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Introduction

In the context of public authorities implementing a sustainable mobility policy, the provision of the public urban transport services offer is regarded as an element of that policy. On account of its characteristics: high transport capacity, low emissions and noise per passenger-kilometre, low energy consumption, and low land use (compared to private cars) (Wyszomirski, ed., 2008), public transport should serve as a pillar of sustainable mobility (Grzelec, Hebel, Wyszomirski 2020).

In undertaking actions in respect of sustainable mobility, public authorities align their own policies with the goals of sustainable mobility. Concepts in the field of sustainable development, an element of which is sustainable mobility, appear to focus on two main ideas. There is no contradiction between economic growth and "green" pro-ecological development (Wanner 2015). It is recognised that the current social and economic system, oriented towards accumulation and growth, can and should be replicated, and our way of life should be maintained, achieving ecologically sustainable development through a change of subsystems using modern technologies (Scruton 2012). Proponents of the second concept, degrowth, claim the need to radically transform the social and economic system through: "a fair reduction in production and consumption that enhances human well-being and improves environmental conditions both locally and globally, in the short and long term" (Schneider, Kallis, Martinez-Alier 2010). When conducting sustainable mobility projects, in order to demonstrate the justification for pursuing such a policy, politicians and officials refer to the reports of agencies such as (EEA 2022) and reviewed scientific publications (Gallo, Marinelli 2020). They also cite political and social justifications concerning the influence of sustainable mobility in areas

such as well-being, equality in society, and quality of life (Beyazit 2011; Jones, Lucas 2012). Justifications for actions advancing the goals of sustainable transport can be found in the micro- and macro-economies, using the Lorenz curve and the Gini coefficient to measure the outcomes (Delbosc, Currie 2011).

The critical approach to sustainable mobility policy is not concerned with the policy itself[1], namely, the aspiration to reduce the negative effects of urban transport on cities and the lives of their residents. There are, however, calls for the wider involvement of shareholders in the creation and implementation of sustainable mobility plans (Botte et al. 2019). Pointing to attempts to reconcile ecological goals with economic growth (Krähmer 2021), calls have been made to reconsider the classification of electric vehicles as an effective instrument of sustainable mobility (Henderson 2020).

Leaving aside the unresolved matter of the best path to sustainable mobility, it can be claimed that it not only affects the views of academics but is also reflected in economic practice, including the identified actions of local authorities in transport policy. From the point of view of the goals and solutions included in this monograph, it is important to highlight that in many publications dedicated to the problem of sustainable development, including sustainable mobility, the authors cite research and report perspectives that are selective towards matters requiring further research and discussion[2], and often ignore the problem of shaping human needs and attitudes rooted in personal freedom, under the assumption that a collectivist approach to civilizational development and the pursuit of set objectives is consistent with the norms of democratic societies. In many publications on topics such as electromobility in public urban transport in Poland, it is ignored that many studies of cost-benefit

[1] Nevertheless, there are also scientific publications which are critical towards the idea of a scientific consensus concerning the human causes of climate change (Dentelski et al. 2023).

[2] An example of this is the universal practice of limiting citations to the summaries of Intergovernmental Panel on Climate Change (IPCC) reports.

analyses show that, in the current energy conditions, the operation of electric vehicles is without economic or social justification (when factoring in internal costs) (Jagiełło 2021).

The author of this monograph is of the opinion that sustainable mobility must not be only a political project, conducted using public funds, which omits the market as a reference point for assessing the benefits, costs, and risks for social and economic development. The concepts of sustainable mobility and the smart city, both of which employ modern technologies, must be treated as innovations, which should ultimately be verified by the market and the procedures of public choice based on democratic rules.

In this context, the right solution for public urban transport, which will allow its services to form the principal sustainable means of meeting transport requirements, is to recognise the role of marketing in shaping the service offering of this transport mode. Marketing concepts related to shaping transport services, pricing, service distribution, promotion mix, customer service, tangible service evidence, acquiring and retaining loyal customers, as well as establishing partnership-based principles of cooperation within the logistics chain, are proven methods of effective operation. They align with the objectives of sustainable mobility and enable their achievement. The realisation of the concept of marketing mix in public urban transport allows services to be offered that are adapted to the transport needs, expectations, and preferences of residents. Only a high level of satisfaction with the quantity and quality of services offered can be an indicator of the ability of this mode of transport to satisfy an increasing number of transport requirements and improve its share in urban transport.

