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ANALYSIS OF THE DEVELOPMENT OF MEANS OF TRANSPORT IN LARGE METROPOLIS – A CASE OF KRAKOW

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Purpose: The purpose of this paper is to assess the use of transport on the example of the city of Krakow.
Design/methodology/approach: The article uses the following methods to achieve the set goal: literature analysis, descriptive and statistical analysis of data obtained in primary research carried out by the authors using the observational method.
Findings: The process of developing means of transport depends, among others, on: on the city's transport policy and residents' awareness of sustainable development. Each studied street had a means of transport that could be considered dominant on it. In total, the majority of passenger cars were recorded on all streets, followed by pedestrian traffic. It can also be noticed that the traffic of individual means of transport in Krakow is not even. This applies especially to car traffic.
Practical implications: When planning the organization of transport in the city, it should be taken into account that the traffic of individual means of transport in Krakow is not uniform and the fact that there are communication routes running through the city that are specifically used by a given type of vehicles. This applies to both public transport vehicles that operate only on designated routes and private vehicles. When designing changes in infrastructure, it is also necessary to take into account the expectations of groups using different means of transport and to ensure the possibility of quick travel, among others thanks to Intelligent Transport Systems.
Originality/value: The article provides insight into the way transport is used in various parts of the city of Krakow. This will allow for the development of changes in the city's transport infrastructure allowing for better use of public transport, which will contribute to environmental protection, reduce traffic intensity in Krakow and increase residents' awareness of sustainable development.

Keywords: transport, road traffic, means of road transport.

Category of the paper: Research paper.

1. Introduction

Moving shorter and longer distances has been an integral part of people's lives since the beginning of time. Over the centuries, methods to make traveling easier have been improved. Currently, there are many options for moving around the city (Wiktorowska-Jasik, 2016). The choice of means of transport depends on the distance, costs and time you want to spend, the luggage you want to transport, your physical condition and the driving comfort you want to achieve. Ease of movement is one of the important factors in assessing the quality of life. The current development of technology and globalization means that transport is subject to constant changes. Solutions used in the design and production of means of transport, as well as in the organization and construction of transport infrastructure, must meet the requirements of modern people. Each city is characterized by its own spatial layout, which is usually subject to constant changes. Krakow covers an area of 327 km^2, but including the entire agglomeration it covers approximately 3200 km^2, which is almost 10 times larger. The span of Krakow from north to south is 18 km and from west to east 31 km. According to „Krakow in numbers 2022", the total length of the street and road network in Krakow was 1110.2 km. The bicycle paths had a total length of 176 km. There were 28 tram lines with a total length of 365 km and 181 bus lines with a total length of 2,394 km in Krakow. According to MPK S.A. estimates in 2022 it carried 220 million passengers. There were 665,881 vehicles registered, including 531,209 passenger cars. This means that 852.6 vehicles were registered per 1,000 inhabitants, including 680.2 passenger cars. The Krakow authorities, through their policy, want to reduce car traffic in favor of bicycle traffic and public transport (https://www.bip.krakow.pl/zalaczniki/dokumenty/n/424929/karta). The Main Market Square is similar in shape to a square with sides of 200 m. Eleven streets radiate from it. The historic city center is surrounded by 4 ring roads: I, II, III and IV. The first ring road runs through streets where, on many sections, traffic is limited to one direction. Only public transport and service vehicles can move in the other direction. The aim is to eliminate car traffic from the city center and thus make the area more pedestrian-friendly. The second bypass is closed and fully passable. The third ring road is not completely finished. Some of them are in construction plans, and some are under construction (Trasa Łagiewnicka). Therefore, it is not yet passable along its entire length. The fourth ring road is also not completely completed. It will have a total length of 60 km. Ultimately, it will surround Krakow, and its route will include 18 road junctions, where you will be able to access individual districts or towns (https://pl.wikipedia.org/wiki/Obwodnice_Krakowa).

2. Literature review

The implemented transport policy in cities determines the development of transport in these areas. If this policy is consistent with the idea of sustainable development, it is able to increase the quality of life. Sustainable development is a model of harmonization of social, economic and environmental systems (Kryk, 2003; Misztal, 2022). The goal of sustainable development is to use natural resources and organize social life in such a way as to maintain a high quality of life (Costa, 2022; Sun et al., 2023). The quality of life in cities where passenger cars dominate urban travel is much worse than in cities where the so-called clean transport. The use of cars by city residents causes excess exhaust fumes and noise, and they live in traffic congestion conditions (Petelewicz et al., 2016). An example is the city of Krakow, where there is still too little social awareness in the field of sustainable transport, which results in Krakow's situation still among the most polluted European cities. The motorization rate expressed in the number of cars per 1000 inhabitants in Poland increased two to three times in the years 1999-2016 (Wyszmorski, 2017).

The idea of sustainable development focuses on the future of electric buses, electric and autonomous cars, and the shared use of passenger cars in the light of the so-called sharing economy and cycling as a means of urban transport. The structure of urban travel is still dominated by passenger cars (Grzelec et al., 2017; Witkowski, 2023). The policy of sustainable transport development in cities should therefore aim to provide residents with a satisfactory quality of life, which is considered the most important resource determining the city's development, and to achieve a competitive advantage by attracting new capital to the city and new residents (Wyszmorski, 2011). To talk about sustainable transport, it is necessary to assume coexistence of implementation environmental values, society's needs and economic goals. When attempting to introduce modern means of transport, it is necessary to apply the smart administration and smart city philosophy, based on access to modern information and communication technologies and the creation of sustainable transport systems of a diverse nature (Mielczarek-Mikołajów, 2021). The transport sector is included in the smart city concept because with its development, all departments of the national economy function effectively and efficiently (Bıyık et al., 2021). It is also an extremely important area for sustainable development due to its social and economic benefits (Jać et al., 2015). You can't talk about a smart city without mentioning the applications used en masse in urban transport. One mobile transportation app can meet most needs in the transportation industry, from ridesharing to GPS location, route planning, navigation to data collection and analysis of traffic conditions for advice on when to travel (Nowotarska-Romaniak, Sczepanik, 2023).

