



Towards Smart Mobility from the Perspective of the COVID-19 Pandemic: Polish Experiences on the Example of Warsaw

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Purpose: The article aims to bring the concept of smart mobility closer in the context of implementing the passenger transport process - public during the Covid-19 pandemic in the Warsaw metropolis in Poland.

Study design/methodology/approach: Analyses of the process implementation were presented, along with the prospect of moving towards smart mobility. It used the literature review and case study method to present a picture of the metropolis of Warsaw. They carry out a ranking comparison of cities in the IESE City Motion Index for 2020 and 2022 in the smart mobility sub-area.

Findings: The cities and agglomerations of the future, especially in Poland, will strive to become more intelligent by building a complex structure of interdependent physical and virtual networks and digital platforms based on technological solutions. This will also be reflected in implementing the smart mobility idea and transport processes. Creating effective and efficient urban transport should consequently increase the quality and comfort of travelling. Warsaw metropolis can be a case for other cities in Central Europe.

Originality/value: This work presents how to transform smart mobility in a smart city context. The article's value was to show how, through the prism of the COVID-19 pandemic, Warsaw dealt with the phenomenon and how it influenced its further pursuit of the smart city. The research results presented in the article also concern the sphere of public transport and passenger transport processes through the quality and comfort of travelling.

Keywords: smart mobility, smart city, COVID-19

Introduction

The smart mobility city concept should therefore be considered as an element of a smart city in the context of cities' ability to adopt Industry 4.0 solutions (including digital solutions and the dissemination of cyber-physical systems (Bitkowska et al., 2021; Pieriegud, 2018; Gierszewska, 2020; Rostek 2023; de Souza, et al., 2022; Yalçın, 2021). A new perspective for changes and development of cities and agglomerations enables the implementation of the vision of individual stakeholders, including the needs and creativity of its inhabitants. From this perspective, the agglomeration of the place - the agglomeration of the future will be based on digital platforms, as well as on the synergy of physical and virtual networks, as well as transport infrastructure (Pieriegud, 2018, Gierszewska, 2020). One of the key areas is public transport and passenger transport processes. Issues related to mobility help cities improve the quality and comfort of travelling (Schulz, Bohm, Gewalt, Krcmar, 2020; Pawłowska, 2017). The impact of the COVID-19 pandemic has significantly affected transport processes in urban agglomerations and also influenced the demand among passengers for the services provided (Kieu & Cai, 2018). The main research question was formulated as follows: In what direction is the implementation of passenger transport processes in Warsaw headed under the influence of digitization processes from the perspective of the COVID-19 pandemic? The article's main purpose is to bring the concept of smart mobility closer in the context of the passenger transport

process during the COVID-19 pandemic in the metropolis of Warsaw. In the above work, the desk research method was used. Analyzes of the process implementation and the perspective of moving towards smart mobility were presented. The pace of dissemination of the smart concept in individual agglomerations will depend on the level of development and availability of transport and technological infrastructure, as well as residents' adaptation to the proposed solutions.

Smart Mobility and the Conditions of the Passenger Transport Process

The concept of smart mobility is becoming an increasingly important area of research, both from theoretical and practical points of view. The concept of smart mobility is implemented in transport networks, both in the area of urban planning and transport planning. Developing a unified definition of smart mobility is a difficult challenge, which may also be because this idea is constantly evolving. The set of selected definitions is presented in Table 1.