This monograph presents the following research hypothesis: The adaptation of the number and quality of public urban transport services to the different preferences and expectations of residents on the quality of services and their complex transport behaviours requires the transport organiser and provider to carry out marketing research. Accordingly, the achievement of sustainable mobility goals is determined by shaping

the public urban transport services offer according to the marketing rules and regulations, based on the results of marketing research. The results of such research should be used to validate the effectiveness of the activities of public authorities in relation to sustainable mobility.

The aim of this monograph is to show that the decision processes concerning the quantity and quality of public urban transport services should be based on the outcomes of research into demand, preference, transport behaviour, and customer satisfaction. Research outcomes in these areas may support the decision-making process, however, it should be remembered that not all factors that determine demand on public urban transport services identified by researchers can be implemented in practice. This is determined by specific market-related constraints, including financial constraints and constraints resulting from certain transport behaviours. Attempts to change these behaviours, which are reliant only on administrative solutions (obligations and prohibitions) may cause society to strongly resist the goals of sustainable development, which in democratic countries, in certain political conditions, could lead to their radical modification or even to resignation from such goals.

Publications dedicated to the issues addressed in this monograph are spread across multiple themes within the scope of the research topics. Papers published in journals tend to focus on narrow research areas, much like the reports produced by institutes or organisations dedicated to the functioning of public urban transport. Monographs on the complex issue of the functioning of this transport mode typically focus on demand, price elasticity of demand, or market organisation. In the majority of cases, work on marketing research deals with market phenomena as a whole, whereas the subject matter of public transport research is most often explored in handbooks. This monograph aims to address this gap by showing the role of marketing research in achieving the goals of sustainable mobility in urban areas.

The monograph consists of seven parts.

Chapter 1 characterises sustainable mobility in terms of its essence, the management of this form of human activity, the conditions influencing

the implementation of actions outlined in Sustainable Urban Mobility Plans (SUMP), and implementation concepts, including Mobility as a Service (MaaS).

In Chapter 2, public urban transport is presented as a sustainable mobility service. The discussion focuses on the development of motorisation as the main driving force of urban mobility and the consequences of the uncontrolled increase in the number of cars and the number of trips carried out by this transport mode in cities and agglomerations. The chapter includes examples of breaking the development deadlock of cities connected with the development of motorisation, which leads to the dysfunction of urban areas. It discusses the role of public transport in the realisation of urban mobility goals, whilst providing examples of the effective substitution of journeys by car with public transport. The conditions for the development of public transport are also indicated.

Chapter 3 focuses on the characteristics of public urban transport. In the course of the analysis of the market characteristics of this transport mode, the main conditions concerning the formation of demand, supply, prices, and competition in public urban transport are presented.

Chapter 4 looks at the scope and characteristics of the sources, methods, and research instruments used in marketing research related to public urban transport. The chapter's content is largely based on the experiences of the author and his team, with whom he has worked for more than 30 years as a researcher and practitioner on shaping the market for this transport mode.

In Chapter 5, the author discusses the main elements which make up the public urban transport services offer, determined by the characteristics of transport services. This section of the monograph contains a review of the literature and makes use of the rich but dispersed research results on demand, preferences, and transport behaviour in the international and Polish literature as well as the author's own results and those of his colleagues. The principal focus of the discussion in this chapter are the attributes of public urban transport.

Chapter 6 includes an overview of the results of chosen marketing research into public urban transport in the context of their application in the implementation of sustainable mobility in cities and agglomerations. A significant part of this chapter contains the author's own research findings, published in journals and conference proceedings, as well as analyses that have yet to be published. It also quotes interesting research results of other authors, including those with whom the author had the pleasure of working in various research teams.

Chapter 7 presents the conditions for conducting and utilising marketing research in public urban transport in meeting the goals of sustainable mobility.

The monograph ends with a summary of the most important conclusions.