Research on the implementation of mobile technology in the Polish public transport system has already been carried out. A review of information technologies supporting traveling by public transport in Poland and Germany was carried out, defining the basic features and

functions of the systems operating in the analyzed years (Bojda, 2011). Several studies analyzed the introduction of passenger information into the mobile system in various Polish cities. The research concerned cities such as Radom (Grad et al., 2013), Krakow (Kędzior, Bryniarska, 2015; Bryniarska, Gacek, 2018), Upper Silesian Industrial District (Kos, 2016; Bartnicki, 2023) and Lublin (Berlińska, Choma, 2018). The aim of the study in Krakow was to assess the level of passenger information based on the opinions of public transport users. Passengers assessed the quality of information available during the trip at the planning stage, at stops and in vehicles (Nowotarska-Romaniak, Sczepanik, 2023). Research was also carried out in Krakow (Bryniarska, Gacek, 2018) aimed at characterizing and assessing travel planners in terms of their usefulness for public transport passengers in the city. This study showed the extent to which websites and mobile applications are used and what information they contain is the most important, valuable and helpful. Sustainable transport must take into account the availability of transport services in accordance with the requirements of health and ecological safety, it must be consistent with the principle of intergenerational justice, with appropriate land use, and with the need to reduce noise. Its aim is to improve the standard of living and safety, promote public transport and take into account the needs of pedestrian road users (Piaseczny, 2016). In accordance with the policy of sustainable development, the development of public transport in cities must shape transport offers based on the results of research on current transport preferences potential passengers; use ecological means of transport using electric drive; provide public transport with priority in road traffic, e.g. by separating traffic lanes, buses powered by combustion engines should be replaced with electric buses (Hebel, 2017). Sustainable transport is the answer to failed policy transport that took place in the second half of the 20th century. The concept of sustainable transport is the basis for a number of activities of European Union bodies. There is a so-called White Paper of 28 March 2011 announcing the creation of a single European transport area while ensuring the reduction of gas emissions greenhouses. This will support ecology. It should be added that assumptions regarding sustainable transport are adopted at the EU and national levels, including at the local level (Mielczarek-Mikołajów, 2021, Biała Księga, 2011).

In order for sustainable transport to develop, public authorities should focus on reducing pollution, exhaust fumes and car traffic, minimizing noise, developing public transport, which can be achieved by creating effective public transport, as well as ensuring safety in transport or promoting alternative forms of transport such as bicycles and others (Sobol, 2017). A good alternative to public transport is the possibility of renting city bikes or electric scooters (Korneć, 2018). The concept of the so-called Car-sharing, i.e. a short-term car rental system. In Poland, this system has been operating since 2015. The first cities to introduce car-sharing include Warsaw and Wroclaw. Over time, they were also introduced in other cities (Pawłowska, 2017). In Krakow, private entities have been engaged in this type of activity, e.g. Traficar. When designing infrastructure transport for the city, it should be borne in mind that travelers choose travel routes mainly due to their own criteria optimization. Most often, these are: travel

time, travel comfort, and costs. Simultaneously urban development is quite dense and, especially in cities with a long history, not adapted to modern means of transport and the multitude of journeys. Therefore when designing the layout, on the one hand, needs should be taken into account as much as possible residents and visitors, and on the other hand, carefully analyze the restrictions resulting from development, current technical possibilities and available finances (Misztal, 2023). In relation to large metropolises, which is undoubtedly Krakow, a good solution seems to be electric scooters and UTO personal transport devices, i.e. electrically powered vehicles, e.g. an electric skateboard, an electric unicycle or a Segway without a seat or pedals, designed to be moved only by the driver in the driver's seat on this vehicle. To rent electric scooters, it is also necessary to have an application (He et al., 2021). In May 2021, changes to the Act of June 20, 1997, Road Traffic Law (Journal of Laws of 2021, item 450) came into force, which specify what it is and how the above-mentioned persons can move. vehicles. The road law also addressed devices powered by muscle power and adapted to move in a standing position, called movement-assisting devices (UWR). These include: roller skates, roller skates, skateboards, traditional scooters (https://www.gov.pl/web/infrastruktura/nowe-przepisy-dotyczace-hulajnog-elektricznych-i-urzadzen-transportu-osobistego2).

Another solution in urban transport is first and last mile transport. This is the first and last stage of the journey. This may apply to both the transport of people and goods (http://www.gios.gov.pl/pl/eea/aktualnosci/produkty/658-zrownowatyny-transport-wmiastach). Within in the last decade, with the development of technology, the number of online purchases has increased. This trend was also intensified by the pandemic, where access to stores was limited. In the transport of goods, the last mile is the delivery of the shipment to the final recipient - home or another agreed place. Parcel lockers make things easier, where parcels are left for many customers who collect the parcel at a set time (Wierzbicka, 2023). First-mile passenger transport is the delivery of a passenger from the starting point to a transfer point (where there are larger passenger flows), and last-mile transport is the delivery from the transfer point to the destination point (Niekurzak, Kubińska-Jabcoń, 2022). The construction of a Fast Agglomeration Railway, metro or tram is profitable in the case of large passenger flows. However, it should be remembered that people live several kilometers away from the stops of such means of transport. To use this mode of transport, they must cover the distance from their home to the bus stop. They can do it done on foot, by bike, by car, by another form of public transport, etc. This means the need to build appropriate infrastructure, such as parking lots or public transport (Byliko, 2023). Due to short routes and usually low population density, the vehicle does not have to accommodate many passengers or reach high speeds. However, it should travel frequently and stop close to the passengers' place of residence (Ochojski, 2022). An example of a vehicle that meets the criteria for first and last mile transport is the Navya Arma. It is currently in the testing phase. It has been produced since 2015 and can accommodate 15 passengers (including 11 in seats) (Niekurzak, Kubińska-Jabcoń, 2021). It reaches speeds of up to 45 km/h. It uses an electric drive and has a low floor. An example of a district designed to minimize car traffic is Seestadt Aspern in Vienna. A road runs through it, which constitutes

a "bypass" of the district center and leads traffic outside. Tested there are Navya vehicles. In addition to communicating with traffic lights (which allows priority to be given at public transport intersections) and detecting pedestrians and cyclists, the vehicles warn other autonomous vehicles about dangers. Work on sensors and communication was undertaken by Siemens. C2X technology was used, i.e. a road traffic management system that ensures communication between vehicles, infrastructure and traffic control centers. Vehicles receive data almost in real time, and on-board components (OBU) provide the vehicle's position, speed and direction (Tomaszewska, Florea, 2018).