Table 1: Smart Mobility definitions

Smart mobility definitions	Authors
It refers to an advanced multi-sectoral system in which the main actors are: network operators and commercial entities.	Pavic, Pandzic, Captuder, 2020, pp. 2.
It means the ease, convenience, affordability and accessibility of travelling to your destination with minimal impact on the environment and others.	Lyons, 2018, pp.4.
It means object detection, distance estimation, tracking, semantic segmentation, scene analysis and understanding the obtained data about the surrounding environment for an autonomous vehicle in the surrounding environment using sensors, processing this data and adapting its behaviour to this information.	Khemmar, et al., 2022, pp.2.
In particular, it covers key initiatives in its scope, referring to connected and autonomous vehicles. It supports activities that, from the perspective of technology, support transport, e.g. Internet of Things, Internet.	Nikitas, et al., 2020, pp. 3.
A system that provides tailor-made mobility services based on understanding user preferences and city vision through the use of emerging ICT infrastructure.	So, An, Lee.,2020, pp.1.
Architecture consisting of road infrastructure and road routes, a fleet of public transport vehicles that affect residents' quality of life and facilitate travel.	Berrone & Ricart, 2022, pp.20

Smart mobility is a development concept in terms of efficient, smooth and individualized travel of residents between places designated by them, within the city's administrative area or beyond its borders. Every year the competitiveness and complexity of solutions increases.

Table 2: Classification of smart cities according to the smart mobility criterion in 2020 and 2022

2020			2022		
Place	City	Mobility	Place	City	Mobility
1	London (United Kingdom)	3	1	London (United Kingdom)	4
2	New York (USA)	1	2	New York (USA)	1
3	Paris (France)	2	3	Paris (France)	3
4	Tokyo (Japan)	56	4	Tokyo (Japan)	62
5	Reykjavik (Iceland)	57	5	Berlin (Germany)	7
6	Copenhagen (Denmark)	29	6	Washington (USA)	37
7	Berlin (Germany)	4	7	Singapore (Singapore)	58
8	Amsterdam (Netherlands)	11	8	Amsterdam (Netherlands)	20
9	Singapore (Singapore)	55	9	Oslo (Norway)	33
10	Hong Kong (China)	71	10	Copenhagen (Denmark)	31

...					
69	Warsaw (Poland)	45	54	Warsaw (Poland)	26
...					
95	Wrocław (Poland)	49	88	Wrocław (Poland)	92

Just a decade ago, smart mobility seemed to be something unattainable for developing cities. This has changed with the dynamic technological development (Vitunskaitė et al., 2019, pp. 316). Efficient public transport revolutionizes people's lives and improves the economic sphere while reducing environmental pollution. The presented IESE ranking - table 2, should be a signpost for Polish cities aspiring to the top ten and be perceived as an example to follow in the region of Central Europe. By definition, public transport is one of the branches of the economy that most closely follows innovative solutions in the areas of vehicle resources used (e.g. rail, wheeled and underground). In its efforts, it ensures effective travel for residents in three important relationships:

- home–work–home,
- home–school–home,
- home–destination–home.

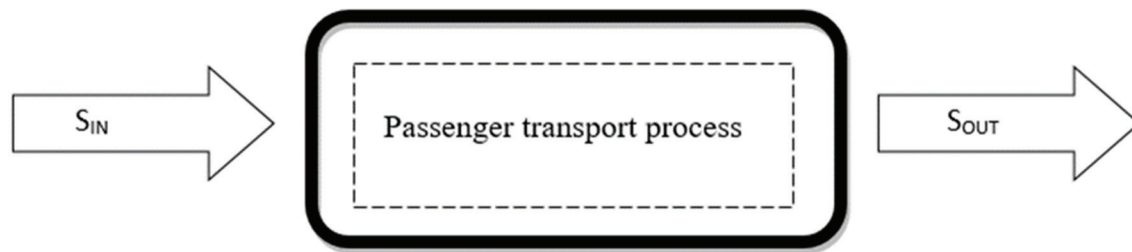
City managers put a lot of effort into managing public transport, which consists of the following means of transport: trams, buses, railways, trolleybuses and the metro. Each city stands out in terms of its solutions to travel around it. Also, providing an alternative for non-motorized people. The communication system supports "friendly" solutions to the environment and climate, while deepening the sustainable development of the city and nature. Focusing on public transport is important but not sufficient to implement the idea of sustainable development. Also important are such criteria as city economy, standard of living, natural environment, and city management. Combining the relationships between people, enterprises, technology, infrastructure, consumption, energy and space is crucial - developing a balanced share in the entire urban system. The adopted classification allows for the formulation of the thesis that the idea of a smart mobility city requires significant involvement of all stakeholders: city officials, entrepreneurs, residents and experts in the field of science.

