years 2021-2042* (2021).

to look for alternatives to reduce pollution and limit its negative impact on the environment. An important aspect, therefore, is the search for solutions that will reduce the use of individual transportation and encourage users to use public transportation. Within the framework of environmental protection, there is an emphasis on greater financial contributions to public transportation, modernization of the public transportation system and infrastructure (Tab. 6).

The organizer of public mass transport is a competent local government unit, an association of competent local government units, a metropolitan association or the minister responsible for transport, ensuring the operation of public mass transport in a given area. Transport organizers are required to develop, adopt and update a plan for sustainable development of public mass transportation, called a transport plan having the rank of a local law (Tab. 7).

As can be seen from Table 8, each city mainly focuses on 4 goals, namely infrastructure integration, integration of transportation management and organization, expansion of lines and infrastructure, and expansion of passenger information. Each city develops these goals in its own way, but after analysis it can be concluded that to a large extent cities are implementing the same solutions or very similar ones. An important aspect influencing users' decisions to choose public transportation is, first of all, the availability and modernization of infrastructure, adapting it for the elderly and disabled. Finding such solutions

Table 6

Environmental analysis of sustainable transport

City / Criterion	Environmental protection
Poznań	– assumed actions: more funding for public transportation, introduction of intelligent management systems, creating integrity of each mode of transportation in the city, increasing the number of „Park and Ride“ parking lots
Gdańsk	– creating protected areas within the City of Gdansk, such as nature reserves, landscape parks, protected landscape areas – creating a Spatial Information System of Gdansk – acoustic maps that show the exceeded noise limit near linear infrastructure – the City of Gdansk has found that rail transportation is the least harmful to residents and the environment
Szczecin	– involvement in the promotion of public transportation, which involves making the public aware of the environmental impacts of individual transportation – increasing air pollution through transportation activities – continuous analysis of noise due to transit routes and the passage of streetcars on old railroad tracks – in plans: track improvements, newer fleets of means of transportation, noise reduction
Warszawa	– main goals: noise reduction: newer rolling stock and modernized railroads; air and water quality: rolling stock powered by alternative energy sources and greater control of individual means of transportation – city of Warsaw introduces: green zones, bus lanes, noise barriers
Łódź	– construction of a bicycle road system in the city – education on counteracting low emissions and promotion of public transportation
Bydgoszcz	– friendly, ecological, functional and safe transportation solutions – internal and external transport accessibility of the Bydgoszcz functional area – climate protection and adaptation to climate change
Kraków	– the authorities of the city of Krakow are focusing their efforts on reducing noise, by: introducing acoustic barriers, using quiet pavement, purchasing low-emission means of transportation, developing an intelligent management system
Katowice	– main objectives: purchase of low-emission public transportation, encouraging the public to purchase alternative-powered cars, expanding car sparing
Częstochowa	– introduction of protected areas – greater financial investment in the purchase of low-emission transportation vehicles on the issue of EURO standards – main goals: promotion of public transportation and cycling, paid parking spaces, elimination of old vehicles
Wrocław	– the main measures include: the creation of a transport network for public transport, the purchase of ecological means of transport, the creation of integrated transfer points, reducing the operation of individual transport

Source: based on *Sustainable development plan for public collective transport for the city of Bydgoszcz* (2013), *Sustainable development plan for public collective transport for the municipality of Kraków* (2013), NIEDZIELSKI et al. (2014), *Public transport sustainable development plan for the city of Warsaw* (2014), FRANEK et al. (2015), *Plan of sustainable development of public transport in Wrocław* (2016), *Sustainable development plan for public collective transport for the city of Łódź until 2025* (2018), THIEM et al. (2019), *Plan of sustainable development of public collective transport for the city of Częstochowa* (2020), *Plan of sustainable development of public collective transport for the city of Gdańsk for the years 2021-2042* (2021).