Another effective solution in urban transport is the metro. The main goal of building the metro is to improve traffic by transporting a large number of passengers on a route that has no intersections and can therefore cover distances faster than on the surface. Ground traffic is also not interrupted by the metro (Witlowski, 2012). It is used in large cities with large passenger flows (Janczewski, Janczewska, 2021). Plans to build the first metro tunnel appeared already in the 1960s in the „Local Spatial Development Plan of Krakow". Various options were taken into account when developing the optimal solution, including: fast tram, metro, premetro) and these solutions were analyzed in 5-year time frames from 2028 to 2058. Taking into account financial, social and functional factors, one variant was chosen. On June 7, 2021, the "Feasibility study for a fast, collision-free rail transport in Krakow. The latest study assumes the construction of a pre-metro line that will be 21.82 km long and will have 32 stops along its route. It is to connect Jasnogórska Street with Wzgórza Krzesławickie. It will not be a metro as defined, but a tram that will quickly move from one part of the city to another. For this purpose, it is planned to build a 6.6 km long tunnel and a 1.4 km flyover. Therefore, it will be underground-ground-above-ground urban transport. The entire construction is to be completed in 2037, but the first sections are to be put into operation in 2033 (https://www.transport-publiczny.pl/wiadomosci/krakow-bedzie-mial-premetro-wyniki-studium-69116.htm).

Autonomous transport capsules are one of the most modern forms of transport. They move without a driver. The most famous ones are located at Heathrow Airport in London. They are an alternative to traditional buses. They can accommodate 4 people with luggage. They arrive at the terminals approximately every 1 minute and connect 5 terminals and a parking lot (El-Sherif, 2021). After passengers enter the vehicle, simply select their destination (terminal number or parking lot) on the touch screen. The automatic transport capsule will find the route and take passengers to their destination on average several times faster than a traditional bus. The capsules are computer-controlled, it is not possible to change their direction. For them, a viaduct was built connecting the parking lot with the terminal. The routes are repeatable, but depending on the selected destination, the capsule goes to a given place (Appio et al., 2019). The whole thing is specially prepared and is approximately 4 km long. The vehicle can reach speeds of up to 40 km/h. Such devices work well in confined spaces, such as airports, but it would be much more difficult and expensive to introduce them to general use in cities (https://podroze.se.pl/aktualnosci/automatyczne-kapsuly-transportowe-na-heathrow- lotn/1578).

3. Research methodology

For the purposes of this paper, the observational method was used. The observational method is a scientific procedure in which the occurrence of observable behaviors is revealed. These behaviors are organized and analyzed, both qualitatively and quantitatively, through the use of instruments and parameters that allow the detection of relationships between them (Anguera, Hernández, 2014). Their goal was to observe how the traffic of pedestrians and individual types of vehicles in the city is distributed depending on legal restrictions, as well as the distance from the center and other characteristic features. It is also helpful in developing urban infrastructure that takes into account the needs of residents. Eight points in the city were selected for the study. These are cross-sections of the streets: św. Tomasza, Szewska, Dunajewskiego, Karmelicka, Aleja Mickiewicza, Nawojka, Piastowska, Rajska. Two of them are located inside the 1st ring road (St. Tomasza - has no points in common with the Main Square, Szewska - has a point in common with the Main Square), two between the 1st and 2nd ring roads (Karmelicka - is an extension of Szewska Street leading directly from the Market Square, Rajska - is perpendicular to Karmelicka Street), two between the 2nd and 3rd ring roads (Nawojki - is an exit street from the city center towards the west, Piastowska - is perpendicular to Nawojki Street), one on the 1st ring road (Dunajewskiego) and one on the 2nd ring road (Aleja Mickiewicza). All points are located west and north-west of the Main Square. The research was carried out for 1 hour outside the early morning and afternoon peak, i.e. between 10 a.m. and 1 p.m., and for 1 hour during the afternoon peak, i.e. between 3 and 6 p.m. The following terms were introduced in the work: "morning" meaning the examination between 10 a.m. and 1 p.m. and "afternoon" defining the examination between 3 and 6 p.m. The test was not carried out in weather conditions that were significantly different from those in other tests. In practice, it was sunny during the research cloudy, but warm and no rain. It should be noted that during the study, some solutions previously used in connection with the Covid-19 pandemic remained, therefore a large group of people worked remotely, which also had an impact on traffic on the city streets (Olkiewicz, 2023). The research was carried out in May because it is not a month when many people go on holiday, and on the other hand, tourists are slowly starting to come to Krakow (Niekurzak, Kubińska-Jabcoń, 2021) and (Kubińska-Jabcoń, Niekurzak et al., 2022). The weather in May encourages the use of alternative means of transport, e.g. electric scooters, mobility devices or bicycles. It should be noted that the aim of the study was not to count all people moving on a given street, but only vehicles. Therefore, when implementing the test results, it should be taken into account that there may be 2 or more people in/on the vehicles. According to the information posted on the website of the Public Transport Authority in Krakow, the number seats in buses range from 16 to 45. Due to incomplete occupancy, it was assumed that on average 75% of the seats in the bus are occupied, which, rounded up to the nearest unit, is 25 occupied seats. A similar approach

was adopted in trams. Data for calculations were taken from the website of the Public Transport Authority in Krakow (http://kmkrakow.pl/informacje-o-systemie-kmk/tabor-naczków-operatorow.html).

An average of 75% of the seats occupied, rounded up to one, gives 40 people. The study assumed that the bus transports an average of 17 people - the average of the minimum and maximum number of people in the vehicle. The average number of people in a coach was 38 - one of the most popular carriers has coaches with 51 seats, while the minimum number of people is 24. The arithmetic mean of these two numbers was taken and the result was rounded to unity. Based on research published in "The Concept of Integration of Transport Systems in the Krakow Functional Area" the average passenger car capacity is 1.3 people (http://metropoliakrakowska.pl/wp-content/uploads/2019/01/Koncepcja-integracji-system%C3%B3wtransportowych-KrOF.pdf).