The formation of the transport process consists of mapping the fundamental features (Pyza, 2009, pp.144), which includes analysing structural elements in the transport process. The definitions of the described issue are summarized in Table 3 below.

Table 3: Selected definitions of the transport/transport process

Definitions	Authors
It covers only a range of activities associated with the active and passive involvement of the rolling stock of a specific mode of transport. The transport process, depending on the number of modes of transport involved in its implementation, may include one or more transport processes.	Grobelny M. & Klimkiewicz J., (2009, http://www.wnp.pl)
It covers only a range of activities associated with the active and passive involvement of the rolling stock of a specific mode of transport. The transport process, depending on the number of modes of transport involved in its implementation, may include one or more transport processes.	Goździewska A., (2012, pp.765)
It has its purpose, which results from the adopted strategy. First, there is a need for a close connection between the transport company's goals and the customer's expectations.	Łukasik Z. & Olszańska S. (2016, s. 644)
When organizing it, it is necessary to choose the appropriate means of transport, designate a route containing the least number of elements limiting the passage and obtain appropriate transport permits.	Jerzyło P. & Wawrzyńska A., (2017, s. 1746)

The perspective of the transport process - a system approach with entry to and exit from the system is presented in Figure 1.



Description of:

S_{IN} – demand for transport service,

S_{OUT} – evaluation of the quality of the transport service.

Figure 1: Schematic of the transportation process in a system view

At the entrance to the system (S_{IN}), we receive information on the demand for transport services. The central area is the entire transport process, where basic and supporting activities occur. On the other hand, at the system output (S_{OUT}), we receive information about the quality of the service from the passenger. The transportation process allows all residents to travel home and allows travel outside the city's administrative boundaries (Curtis et al., 2019, pp.42). The diagram illustrates the interconnected individual activities, as they are the responsibility of the public transport operator, resulting in the performance of passenger transport. This begins with preparation, deciding on the readiness to provide a transport service, and checking all systems accompanying the service. When the above requirements are verified, the first passengers are admitted, and the activities are carried out. During the operation, the carrier monitors the traffic, and in the event of any threat, intervention and suspension of the process occur. There is an inquiry whether further provision of transport can be continued; in the event of a negative decision, a supporting sub-process is carried out to be able to provide the basic service again. In the end, the flow of passengers is closed, and the developed executive and statistical documentation is then prepared (after their development, the process is considered complete, and actions are taken until the next day of providing the transport service). Many experts emphasize that it is necessary to harmonize the public transport process efficiently and economically to meet the needs of those concerned (Kang et al., 2020 Lemańska-Majdzik, 2017).

Analysis of the passenger transport process in the Warsaw metropolis in 2018-2022 and the COVID-19 perspective

The process of passenger transport in the Warsaw metropolis is constantly evolving and changing. Significant passenger traffic makes it necessary to expand the infrastructure and use new solutions to improve the comfort and quality of passenger travel. Warsaw This is expressed not only in the fact that it is the capital where central offices are concentrated because, in the 1990s, many international corporations started their operations. Warsaw is a city with traditions, a difficult history, with beautiful monuments. It is a city with the largest number of cultural institutions in Poland - theatres, cinemas, concert halls, museums, and churches. There are also several sports clubs with great traditions and achievements in the form of world, European and Olympic champions. Foreigners pay attention to the beautiful, well-kept greenery and carefully tended parks. The capital is the largest academic centre with 66 universities. First reported in Wuhan, China, in late 2019, COVID-19 has remained a global pandemic. As of July 17, 2021,