Table 7

Principles in organizing the transportation market in selected Polish cities

City / Criterion	Principles of carriage market organization
Poznań	ZTM in Poznan, is responsible for transportation planning and management, MPK in Poznań sp. z o.o. is the largest internal operator in Poznań
Gdańsk	ZTM is responsible for urban transportation planning and management, GZDiZ Gdańsk road and greenery management, provides appropriate conditions for the operation of public transport
Szczecin	Road and Public Transport Authority, is responsible for planning and monitoring public transport
Warszawa	municipality, on a communication line in municipal passenger transport, county – on a line or network of transport in county passenger transport
Łódź	the Municipality of Łódź is the organizer of public transport, manages roads and infrastructure
Bydgoszcz	Municipal Roads and Public Transport Authority Bydgoszcz
Kraków	the Municipality of Krakow is the organizer of public transportation, Board of Municipal Infrastructure and Transport in Krakow provides appropriate conditions for the operation of public transport
Katowice	Metropolitan Transport Authority, is responsible for public transport in Katowice
Częstochowa	Municipal Transport Company of Częstochowa, is responsible for the management and planning of public transportation Municipal Road and Transport Authority in Częstochowa, is responsible for monitoring the operation of public transport
Wrocław	The City Council of Wrocław is responsible for managing and planning public transportation The Board of Roads and City Maintenance is responsible for the maintenance of bus stop infrastructure and the overall operation of public transportation

Source: based on *Sustainable development plan for public collective transport for the city of Bydgoszcz* (2013), *Sustainable development plan for public collective transport for the municipality of Kraków* (2013), NIEDZIELSKI et al. (2014), *Public transport sustainable development plan for the city of Warsaw* (2014), FRANEK et al. (2015), *Plan of sustainable development of public transport in Wrocław* (2016), *Sustainable development plan for public collective transport for the city of Łódź until 2025* (2018), THIEM et al. (2019), *Plan of sustainable development of public collective transport for the city of Częstochowa* (2020), *Plan of sustainable development of public collective transport for the city of Gdańsk for the years 2021-2042* (2021).

Table 8

Direction and development of public transport in 10 cities

City / Criterion	Directions of development of public transport
1	2
Poznań	integration of infrastructure of various modes of transport; extension of P+R parking lots at stops and stations; integration of transport management and organization; attaching suburban lines to the ZTM Poznań network; extending city lines to neighboring towns and cities; introduction of a common ticket for railroad and public transport; common passenger information system; introduction of Poznań Electronic Agglomeration Card

cont. Table 8

1	2
Gdańsk	development of public transport network and modern networks of pedestrian and bicycle transport systems; construction and modernization of public transport infrastructure; improvement of transport accessibility conditions; integration of tariff and ticketing system; use of only low- and zero-emission vehicles; expansion of passenger information systems; adjustment of public transport network for elderly and disabled people
Szczecin	expansion of the transport system; improvement of spatial, temporal and economic accessibility; adaptation of public transport for the elderly and disabled; introduction of electronic ticketing and city card system
Warszawa	organizational and functional integration of all public transport subsystems (rail, bus, streetcar, metro); introduction of a common ticket; development of transfer parking systems; launch of modern passenger information systems; modernization and development of the tramway communication system; development of the metro system, expansion of further lines; improvement of railroad communication
Łódź	expansion of the streetcar network; modernization of the railroad network system; construction of multi-level interchanges to improve integration of transport within the city; construction of P+R parking lots; improvement of service standards by increasing the frequency and routes of vehicles
Bydgoszcz	expansion and modernization of public transport infrastructure; adaptation of public transport network for the elderly and disabled; improvement of spatial, temporal and economic accessibility
Kraków	expansion of the streetcar network system; modernization of the railroad network system; construction of multi-level interchanges to improve internal integration of urban transport; construction of P+R parking lots; improvement of vehicle frequency and routing; introduction of a traffic priority system for public transport vehicles; expansion of the passenger information system
Katowice	introduction of changes in the organization of car traffic in the city center; giving public transport priority in traffic, including expansion of bus lanes; organizational and infrastructural integration in public transport; development of public transport infrastructure, transfer centers, Park&Ride hubs, improvement of the standard of bus stop infrastructure – safety and standard of use, accessibility for people with disabilities
Częstochowa	opening of a Passenger Service Center and passenger service points; integration of public transport with long-distance transport (rail and bus); modernization of roads and public transport infrastructure; prioritization of bus transport on the main routes used by it; introduction of low-floor vehicles to facilitate travel for people with disabilities; introduction of ticket vending machines in all vehicles
Wrocław	concentration of transportation services on the main directions of gravity, but with minimum accessibility standards for each functional area; further expansion of service coverage and improvement of the standard of the tramway subsystem; coordination of timetables within the framework of interacting local government units and voluntarily with commercial carriers; prioritization of traffic for public transport vehicles