In this work, the coefficient was related to passenger cars, as well as taxis and cars used in car-sharing. Law enforcement cars usually carry two people, e.g. a patrol, which is why the value 2 was adopted at work. Motorcyclists usually ride alone, but there are also passengers. The coefficient was assumed to be 1.1, which means that every 10th motorcycle carries a passenger. A coefficient of 1 was assumed for a bicycle. Low-speed vehicles have very different capacities. Some routes are operated only by drivers without passengers. It was assumed that on average there are 6 people in a slow-moving vehicle at the same time. The main aim of the research was not to present the share of all moving people in traffic, but only the structure of means of transport. Hence the coefficients w adopted in this work Depending on the season, time of day, and the detail of the analysis performed, they may change. The research included the following means of transport and forms of movement: a) pedestrians - this group included people walking, running, riding in a stroller or wheelchair, carried on their hands, as well as using ride-on bikes and push-bikes for children, b) bicycle - for This group includes "vehicles with a width not exceeding 0.9 m, moved by the muscles of the person driving the vehicle". This group includes both traditional vehicles and those with an electric engine (so-called electric bicycles). The age of the person driving the vehicle was not taken into account, c) passenger car - this group does not include vehicles classified into other categories, in particular the group of taxis and cars used in car-sharing, delivery cars and law enforcement and municipal services, d) taxi and cars used in car-sharing - for the purposes of the study it was assumed that this was a car passenger car used to transport people (max. 8) for commercial purposes. These cars were recognized based on the inscriptions placed on the side of the vehicle and on the roof. The purpose of separating these vehicles was to examine how many vehicles are not used by one household, but are used by more people. This use of vehicles contributes to an increase in free parking spaces and is also one of the elements of the transport policy aimed at limiting the number of combustion vehicles registered in the city.

It should be noted that vehicles used in car sharing are the property of companies, e.g. Traficar, and the research does not include unmarked vehicles that, for example, a group of friends borrow from each other. Such a solution is currently so rare in Krakow that it can be omitted. During the research, it was observed that taxis are used much more often on the streets of Krakow than cars used in car-sharing, e) commercial vehicle - according to the Road Traffic Law, a heavy goods vehicle is „a motor vehicle designed to transport loads; this term also includes a truck and passenger car designed to transport loads and 4 to 9 people, including the driver" (Act of June 20, 1997, Road Traffic Law (Journal of Laws of 2021, item 450)). For the purposes of the research, it was assumed that the main purpose of using a delivery vehicle is to transport cargo. Due to the fact that some vehicles are used both for the purpose of transporting people and goods, the research may raise some doubts whether a given vehicle should be classified as a passenger car or a commercial vehicle. The criterion according to which the division was made was whether the vehicle was used mainly to transport people or goods. Membership in a given group was determined by the way the vehicle was marked on the body, the size of the vehicle, and possibly what was inside and on the vehicle. This is the most diverse group because it includes both relatively small vehicles, e.g. used to transport valuables and cash, and trucks. However, the aim of the study was not to focus on this group of vehicles, therefore, if there was greater interest in this group, the research should be repeated taking into account the appropriate subcategories. This group does not include vehicles of security and municipal services, f) bus - a vehicle used to transport people for commercial purposes on fixed routes, with at least 10 seats including the driver, and a maximum of 23 seats, g) coach - a vehicle used to transport people for commercial purposes on fixed routes, with a minimum of 24 seats, h) public transport bus - this group included both vehicles operating on their routes , as well as technical crossings, exit to the route and exit to the depot, i) tram - „a vehicle intended for the transport of persons or goods powered by electricity, moving on rails on public roads" (Act of June 20, 1997, Traffic Law road (Journal of Laws 2021, item 450). The study included both trams running on fixed routes and technical crossings, j) security and municipal services - this group included all municipal, uniformed and security services, regardless of the vehicle they used. These included both passenger cars and large vehicles, e.g. used for garbage collection, k) electric scooters, i.e. electrically powered vehicles, two-axle, with a steering wheel, without a seat and pedals, designed to be moved only by the driver on this vehicle, l) personal transport equipment (UTO) - „electrically powered vehicles, excluding electric scooters, without a seat and pedals, structurally intended for movement only by the driver on this vehicle" (Act of June 20, 1997, Road Traffic Law, Journal of Laws of 2021, item 450). This includes: electric skateboard or Segway, m) device supporting movement - these are "sports and recreation devices or equipment intended for the movement of a person in a standing position, powered by muscle power" (Act of June 20, 1997, Road Traffic Law, Journal of Laws of 2021 r., item 450). These include: skateboards, scooters and roller skates, n) motorcycles and mopeds - a motorcycle is a „two-wheeled motor vehicle of the L3e category or a two-wheeled

vehicle with a sidecar of the L4e category or a three-wheeled vehicle of the L5e category with symmetrical arrangement of wheels, while a moped is „a two- or three-wheeled vehicle equipped with an internal combustion engine with a cylinder capacity not exceeding 50 cm^3 or with an electric motor with a power not exceeding 4 kW, the design of which limits the driving speed to 45 km/h" (Act of June 20 1997 Road Traffic Law, Journal of Laws of 2021, item 450), o) low-speed vehicle - a motor vehicle whose design limits the driving speed to 25 km/h, excluding an agricultural tractor (Mikulik, Niekurzak, 2023). All low-speed vehicles that were observed during the study are popularly called melexes and are mainly used for transport for tourist purposes. In this work, the phrase „means of transport" is used to cover all forms of transport mentioned in the article.

4. Results and discussion

Results obtained at ul. Saint Thomas 9, where there are several popular eating places nearby, concerned people going to these establishments, as well as people who deliver food from restaurants on bicycles. Therefore, it should be assumed that pedestrian and bicycle traffic is not exclusively through traffic on this section. This is the street inside the first one the ring road, where entry is prohibited, except from 8 p.m. to 9:30 a.m only for the duration of cargo operations, money convoy and service technical, bicycles, special services, municipal services, horse-drawn carriages, special convoy to the bank, with the permission of the road authority. Movement of residents and taxis are allowed. On the street of St. Thomas is a paid parking zone The survey was conducted on May 31, 2025, between 11:53 and 12:53 and from 15:25-16:25. Morning and afternoon traffic on the street Saint Thomas (Table 1).

Table 1.
Morning and afternoon traffic on Saint Thomas Street - own study based on Bazior A.

Mode of transportation	**Test time**	
	Morning	**Afternoon**
walking	220	332
bicycle	9	21
car	24	16
Taxi	4	2
truck	4	6
enforcement services	1	0
electric scooter	0	1
movement assist device	0	1
motorcycle, moped	3	1
Sum	**265**	**380**

Pedestrian traffic has by far the largest share in traffic – over 80% of all traffic. This is due to legal restrictions on cars driving around the center. In the afternoon, pedestrian traffic was approximately 50% higher than in the morning. Afternoon cycling more than twice as many were recorded. However, the number of passenger cars was greater in the morning – 50% more than in the afternoon. In total, no cars passed however, a lot - on average, a passenger car passed once every 3 minutes. The rest too few means of transport have been observed to draw conclusions so far passing them. Below are the results obtained at ul. Szewska, where traffic is prohibited in both directions, except for bicycles, which can move on it in both directions sites 24 hours a day. In the direction from Jagiellońska Street to ul. Dunajewski they can Special and municipal services also move around, arriving at the property or garage and with the permission of the road authority. It is allowed from 8 p.m. to 9:30 a.m entry servicing institutions and shops located in this area. People's vehicles disabled people can enter only between 6 a.m. and 12 p.m. In accordance with with signs, it is a residential zone, so pedestrians can move around the entire area street width. Observation was carried out in the morning from 11:10 to 12:10, and in the afternoon from 15:10 to 16:10. Both tests were carried out on May 25, 2023. Morning and afternoon traffic on ul. Szewska (Table 2).