over 190 million laboratory-confirmed cases and over 4 million deaths of COVID-19 have been reported to WHO (Xiajun et al., 2021). At the turn of 2019 and 2020, the rapid spread of COVID-19 worldwide resulted in significant restrictions, particularly in implementing transport processes (Young, 2020, pp.2641, Parry, 2020, pp.1). The illustration of the above phenomenon in the Warsaw metropolis was a significant change in the implementation of passenger transport processes. It can be illustrated in the number of passengers transported by the city's transport system - Figure No. 2. In 2018-2021, passengers using public transport on an annual basis remained at a comparable level. The first half of the statement shows us conservative passenger flows. The last two years included in Table 4 show approximately a decrease in the following year. 40% compared to the year before the COVID-19 pandemic. In the last analyzed year (2021), in which residents adapted to the status of living in a pandemic, we recorded a slight increase in passenger flows at the level of approx. 10.5%.

Table 4: The number of passengers transported in the years 2018-2021 in the Warsaw metropolis

Transport Operator	2018	2019	2020	2021
Total	1 183 861 117	1 201 651 190	726 242 018	809 430 917
		Decrease [%]	39,56%	10,28%

The calculation of the number of passengers using public transport in the Warsaw metropolis is based on the same estimation system every year. Data obtained from the sale of tickets, the values of the adopted transfer coefficients, as well as data from the rolling stock counted at the exit of the vehicle, and the system of ticket gates at metro stations are used. Building the public transport system of the capital of Warsaw includes various means of communication - public transport: buses (MZA), trams (TW), railway (SKM - Rapid Urban Rail, KM - Mazovian Railways) and metro (MW). In this respect, the capital stands out from other cities in the country regarding the variety of passenger transport. This shows the complexity of the processes needed to meet the needs of residents. The year 2020 was the most difficult in the entire history of Warsaw public transport, as it was introduced by the Regulation of the Minister of Health on March 13, 2020, on the announcement of an epidemic emergency in the territory of the Republic of Poland from March 13, 2020 (Journal of Laws 2020, item 433, pp.1- 2), limits on public transport and minimizing movement only for essential purposes. The above limitation of the availability of places on public transport applied to all cities in the country. The restrictions imposed by the Polish government were divided into three periods. The first period is III - V 2020. During the so-called "hard lockdown", the filling of public transport vehicles could not exceed 30% for sitting and standing places. The next time restrictions fell on the summer months, i.e. June - September 2020, there was an effect of increasing the availability of seats and standing in public transport to the level of 50%. In the last longest period of October 2020 - April 2021, the current limit of places from the holiday period was maintained, positively impacting passenger traffic. The overall pandemic began to improve due to the greater availability of COVID-19 vaccines and greater public awareness of the pandemic (Łabędzki, 2021, pp.185). The analysis of the presented data concerned the largest city and, at the same time, the capital of the country, Warsaw, which has an extensive communication architecture with its diversity.

Table 5: Passengers transported by transport operators of the Warsaw metropolis

Transport Operator	2018	2019	2020	2021
City Bus Company	608 109 631	598 945 712	352 410 091	400 169 852
Warsaw Trams	286 513 713	296 465 085	168 882 369	185 871 513
Warsaw Metro	234 599 894	241 848 472	162 266 214	180 602 565
Rapid Urban Rail	18 934 300	22 035 040	14 933 487	14 581 112
Warsaw Commuter Railway	4 723 855	5 141 821	2 697 557	2 592 532

Mazovian Railways	30 979 724	37 215 060	25 052 300	25 613 343
Total	1 183 861 117	1 201 651 190	726 242 018	809 430 917
Decrease [%]			39,56%	10,28%