Source: based on *Sustainable development plan for public collective transport for the city of Bydgoszcz* (2013), *Sustainable development plan for public collective transport for the municipality of Kraków* (2013), NIEDZIELSKI et al. (2014), *Public transport sustainable development plan for the city of Warsaw* (2014), FRANEK et al. (2015), *Plan of sustainable development of public transport in Wrocław* (2016), *Sustainable development plan for public collective transport for the city of Łódź until 2025* (2018), THIEM et al. (2019), *Plan of sustainable development of public collective transport for the city of Częstochowa* (2020), *Plan of sustainable development of public collective transport for the city of Gdańsk for the years 2021-2042* (2021).

so that the information provided to passengers is accessible and understandable to all, the number of courses and time availability is adapted to them.

The creation of sustainable development plans is of great importance in the sustainable development of transportation and the development of public mass transportation. It has special tasks related to environmental protection, counteracts the increase in the volume of traffic of means of transport inadequate to the capacity of the infrastructure it uses in cities, and reduces the number of traffic collisions and accidents. An important element of the idea of sustainable development is to strengthen the role of collective public transport in cities. Through the creation of transportation plans and the implementation of set goals, public transportation becomes more attractive in terms of travel time, cost and quality of transportation, which contributes to increasing the use of public transportation by users of urban areas. The main aspects that contribute to achieving the specific goals are:

- improving transportation accessibility and quality,
- improving the operation of the transportation system in the plan area,
- integration of the transportation system in the city,
- improving the safety of traffic participants in the city,
- reducing the negative impact of transportation on the environment.

The introduction of transportation plans allows the realization of the goals outlined above, enabling the improvement of the quality of the transportation system in accordance with the principles of sustainable development.

Based on the sustainable transportation plans for the cities used for the study, it can be seen that the concepts of these plans are similar. Transportation plans are created on the basis of the Law on Public Transportation (Act of 16 December 2010 on public collective transport 2010), which is a set of regulations on the organization and operation of regular passenger transportation in public public mass transport performed in our country. The law defines the organizers of public mass transportation and assigns them tasks that consist of planning, organizing and managing public mass transportation. The organizers of transportation in urban areas are the relevant entities identified in the law.

One of the criteria for the selection of cities for the analysis was the population, since according to the Law on Public Collective Transportation, the following are required to develop and adopt plans for the sustainable development of public collective transportation (Act of 16 December 2010 on public collective transport 2010):

- municipalities that have a population of at least 50,000 and independently organize public mass transportation,
- municipalities that have a total population of at least 80 thousand and jointly organize public mass transportation on the basis of inter-municipal agreements.