Table 2.
Morning and afternoon traffic on the street Szewska – own study based on Bazior A.

Mode of transportation	Test time	
	Morning	**Afternoon**
walking	939	1078
bicycle	119	143
car	1	0
truck	1	0
enforcement services	6	2
electric scooter	11	7
movement assist device	1	2
Sum	**1074**	**1232**

Pedestrians have the largest share of traffic. Both in the morning and in the afternoon it is he over 87%. In second place are bicycles, which constitute approximately 11% of the total traffic. All motor vehicles constitute a marginal share of traffic and are used almost exclusively by municipal services, e.g. cleaning. There are more of them in the early morning hours. This is a popular street for people who want to take a shortcut through the Main Market Square, as well as tourists and people who want to relax after work or school. You can often meet groups of several young people heading towards one place from many eating places in this area. Due to limited vehicle traffic mechanical, you could meet people working on renovations who carried all the necessary renovation equipment with them. This is unusual in other locations where delivery vehicles of renovation and construction teams are found. Results obtained at ul. Dunajewskiego 3 were obtained taking into account that it is valid speed limit to 30 km/h. Passenger cars can move in one direction towards Karmelicka Street, while buses, trams, bicycles, police and City Guard - in both directions. Dunajewskiego Street is in a restricted

traffic zone. Behind Matejki Square, i.e. before Basztowa Street, there is an entry prohibition sign, which does not apply to vehicles with a type K parking subscription for sectors A1, A2, A3, A4, from 6-10 p.m. and 1-2 p.m. only for and on time. carrying out loading operations and technical service, with an electric engine without trailers, bicycles, horse-drawn carriages, taxis, CC, CD, UTO and electric scooters, special services, marked medical assistance, commuting to the property, garage or purchased reserved space, KMK, on time of RTV transmissions, with mail, transporting money to banks in zones A and B, with the permission of the road authority and municipal services. The study was conducted on May 25, 2023, from 10:05 a.m. to 11:05 a.m. and on May 26 2023 from 15:50 to 16:50. Due to the fact that the pedestrian and bicycle route runs parallel to the street through Planty, therefore, the study was carried out both on the cross-section of the street and on the appropriate section of Planty. Morning and afternoon traffic on the street Dunajewski (Table 3).

Table 3.
Morning and afternoon traffic on the street. Dunajewski's division into Planty and the street - own study based on Bazior A.

Mode of transportation	**Test time**			
	Morning		**Afternoon**	
	Street	Plants	Street	Plants
walking	176	173	373	569
bicycle	31	45	119	207
car	131	0	155	0
Taxi	04	0	72	0
truck	35	0	20	0
autobus KKM	22	0	26	0
tram	65	0	67	0
movement assist device	22	0	7	0
electric scooter	1	5	10	26
movement assist device	0	1	2	28
motorcycle, moped	7	0	20	0
slow-running vehicle	2	0	5	0
Sum	**586**	**224**	**876**	**830**

Traffic on the street Dunajewskiego is more diversified than inside the 1st ring road. Pedestrians constitute 43% of traffic in the morning hours, and bicycles constitute over 9% of traffic. In the afternoon, pedestrians account for approximately 55% of traffic, and bicycles account for approximately 19%. You can observed a more than twofold increase in the number of pedestrians and a more than fourfold increase number of cyclists in the afternoon compared to the morning. The traffic of electric scooters, mobility devices and motorcycles is also greater in the afternoon. The city's transport policy aims to limit car traffic and therefore the first ring road is not two-way along its entire length. Road signs are also erected ordering driving in the direction "from the Market Square". In the morning, a larger number of law enforcement vehicles and delivery vehicles were observed. The differences between the traffic of private passenger cars and taxis are not large. Almost all car traffic goes towards ul. Karmelicka. Public transport is average every 40 seconds. This transport is organized by the Municipality

of Kraków. NO movement of private buses and coaches was observed. Results obtained at ul. Karmelicka 50, which connects the first and second ring roads and has one lane in each direction, which are not separated from each other, are presented below. The tram track is not separated. This means that all combustion vehicles, trams and bicycles have one lane in each from the pages. The speed limit is 30 km/h. The survey was conducted on May 24, 2023, from 10:25 a.m. to 11:25 a.m. and on May 26, 2023, from 5:07 p.m. to 6:07 p.m. Morning and afternoon traffic on the street Karmelicka (Table 4).

Table 4.
Morning and afternoon traffic on the street Szewska – own study based on Bazior A.

Mode of transportation	Test time	
	Morning	**Afternoon**
walking	658	895
bicycle	85	199
car	205	178
Taxi	82	68
truck	40	8
autocar	1	0
tram	49	57
enforcement services	14	4
electric scooter	7	15
movement assist device	0	5
motorcycle, moped	11	10
Sum	**1152**	**1439**

In the afternoon, ul. More than 30% more pedestrians crossed Karmelicka and more than twice as many bikes as in the morning. More passed through in the morning delivery vans (up to 5 times), taxis (by approx. 20%) and cars personal services (by approx. 15%) and security services (3.5 times more). Cars delivery vans are largely dependent on individual working hours enterprises. An interesting observation is a small difference in the number of passenger cars depending on the time of day, and even a smaller number in the afternoon (by approximately 14%). There were 3.5 times more law enforcement cars in the morning than in the afternoon, and more than twice as many electric scooters. Movement aids only appeared in the afternoon. Public transport vehicles mainly include trams. In addition, there was one coach from a private company. 16% more trams passed in the afternoon than before noon. This is due to the timetable, because during rush hours there are trams and buses usually run more frequently. Based on the study conducted, it is impossible to determine the difference in the number of motorcycles, because the difference shown is not statistically significant. The results obtained on Adam Mickiewicza Avenue were carried out at pedestrian crossing connecting Krakowski Park with ul. Kochanowski with a shift towards the intersection with ul. Czarnowiejska. There is no pedestrian crossing traffic lights. The avenues have 3 separated traffic lanes in each direction green belt. The speed limit is 50 km/h. Rightmost lane on each side constitutes the so-called bus lane intended only for buses, coaches, buses, taxis, police, City Guard, motorcycles, ambulances, municipal Transport of Disabled Persons. There is a sidewalk on the