There was a significant decrease in the number of passengers transported in the first year of the pandemic at the level of approx. 40%, while in the following year, the decrease was approx. 10.5% compared to previous years. The decrease in profits from ticket sales caused by the COVID-19 pandemic did not lead to a crisis situation in the city's public transport of Warsaw. It also did not disturb the operation of municipal public transport operators in terms of changing transport services. According to the multiannual contracts (Table 5), it should be concluded that the impact of the COVID-19 pandemic did not lead to a severe crisis, and the implementation of transport processes was effective. Preventive measures taken by the Public Transport Authority concerned the maintenance of the pre-pandemic frequency of transport during rush hours. This was dictated by ensuring the comfort of travelling passengers and maintaining social distancing. For passengers, there was no deterioration in functioning during the COVID-19 pandemic, and the only change was the limited availability of public transport during off-peak hours, which travellers use less.

The confirmation of maintaining the economic stability and functionality of collective transport operators in the Warsaw metropolis, in addition to the continuity of contracts, was also included in the transport rates for individual entities - Table No. 6. Following the contracts (Table No. 4), the rate for each year of operation in the period 2019-2022 was determined and changed by mutual agreement in writing. The COVID-19 pandemic, which covered the Warsaw metropolis, also affected passenger transport entities. The city authorities analyzed the pandemic situation and the financial condition of the city budget. The decisions that were made consisted in maintaining the economic stability of communication operators - a gradual increase in the rate of transport performance. The above procedure helped to go through the entire critical period for communication relatively smoothly and to keep the companies operating at the assumed financial level.

Long-term contracts concluded with Warsaw's capital city aim to maintain the assumed level of functioning of the entire transport process, even during the pandemic crisis. Thanks to such activities, the continuity of operation and economic stability of enterprises, operators and the possibility of carrying out transport processes were maintained. Table 6 presents the transport performance for each operator at the level of over 99% in each of the presented years. However, the percentage share of each carrier is maintained in accordance with the supply capacity of available seats for passengers. Following the adopted long-term agreements (Table 4) concluded between the Public Transport Authority and the operators: Warsaw Trams (TW), City Bus Company (MZA), Warsaw Metro (MW), Fast Urban Railway (SKM), Mazovian Railways (KM) and Warsaw Commuter Rail (WKD), the content of these agreements are written with a division into each year of the so-called "planned vehicles" - how many kilometres will be covered by all means of transport of a given operator in a given year for which the contract is valid. Then, each operator independently settles the "execution of trucks" and settles with the client based on invoices. Table No. 6 presents the contracted transport performance for the actual performance of superficial tasks.