An important aspect that was used to select the compared cities is the area, the size of which is adequate to the number of residents living in the areas. Its size affects the possibility of expanding infrastructure, which translates into the number of lines used in public transportation, which also increases the need for rolling stock and the number of stops. The number of residents translates largely into the demand for public transportation. In these cities, special attention should be paid to introducing innovative solutions to encourage users to use public services. Traveling by individual transportation involves long travel times, because with such a large population, these cities are constantly experiencing traffic bottlenecks in the form of congestion and congestion. This translates into a very high number of collisions and accidents, as well as a very high negative impact on the environment. Also cited when characterizing cities is such an issue as the amount of funds that are allocated for public transportation, as you can see this factor is not adequate to the number of residents in a given area. The amount of funds for public transportation depends primarily on the budget of the local government, but it is also influenced by passengers who buy tickets, which is not a large income. Therefore, in order to be able to introduce solutions to improve public transportation and its infrastructure, it is necessary to look for innovative solutions in terms of replacement with modern rolling stock or infrastructure development. Every effort should be made to find more resources that can be used to fund these goals. The constant trickle of technology brings many interesting solutions, but in order to take advantage of them, adequate funds must be allocated for their purchase and implementation.

In the analyzed transportation plans, we see high correlations between them. These are similarities in the assumptions of the concept of sustainable development. These cities focus on the implementation of the assumptions in legal and political terms, i.e. primarily the implementation of the city's strategic transportation documents, sustainable public transport plans and sustainable urban mobility plans. An important aspect running through these plans is the integration of public transportation in the areas covered by the plans, through a combination of urban public transport, rail, streetcar, as well as subways. Aiming in large cities to reduce the use of cars by users, through traffic exemptions for individual transportation in selected areas of the city, emission fees and paid parking zone measures, etc.

In terms of technology and technology, we can meet common assumptions that seek to modernize and purchase new public transport fleets, develop Park&Ride parking lots, which will allow to change the role of the personal car to a substitute that will allow in mutual complementarity in meeting needs with public transport. Creating an integrated information and communication system covering the operation of public transport. Seeking solutions to improve the fluidity of urban public transport and increase traffic collision-free traffic by introducing dedicated lanes for public transport, such as bus lanes. Adapting

public transportation rolling stock to carry users with limited mobility, the elderly or disabled, but also with an eye to people with baby carriages.

On economic issues, solutions should be sought to raise as much money as possible for investment in public transportation. Therefore, it is important not to use only local government funds, but also to look for funds within the framework of funding that can be obtained from the European Union, but also from other projects, such as CIVITAS.

Another important factor is the socio-demographic factor, which involves seeking to provide transportation service to places that have not been served so far, or where urban public transportation is poorly served. It is important to provide travel convenience solutions for the elderly and disabled, to increase the safety of public transport passengers. Seeking continuous solutions to encourage users more to travel by public transportation, through the introduction of new connections and flexibility of services. An important factor influencing the use of public services is the prices for services, so look for solutions to reduce them and use this to encourage people to use public transportation.

Organizationally, the focus should be on implementing systematic surveys to help assess residents' transportation behavior and preferences. It is important to consistently implement plans and projects within the framework of the sustainable mobility concept. Integrating public transportation at interchanges would also be a great improvement.

In order to encourage residents to use public transportation, it is necessary to focus on marketing that will promote urban public transportation, in terms of price promotion. Introducing measures to perpetuate a positive image of public transportation among residents would also go a long way in encouraging users to use public transportation.

Comparing the transportation plans of some of Poland's larger cities, it can be seen that they focus on achieving similar goals. The pursuit of sustainable public transportation is not only the idea of our country, but also of all European Union member states. Joint initiatives such as the CIVITAS program are being developed to unite cities in Europe. Such activities are expedient in an effort to create a unified plan for the European transport area.

The White Paper is a record of actions to create a unified vision for transportation in Europe. Summarizing these actions from the provisions of the White Paper, we come to the conclusion that cities in Poland must be ready to catch up with European cities in transport development. They are obliged to introduce solutions to cope with rising fuel prices, reduce exhaust emissions, reduce congestion and introduce modern technologies. It is necessary to strive to unify the transport area in cooperation with national, regional and local authorities in a more dynamic manner and based on technological, organizational and marketing solutions.