In the English literature, the terms "transport" and "transit" are used interchangeably and refer to bus, coach, light and heavy railway, tram and ferry services, as well as taxis and rental cars (Wallin Andreassen 1995; Parkan 2002; Balcombe et al. 2006). The term "public transport" is mainly used in Europe, Japan, and Australia, while the terms "mass transit" and "public transit" are more commonly used in North America and Southeast Asia (primarily in China, Hong Kong, and Singapore). These terminological conventions, however, are not strict rules and are often used interchangeably (Redman et al. 2013). In the literature, the term public urban transport refers to all passenger transport services offered in cities and metropolitan areas (i.e., within the scope of urban mass transit, as well as individual transport services such as car sharing, bike sharing, e-scooter rentals, taxis, and Uber). The subject of this monograph is, however, mainly public urban transport in the form of buses, trolleybuses, trams, urban rail, metro, water trams and other public transport modes as part of the integrated services offering, in particular in terms of tariffs. Therefore, the author uses the term public urban transport in this narrower meaning. An exception is made with the research results of other authors in cases where it was unclear whether these results concern public urban

transport. In such instances, the original vocabulary, or a faithful translation, has been maintained (e.g., public transport, urban transport).

The monograph is aimed at researchers and students involved in the study of sustainable mobility and public urban transport. It will also be of interest to practitioners and policy-makers implementing specific solutions concerned with mobility and the functioning of public urban transport.

Part of the marketing research results presented in the publication, especially in Chapter 6, but also those concerning practices in forming a public urban transport services offer, are the original work of the author and have not been previously published. The author is a member of staff in the Transport Market Department in the Faculty of Economics at Gdańsk University. He is also a practitioner in research and shaping the public transport services offer in the greater Gdańsk area and in other cities in Poland.

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The monograph is the result of many years of research work of the author and his team of colleagues, whom he would like to thank sincerely for their years of collaboration, reflected in the author's scientific research work and work as a practitioner in the operation of public urban transport. I would especially like to thank Professor Olgierd Wyszomirski, my mentor, doctoral supervisor, and for many years my superior at the University of Gdańsk and in economic practice. I would also like to express my gratitude to Professor Katarzyna Hebel, my colleague at the Transport Market Department, with whom I still have the pleasure of conducting research, analyses and publishing research results. I also thank Maciej Helbin and Adam Raszpunda for their help in compiling data for analysis. Finally, I would like to thank Doctors Hubert Kołodziejski, Director of the Public Transport Board in Gdynia; and Kamil Bujak, Chair of the Public Transport Metropolitan Association of Gdańsk Bay for permission to use the results of marketing research financed by the entities under their management.

1. The nature and determinants of sustainable mobility management in urban areas

In a sustainable approach to socio-economic development processes, concern for economic growth is accompanied by respect for ecological resources. In the long run, the development of the economy must remain within the limits of the environment's carrying capacity. Therefore, basic human needs should be met in a way that respects the sustainable use of resources. The traditional, still currently employed approach to economic development aims to achieve maximum economic growth, without paying attention to the associated ecological aspects. At the present stage of sustainable development, its guiding paradigms are undergoing modification.

Changes in the rules of functioning of the entire economy and the transition to sustainable development have resulted in radical changes in the production of energy and the protection of the climate. This transition is characterised by the management of processes (Monkelbaan 2019). There is not one optimal management development method that ensures its sustainability. When implementing initiatives, each case must be considered individually. It cannot be assumed that the exclusive use of the self-regulating market mechanism or solely the actions of public authorities will suffice to achieve the goals of sustainable development (Kemp, Parto, Gibson 2005).

Paprocki indicates the obstacles appearing in some of the principles for a sustainable economy: "Analyses carried out in the second decade of the 21st century have indicated growing doubt about future scenarios that assume continuous and increasingly accelerated growth in generation capacity and efficient energy production using the aforementioned

renewable energy technologies Thus, it raises doubts about the legitimacy of the development process following an exponential growth pattern. In several Western European countries, a slowdown has been observed in the development of photovoltaic cell capacity, along with a stabilisation in the share of electricity generated by these cells in total electricity production (...), and it cannot be ruled out that the pace of implementing new solutions will decelerate sooner than enthusiasts anticipate. As a result, the expected growth in outcomes may slow down or even fade out entirely, leading to a development process that follows the course of a logistic function" (2018).

Achieving more sustainable transport necessitates coordinated and concurrent efforts in land use management, transport, and finance, alongside the execution of strategic infrastructure investments and a focus on environmental care (Kennedy et al. 2005).