Old Town side, while on the Krowodrza side there is a very narrow, practically unused sidewalk. However, it should be noted that from Plac Inwalidów to ul. Czarnowiejska along Aleja is located Krakowski Park. The alley running along Mickiewicza Avenue serves as a route walking and cycling. In the study, it was treated as part of the Avenue. There was a test conducted on May 24, 2023 at 11:24-12:24. The afternoon examination was also conducted on May 24, 2023, from 4:00 p.m. to 5:00 p.m. Morning and afternoon traffic on al. Mickiewicza divided into the direction of vehicle traffic (table 5). Table 5 does not include pedestrians, bicycles, electric scooters and movement support devices.

Table 5.
Morning and afternoon traffic on al. Mickiewicz's division into the direction of vehicle movement - own study based on Bazior A.

Mode of transportation	Test time			
	rano w stronę		Popołudniu w stronę	
	Czarnowiejskiej	Placu Inwalidów	Czarnowiejskiej	Placu Inwalidów
car	1194	1164	1106	1174
Taxi	70	122	66	80
truck	107	155	74	87
bus	52	49	53	48
autokar	6	12	11	8
autobus KKM	41	37	55	50
enforcement services	19	15	6	9
electric scooter	21	24	31	63
slow-running vehicle	0	1	0	0
Sum	**1510**	**1579**	**1402**	**1519**

The number of passenger cars does not vary significantly, taking into account the direction driving or time of day. Approximately 2,300 people pass through the avenue every hour cars. Additionally, 192 taxis and so-called cars passed by in the morning. car sharing, and in the afternoon 146 such cars. This is not a significant difference. It passed before noon over 60% more delivery vehicles. This may be due to the fact that delivery to stores, and services, e.g. construction, are provided to a greater extent during working hours. It is worth paying attention to the fact that among cars delivery vehicles, only one case was a car that can be colloquially referred to as a TIR. There is no transit road through Aleje Trzech Wieszczów. Through the Avenues Many public transport buses pass by, as well as private buses and coaches carriers. A bus or coach runs one way on average every minute, however public transport bus every 1.5 minutes one way. 34% more buses city buses run in the afternoon. This is related to the timetables they take into account higher traffic volume during rush hours. Security services drove over more than Twice as many in the morning than in the afternoon. This is mainly because some companies work mainly in the morning. In the afternoon, twice as many motorcycles passed through than in the morning. During 2 hours of research, 1 low-speed vehicle was observed, which means that there are also such vehicles on the Avenue, but their number is negligible number. Collective results of other means of transport divided by alley in the Park Krakowskie and on the street (table 6).

Table 6.
Aleja Mickiewicza - morning and afternoon traffic on sidewalks and alleys - own study based on Bazior A.

Mode of transportation	Test time			
	rano w stronę		Popołudniu w stronę	
	Alley In Krakow park	Outside the park on the street	Alley In Krakow park	Outside the park on the street
walking	104	42	118	58
Bicycle	53	5	121	21
electric scooter	6	2	12	2
movement assist device	0	0	8	0
Sum	**163**	**49**	**259**	**81**

Table 6 shows that most pedestrians, cyclists and people riding scooters move along the alley in Krakowski Park. Of course, some of them could have walked around the park and not gone to a specific destination, but considering that on this side of the Avenue, apart from the alley in the park, there is a very narrow sidewalk, they chose the alley. Moreover, the layout of the paths makes it the shortest way to walk along the Avenue. The study was conducted behind a large fork in the paths, further limiting the number of people just walking through the park. The number of pedestrians increased by 20% in the afternoon. The number of bicycles increased by 140%. This may be due to the fact that some residents use bicycles as a means of transport to and from work or university, but also use them for rides and running errands after work. The number of electric scooters almost doubled in the afternoon compared to the morning hours. Movement support devices only observed after noon. Results obtained at ul. Piastowska, which is parallel to the ring roads, were carried out between the intersection with Rolnicza Street and Cadets. In this section, the road consists of a road (one lane in both lanes). directions) and sidewalks separated by green belts on both sides of the road. The speed limit in the examined section is 50 km/h. The study was conducted by one person on May 27, 2023 at: 11:40 – 12:40 and 16:35 – 17:35. Morning and afternoon traffic on the street Piastowska (Table 7).

Table 7.
Morning and afternoon traffic on the street. Piastowska – own study based on Bazior A.

Mode of transportation	Test time	
	morning	afternoon
walking	93	155
bicycle	43	95
car	603	642
Taxi	32	28
truck	93	49
bus	1	0
autobus KKP	5	5
enforcement services	5	5
electric scooter	3	5
movement assist device	5	3
motorcycle, moped	10	14
Sum	**893**	**1001**

A clear difference can be observed in the number of pedestrians. In the afternoon there were them about 67% more than in the morning. More than twice as many bicycles were ridden in hours afternoons. The traffic of delivery vehicles was definitely higher in the morning, almost twice as many such vehicles passed by then than in the afternoon. Whereas in the case of passenger cars and taxis, there is no significant difference. Also no significant differences were noticed in other means of transport. Results on the street Nawojki, which is a road connecting ring road II with III, were obtained at the level of ul. Grammar 10. At this point, Nawojki Street consists of two lanes - one in each direction - not separated by greenery. There are sidewalks on both sides of the street. The study was carried out by one person on May 27, 2023, from 10:32 a.m. to 11:32 and 15:25 – 16:25. Morning and afternoon traffic on the street Nawojki (Table 8).

Table 8
Morning and afternoon traffic on the street Nawojki – own study based on Bazior A.