Table 6: Transport work of operators of the capital city of Warsaw in 2018-2022

2018	TW	MZA	MW	SKM	KM	WKD	Total
Planned wozokm	52 896 722,00	120 185 591,97	35 780 709,60	14 140 904,43	5 455 965,52	537 738,76	228 997 632,28
Done wozokm	52 793 614,00	119 615 460,24	35 567 539,50	13 817 057,88	5 426 197,55	536 207,04	227 756 076,21
Execution	99,81%	99,53%	99,40%	97,71%	99,45%	99,72%	-
Actual share of passenger transport	23,18%	52,52%	15,62%	6,07%	2,38%	0,24%	100,00%
2019	TW	MZA	MW	SKM	KM	WKD	Total
Planned wozokm	54 215 163,00	119 719 157,56	37 237 966,20	14 965 659,34	5 801 945,15	552 399,64	232 492 290,88
Done wozokm	54 072 341,00	118 785 116,44	37 153 726,20	14 967 417,06	5 777 261,48	550 927,14	231 306 789,32
Execution	99,74%	99,22%	99,77%	100,01%	99,57%	99,73%	-
Actual share of passenger transport	23,38%	51,35%	16,06%	6,47%	2,50%	0,24%	100,00%
2020	TW	MZA	MW	SKM	KM	WKD	Total
Planned wozokm	52 428 763,00	116 051 661,94	42 312 823,20	15 271 828,75	5 606 351,19	546 492,96	232 217 921,04
Done wozokm	52 311 942,00	115 718 917,17	42 072 087,00	15 357 512,47	5 587 154,57	545 525,45	231 593 138,66
Execution	99,78%	99,71%	99,43%	100,56%	99,66%	99,82%	-
Actual share of passenger transport	22,59%	49,97%	18,17%	6,63%	2,41%	0,24%	100,00%
2021	TW	MZA	MW	SKM	KM	WKD	Total
Planned wozokm	49 400 712,00	107 172 964,00	40 673 028,00	14 782 248,00	5 935 369,00	559 638,00	218 523 959,00
Done wozokm	49 292 189,00	106 822 183,00	40 580 408,00	14 933 510,00	5 900 777,00	557 883,00	218 086 950,00
Execution	99,78%	99,67%	99,77%	101,02%	99,42%	99,69%	-
Actual share of passenger transport	22,60%	48,98%	18,61%	6,85%	2,71%	0,26%	100,00%
2022	TW	MZA	MW	SKM	KM	WKD	Razem
Planned wozokm	51 440 446,00	112 621 100,38	45 070 143,20	15 031 948,45	5 725 911,86	521 281,28	230 410 831,17
Done wozokm	51 259 944,00	111 917 634,81	44 474 668,20	16 027 929,62	5 265 270,55	559 291,17	229 504 738,35
Execution	99,65%	99,38%	98,68%	106,63%	91,96%	107,29%	-
Actual share of passenger transport	22,34%	48,76%	19,38%	6,98%	2,29%	0,24%	100,00%

The functioning of the passenger transport process in the metropolis of Warsaw is continuous. The contracted transport performance in 2018-2022 shows us the efficiency of transport processes. This is confirmed by the value of the actual performance of transport by public transport operators at a level above 99%, and in some cases even exceeds 100%, which is a correct phenomenon due to the possibility of an incidental increase in transport, depending on the needs of the manager of the urban transport process - ZTM. The comparative area starts with 2018, which did not record any turmoil. Moving on to the next presented years, 2019 and 2020, we do not record a significant decrease in outsourced transport performance. This shows us that the capital's authorities are concerned about protecting public transport entities from the effects of the pandemic crisis. Only the last two years of 2021 and the incomplete year of 2022 show us a decrease in ordered orders for the service.

The factor influencing this state of affairs was the introduction of a hybrid mode of work for employees in the entire area of the economy. Through the Public Transport Authority, the capital's local government commissioned an earlier analysis of passenger flow through the process, which eventually introduced adjustments to the transport plans. There were no radical cuts to timetables during peak and off-peak periods. In the longer term, the pandemic will end, and then it will be necessary to acquire lost passengers in about 40% compared to previous years. The change may take place only in 2023 and the following years because employers have introduced a hybrid work system, which combines stationary work in the entrepreneur's office and the possibility of working at home on selected days of the week. It will also increase the number of passengers travelling by public transport. Other factors influencing the entire process of urban transport in the capital are important and have a significant impact on the transport system, i.e. the increase in inflation, the impact of which is indirect. The increase in own costs directly impacts public transport operators, e.g. electricity costs, fuel costs for rolling stock and other component costs incurred by these entities. The financial policy of the organizer and manager of the transport process should be very conservative and balanced. This will translate into appropriate actions, will not affect the efficiency of the communication system, and will not lead to the closure of operators participating in the above.

Analysis of the passenger transport process in the Warsaw metropolis in 2018-2022 and the COVID-19 perspective

The development of modern Industry 4.0 technologies, urbanization and intensified movement of residents pose challenges in implementing the passenger transport process in the capital. An important element is the provision of modern solutions in the field of transport processes in the capital city. This is to meet the needs of residents using information and communication technology, ICT and other available tools personalized to the needs of the inhabitant (Warsaw Towards a Smart City, 2018, pp.6).