The strategic goals of the new EU transport policy are to halve the number of conventionally-powered cars in urban transport by 2030 (eliminating them from cities by 2050) (ZAŁOGA 2017). In Poland, it can be seen in transport plans that the analyzed cities are moving towards these intentions. Changes are being made to the organization of automobile traffic in the city center, limiting car access to selected areas of the agglomeration through new regulations on parking demand. The main goal is to give public transportation priority in traffic. Replacement of the car fleet with low-emission modes of transportation is taking place. However, in the future, the main goal will be to replace the fleet with electric or hybrid vehicles. From the point of view of the zero-carbon assumption, electric vehicles with only one battery drive seem to be the right solution. However, hybrid vehicles, in which the main source of propulsion is an electric motor, driven by energy from an on-board power generator, which is a conventional internal combustion engine, could be considered to extend the range of electric vehicles. Member cities must strive to expand their rail networks and infrastructure to jointly create a European high-speed rail network in the future. These activities are aimed at, re-establishing rail as the main mode of transportation for long-distance travel.

The search for innovative solutions is aimed at improving the operation of public transportation in such a way as to encourage the user to switch from personal transportation to public transportation in larger cities. There are many solutions to adapt urban transportation to meet customer expectations. Therefore, it is important to constantly keep up with new technologies and use them effectively.

As a modern system of intelligent transportation systems is the ImFlow system, which is a solution for both a single intersection and a complex network of urban roads. This system allows you to adjust the relevant conditions as needed, and also connects with other ITS applications. It works by isolating intersections and equipping them with their own intelligent module, which optimizes traffic based on a configured strategy. The traffic management system is able to affect changes in the network faster and prioritize public transportation vehicles. It could be used to help introduce a priority system for public transportation vehicles.

More and more people are using bicycles to get around. However, the small number of bicycle paths, still contributes to discouraging users from using this mode of transportation. It would be worthwhile to realize the potential of bicycle travel and create more bicycle paths to ensure safe travel.

Carsharing is an important building block in creating green mobility for modern cities. People will always use personal transportation, the idea behind this concept is to use cars without owning them, which would affect the reduction of personal cars. An additional advantage would be to use the Vivaldi project to expand this concept to include an electronic car key and the use of smart

technologies in vehicles. An additional advantage is that this project includes the possibility of using an electronic ticket and the possibility of paying for a ride with a payment card (ZAŁOGA 2017).

It would be a good idea to introduce a system that integrates all urban transportation options and make them available as a single service. To introduce this type of solution, one could use the program “Be-in/Be-Out. To.” This is a system in which the traveler’s application will connect via Bluetooth. The app will track his journey and manage the tolls. Without having to take out his phone. This not only saves time and unlimited travel value (TUNDYS 2013).

In order to ensure that travelers reach places by public transportation in a flexible way in stopping for individuals, an on-demand service would be a good solution. This solution would be used in the last stages of the trip, usually using micromobility solutions. This would make the offer more attractive, reduce travel time, lower the total cost of travel along the entire route and respond to the demand of residents.

High frequency, 24-hour service, good information, proximity to stops and additional privileges will help make public transportation competitive with the car. All of the above-mentioned features will make public transportation flexible, fast and reliable, just like the private car, and much cheaper, especially for season ticket holders.

Conclusions

An analysis of transportation plans shows that they are similar in terms of the principles of creation and the content I find in them. Cities in Poland are pursuing the idea of sustainable development, regardless of their public transport infrastructure resources. They focus on meeting the guidelines of the Law on Public Public Public Transport (Act of 16 December 2010 on public collective transport 2010), which is a set of rules for the organization and operation of regular passenger transportation in public mass transport performed in our country. The Sustainable Urban Mobility Plan is a document, the introduction of which contributes to European goals related to the creation of a unified transport system, the creation of a common rail network and environmental solutions. The concept of sustainable mobility is being disseminated by the European Commission, among others, through the creation of the Transport White Paper, which describes goals that meet the requirements of sustainable development.

For this reason, action should be taken to modernise the existing sustainable public transport plans in order to improve its operation. This will make the public more likely to choose public transport over individual transport and thus reduce environmental pollution.

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