Mode of transportation	Test time	
	morning	**afternoon**
walking	245	285
bicycle	18	45
car	760	945
Taxi	53	63
truck	159	95
bus	15	12
autocar	6	5
autobus KKP	42	47
enforcement services	18	4
electric scooter	2	7
movement assist device	0	6
motorcycle, moped	8	21
Sum	**1326**	**1536**

Pedestrian traffic in the morning and afternoon was similar. Whereas 2.5 times more bicycles rode in the afternoon than in the morning. Number of cars passenger traffic in the afternoon was approximately 25% higher than in the morning. There were few taxis less in the morning. There were 40% fewer delivery trucks in the afternoon. In the morning definitely more - more than three times - passed by law enforcement vehicles. In turn, in the afternoon, more electric scooters and devices were observed movement aids and motorcycles. This may indicate that these means of transport residents treat it as a form of recreation or a way to get around after work, and not for everyday travel on fixed routes Rajska Street 4 connects ul. Karmelicka from ul. Dolne Młynów. Thanks to this, you can get to Aleja Trzech Wieszczów. The speed limit is 30 km/h. It has one lane and a contralane for bicycles. The study was conducted on May 31, 2023, between 10:42 a.m. and 11:42 a.m. and 4:32 p.m.-5:32 p.m. Morning traffic and afternoon on ul. Rajska (Table 9).

Table 9
Morning and afternoon traffic on the street Rajska – own study based on Bazior A.

Mode of transportation	Test time	
	Morning	**Afternoon**
Walking	238	407
Bicycle	17	49
car	191	274
Taxi	18	18
truck	20	18
enforcement services	1	3
electric scooter	2	2
movement assist device	1	1
motorcycle, moped	10	11
Slow-running vehicle	0	1
Sum	**498**	**783**

In the afternoon, approximately 70% more pedestrians walked and almost three times as many crossed bicycles and 40% more passenger cars than in the morning. Differences in the number of remaining vehicles are too small to draw conclusions from them. Szewska, Karmelicka and Nawojki streets were selected for the analysis due to their location streets through which you can leave the city center. Szewska Street connects the Main Market Square and the 1st ring road, ul. Karmelicka connects the 1st and 2nd ring roads, and ul. Nawojki is an extension Czarnowiejska Street, with which they form a connection between the 2nd ring road and the planned one part of the 3rd ring road. Based on tab. 2, 4 and 8, the number of means of transport used was compared. The collected data indicate a different structure of means of transport in the studied street sections. The least variety of means of transport was observed on Szewska Street. Only pedestrians and cyclists constitute a noticeable group of people traveling. They constitute 87.5% and 11.6% of all, respectively means of transport. The largest group of funds is on Karmelicka Street transport are pedestrians (59.9%). Cars come in second place passenger cars (14.8%), and thirdly bicycles (11%). They came in fourth place taxis and cars used in the form of car-sharing (5.8%), and in fifth place are trams (4.1%). On Nawojki Street, the largest group are passenger cars (59.6%), and pedestrians second (18.5%). Delivery vehicles came in third place (8.9%), in fourth place are taxis and cars used for car sharing (4.1%), in fifth place are public transport buses (3.1%), and only in sixth place bikes (2.2%). It can be noticed that the farther from the Main Square, the number of pedestrians decreases. The difference between Szewska Street and Karmelicka Street is 464 people, but between Karmelicka Street and Nawojki Street it is 1,023 people. This means that for every 700 m further from the Market Square, the number of pedestrians decreases by approximately 500. On Szewska Street, a pedestrian passes on average every 3.5 seconds, on Karmelicka Street every 4.6 seconds, and on the street Nawojkas every 13.6 seconds. Pedestrian traffic is common within the 2nd ring road. A probable explanation for this phenomenon is the relatively short distances between destinations as well as restrictions on car traffic. By When planning traffic organization, it is worth paying attention to the fact that there

are pedestrians in two locations they accounted for over 50% of the traffic, and on Nawojki Street they account for almost 20% of the traffic. Kraków, as a city with a long tradition and historic buildings, was not adapted to heavy car traffic, especially closer to the center at the time of construction There were no known cars in the buildings. This constitutes space limitations at transport infrastructure planning. Only 1 passenger car passed on Szewska Street for 2 hours, 383 on Karmelicka Street, and 1705 on Nawojki Street. 4.5 times more passenger cars passed on Nawojki Street than on Karmelicka Street. On Karmelicka Street a passenger car passes on average every 18.8 seconds, while on Nawojki Street every 4.2 seconds. Measurements from Szewska Street are statistically insignificant. The reason are traffic restrictions inside the 2nd ring road, which is often uneconomical in terms of time and it is financially difficult to drive through Karmelicka Street. There is Nawojki Street used by local traffic, as well as by people wishing to leave the city towards the north and west. The flow is hampered by traffic lights because it's right next to it there is a pedestrian crossing at the examined cross-section. However, none were observed formation of large road congestions. Based on the analysis, it can be concluded that that restrictions are introduced in the city center to limit traffic automotive, they work well. Car traffic on the street connecting the 2nd and 3rd ring roads is 4.5 times higher than on the street connecting the 1st and 2nd ring roads. 262 bicycles rode on Szewska Street for 2 hours, and on Karmelicka Street 284 bicycles, and 63 bicycles on Nawojki Street. Difference between bicycle traffic on Szewska and Karmelicka streets is not large, but compared to the street Karmelicka, bicycle traffic on Nawojki is 4.5 times smaller. This is due to the fact that on the section furthest from the Market Square more people travel by car or public transport. Moreover, probably on that outlet section passengers travel longer distances – which may be too much for some a long cycling route, e.g. from outside the city. In addition, cyclists quite often they avoid busy routes for the sake of their safety and driving comfort. It would be necessary therefore, conduct the study on streets and paths parallel to Nawojki Street. On Szewska Street, a bicycle passes every 27.5 seconds on average, and on Karmelicka Street every 25.4 seconds, and on Nawojki Street every 1 minute and 54 seconds. There are no trams, buses, minibuses or coaches on Szewska Street. Communication collective buses can run on the 1st ring road. Due to the short distances, access to it Is relatively very good. The tests took 2 hours on Karmelicka Street 106 trams and 1 bus, while 89 KKM buses passed on Nawojki Street, 27 buses and 11 coaches. On Karmelicka Street the tram passes averagely every 53 seconds. One coach is statistically insignificant, but it is worth knowing that such vehicles are also able to drive on the street (the infrastructure is there prepared for it). A KKM bus passes by every 44 seconds on Nawojki Street, bus every 4.4 minutes and the coach every 10.9 minutes. Public transport both on the street Karmelicka and Nawojki Street are well developed and run frequently. There are no taxis on Szewska Street because traffic is not allowed there car. 150 taxis arrived on Karmelicka Street within 2 hours and cars used in car-sharing, and such vehicles at 116 Nawojki Street. Is that's 23% less. This is not a very big difference, but it may indicate that there is more people in more remote