As part of the Smart City Warsaw strategy, many systems and applications have been implemented in Warsaw, including:

- Traffic Management System,
- Public Transportation Management System,
- City Monitoring System,
- Open City Data Platform,
- Mobile Warsaw application (Warsaw Innovation Center).

The Smart City Warsaw Strategy 2014–2020 was based on three pillars: innovation, sustainable development and quality of life for residents. The goal of the strategy was to create a city based on modern technologies, minimize the negative impact on the environment and ensure a high quality of life for residents. Warsaw's current Smart City strategy is under development, and the latest information can be found on the city's official website or from local authorities (Smart City Warsaw Strategy 2014–2020; Warsaw Smart City Guidelines). Warsaw's smart city strategy until 2030 will be understood as raising the quality of life of its residents. The city has become digitally mature in its characteristics. It will also be a place that generates innovation, attracts international talent and inspires other cities striving to become smart cities in Poland (Warsaw's Smart Approach To City Transformation, 2019).

The capital tries to respond to its residents' current needs by undertaking various projects. This results in a continuous improvement of the standard of living of residents, tourists and people commuting to work every day. A comprehensive solution available to the public is the Warsaw IoT Platform (Internet of Things), which is responsible for using e-services, including air quality index, availability of parking spaces, location: public transport stops, eco points and public toilets. ICT technology enables communication and data transfer (Łabędzki, 2022, pp.31). This also translates into public transport processes, for example, the internet platform jakdojada.pl, which looks at the "intelligent travel planner" for the passenger in terms of place of time and relationship, e.g., home–work–home or home–school–home. The result is an adequate route based on real data in the real-time axis. The expansion of the capital's collective transport system is a dynamic development in the areas of the means of transport used and the implementation of transport plans entrusted by Warsaw's local government officials.

Summary

Poland's future cities and agglomerations will strive to become more intelligent by building a complex structure of interdependent physical and virtual networks and digital platforms based on technological solutions. This will also be reflected in implementing the smart mobility idea and transport processes. Creating effective and efficient urban transport should consequently increase the quality and comfort of travelling. The passenger transport process is essential in public transport planning and operational control to design an adequate value of commissioned transport work for users. They fully represent the continuity of the transport process in most areas of urban agglomeration. The concept of smart mobility is based on strategic planning intentions regulating the issues of public and private transport, changing the approach to traffic management and communication infrastructure in modern cities, as well as technological solutions.

Therefore, there is a need to expand the technological infrastructure and integrate with the transport platform and infrastructure. An important challenge in the Warsaw metropolis, as well as the construction of digital platforms for residents to provide residents with access to basic services and a sense of security, including, increasingly, the prevention of cybercrime. It is necessary to implement new models of city management, taking into account the changes in the role of stakeholders and the effective use of data generated by them. Therefore, the digital transformation of urban agglomerations, including transport processes supported by Industry 4.0 technologies, is a prerequisite for the implementation of new concepts for the development of cities of the future. This will enable the integration of mobile devices used by residents, also in means of transport, sensors installed in urban space, and integrated data analysis platforms with urban space management processes. The presented analyses and conclusions do not exhaust all possibilities. Therefore, the direction of future research should be aimed at analyzing

the actions taken to build a smart city and the financial outlays incurred. As a consequence, it will influence the more intensive development of passenger transport processes. In large urban agglomerations, significant development benefits can be achieved thanks to the integration of all systems in the field of transport infrastructure and technological infrastructure.

Further research will focus on other provincial cities (e.g. Krakow, Wroclaw, Gdansk, Sopot, Poznan), which will assimilate in their area already used solutions in urban transport. At the same time, they can use the solutions of Western European cities (e.g. Berlin, Vienna, Barcelona, Lisbon), which still have implemented solutions in urban-oriented transport. The above connections can result in innovative solutions in smart mobility and accelerate the development of cities in Poland.

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