places uses public transport from the Market Square and private cars. This may be due to the regular service on this route to and from work or university and covering longer distances. For long ones journeys, using taxis is not financially profitable. Moreover, on the street Karmelicka there are greater restrictions on vehicle traffic, some of which are taxis disabled. This makes them more attractive within the 2nd ring road. On the street A taxi or car-sharing vehicle passes Karmelicka every 48 seconds, and on Nawojki Street every 1 minute and 2 seconds. During the 2 hours of research, 1 car passed on Szewska Street delivery van, on Karmelicka Street 48 delivery vehicles, and on Nawojki Street 254 such vehicles. Szewska Street has restrictions on vehicle traffic, so the result is very small and statistically insignificant. Number of cars on Nawojki Street delivery vehicles was over 5 times larger than on Karmelicka Street. Under investigation it was observed that on More large trucks pass by on Nawojki Street and other large-sized ones. In the city center there are more narrow streets, where the vehicle is difficult to move. Additionally, traffic restrictions apply. Is very few large-format stores, which means delivery vehicles deliver goods in smaller quantities. Store warehouses are often located outside III bypass, so an entrance road towards the center is necessary to make multiple deliveries. A delivery truck passes on Karmelicka Street on average every 2.5 minutes, and on Nawojki Street every 47 seconds. It's worth realizing this traffic planning in the city that many people drive around the city to transport supplies for stores, renovation materials or letters. Such transport will be very difficult or even impossible to replace by public transport or transport bicycle. Based on the tests carried out, it was found that 1 car delivery van on Karmelicka Street is 8 cars passenger cars, and on the street Nawojki on average for 6.7 passenger cars.

Eighteenelectric scooters passed on Szewska Street within 2 hours Karmelicka 22, and on Nawojki 9 street. Electric scooters are relatively new mode of transportation. Currently, most electric scooters are rented. Research has shown that for now it is a less popular means of transport than bicycles. On Szewska Street there are on average 14.6 bicycles per 1 electric scooter, on Karmelicka Street 12.9 bicycles, and 7 bicycles on Nawojki Street. An interesting observation is that the ratio scooters on Szewska and Karmelicka streets are similar to the ratio of bicycles on the above streets. The ratio of electric scooters on Nawojki Street to bicycles should be multiplied by 2 to obtain a similar result as on Szewska Street and Karmelicka. From this we can conclude that travelers have the same reasons they choose bicycles and electric scooters as means of transport. These are appropriate measures for people who do not have to transport large and heavy items and are not afraid wind and changing weather conditions, they travel on long routes appropriate for their condition/battery capacity and do not have balance problems. Riding an electric scooter requires less physical effort and is easier in transport and folding. An analysis was also made of passenger transport in terms of the structure of participation in the movement of people, divided into the mode of movement on Szewska, Karmelicka and Nawojki streets, taking into account the average transport in vehicles. In each of the three cases, the sum of pedestrians and those using public transport is greater

than 50%, and on Szewska and Karmelicka streets it constitutes over 80% of traffic participants. This proves that great attention should be paid when planning urban infrastructure and transport on pedestrian amenities, especially inside the 2nd ring road. From communication The collective road on Karmelicka Street is used by over 60% of people traveling through it examined cross-section. On Nawojki Street, due to the larger one percentage of people using it from cars, this percentage is 48%. It is therefore necessary to take care of yourself for the proper functioning of public transport. This is not just for the sake of it limiting the use of private cars, but above all improving comfort and quality of life in Krakow. The further from the center, the greater the importance passenger cars, and the importance of bicycles is decreasing. Because the street Nawojki is an exit street from the city, so the number of cars may be overestimated and lower number of bicycles compared to parallel streets.

5. Conclusions

The process of developing means of transport depends, among others, on: from transport policy city and residents' awareness of sustainable development. As can be seen in the example of a large metropolis such as Krakow, road traffic restrictions mean that relatively few people use passenger cars inside the 2nd ring road. On the examined streets there is the highest share of pedestrians inside the 2nd ring road and passenger cars on the 2nd ring road and further from the center. There is practically no public transport inside the 1st ring road. But The first ring road is in second place among the streets examined in terms of the number of KKM vehicles. Public transport other than public transport has a significant share on Aleje and Nawojki Street, i.e. on streets with significant passenger flows. Due to the limitations and large share of KKM in the city center, it is practically not profitable to introduce private transport or compete on routes located inside the 3rd ring road. The exception are streets constituting the exit route from cities. Each studied street has a means of transport that can be considered dominant on it: pedestrians or passenger cars. The smallest difference between the dominant and the second-best means was found on Rajska Street. Electric scooters constitute approximately 8.7% of bicycle traffic in Krakow. Devices personal transport was not observed in the study, but the share of devices was supporting movement is marginal. In total, the largest number of passenger cars were recorded on all streets (8,763), of which 53% were on al. Mickiewicza. A total of 7,158 pedestrians were observed, 28% of them on Szewska Street. During the research, bicycles passed through, which constitutes 16% of passenger car traffic and 20% of pedestrian traffic. 28% of bicycle traffic takes place on Dunajewskiego Street. This means that the movement of individual means of transport in Krakow is not uniform. This especially applies to movement automotive. There are special communication routes running through the city way exploited by a given type of vehicles. This applies to both vehicles public transport

that runs only on designated routes, such as and vehicles of private persons. When planning the organization of transport in the city this should be taken into account. It is easier to properly plan optimal solutions in the case of several larger streets, e.g. by protecting against noise or ensuring quick passage, among others. thanks to Intelligent Transport Systems rather than trying to redirect traffic to many smaller streets. It also improves the quality of life of residents. Most people use public transport on the surveyed streets Passenger cars came in first place, while pedestrians came third. When designing changes to infrastructure, the expectations of groups using different means of transport should be taken into account. Every day, travelers make choices about which route to take or walk. Infrastructure may encourage or discourage them to do so, e.g. bicycle traffic on Nawojki Street is relatively low. probably due to heavy car traffic and lack of a dedicated bicycle lane. One possibility is to separate traffic, such as on Dunajewskiego Street (bicycle and pedestrian traffic largely takes place in Planty) or Aleje (where pedestrian and bicycle traffic takes place in Krakowski Park). The second is to separate parallel streets for specific means of transport. Drivers will be happy to choose their own route, where there are two lanes in each direction and few traffic lights. However, pedestrians most people prefer to walk along a quiet street, with green belts and no car traffic relatively small.

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