Zuidgeest and team discuss a sustainable transport system, i.e., a transport system that meets the needs of the public in terms of mobility, accessibility and safety, whilst staying with the accessible and affordable environmental, financial, and social resources. Accessible and affordable resources are outlined based on intergenerational aims (Akinyemi, Zuidgeest 2000; Zuidgeest, Witbreuk, Van Maarseveen 2000).

Sustainable mobility is not a new idea – it was presented in the European Commission's Green Paper on the effects of transport on the environment in 1992, which was a continuation of "Our Common Future" and its discussion on the global challenge of sustainable development.

Sustainable mobility constitutes an alternative paradigm within which the complexity of urban environments may be examined, and the interrelationships between land use and transport can be reinforced (Kennedy et al. 2005). Sustainable urban mobility ensures the possibility of travelling to one's destination in a manner that is convenient, easily accessible both economically and spatially, while minimising the impact on the environment and on other individuals (Lam, Head 2012).

Should the public travel more effectively, in a different way, and/or less often, mobility may become sustainable. Based on this statement,

we can distinguish the three principal strategies of sustainable mobility: efficiency, change, and reduction. The efficiency strategy, indicates that environmental efficiency and availability can be improved through more efficient, innovative technologies, including hard (technology) and soft (reorganisation, promotion, change of habits) solutions. The change strategy refers to changes in travel structure (changes in the share of the various travel modes. The means to achieving a reduction in travel include appropriate spatial planning, teleworking, and a shift in existing travel preferences (Holden et al. 2020).

Three distinct positions emerge in debates concerning who should be entrusted with the implementation and execution of measures aimed at achieving the goals of sustainable mobility (Dryzek 2022):

- entrusting the matter to experts and authorities (*homo bureaucratis*);
- letting residents decide (*homo civicus*);
- leaving the key decisions to companies and the market mechanism (*homo oeconomicus*).

Sustainable urban mobility requires undertaking measures, which should result in: limitation of the need to travel; reduction in journey distances; use of more ecological transport; assurance of greater transport efficiency; improvements in the availability of infrastructure, especially for pedestrians and cyclists (Karoń et al. 2017: 20).

Sustainable mobility is also defined as a purposefully shaped spatial structure and transport behaviours which support the optimisation of journey lengths, in which cars do not undermine the functioning of public urban transport and non-motorised modes of transport, and the maintenance of harmony between transport, the natural environment, and the built and cultural environment is ensured (Rudnicki 2010). Urban sustainable mobility should, therefore, be understood within the context of the long-term strategy for the future development of urban areas, including transport infrastructure and mobility services (Costa, Neto, Bertolde 2017).

An effectively functioning sustainable urban transport system requires the implementation of measures aimed at: reducing mobility needs, adopting transport policies that support a shift in travel modes through the selection of non-polluting travel modes that occupy relatively less urban space, improving the quality of public transport in cities, and considering the determinants of its operation at the urban planning stage, as well as the use of alternative fuels derived from renewable sources (Banister 2008).

The sustainable mobility goals of individual cities vary in their details. European sustainable mobility goals are also subject to change and revision, like all strategic goals. In the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions, the following assumptions were adopted as the objectives of the strategy for sustainable and smart mobility – European transport on the road to the future (Komunikat Komisji do Parlamentu Europejskiego... 2020):

- at least 30 million zero-emission vehicles will be on European roads;
- 100 European cities will be climate-neutral;
- high-speed rail traffic will double;
- regular public transport for distances up to 500 km should be carbon-neutral within the EU;
- autonomous mobility will be widely deployed.

Sustainable mobility goals in cities may encourage local authorities to implement comprehensive measures in its development. They most often include: the accessibility of urban areas for different types of vehicles, urban logistics, intelligent urban transport systems, and road safety in cities (Chamier-Gliszczyński 2016).

The particular aims of mobility management are:

- meet transport needs through more efficient and integrated use of existing transport and urban infrastructure;
- reduce traffic congestion through a reduction in the number and duration of car journeys and a reduction of demand for these journeys;

- limit noise, air pollution and greenhouse gas emissions through the use of energy-efficient vehicles and alternative fuels;
- improve the availability of transport modes through modern technical and technological solutions within vehicles and the infrastructure;
- integrate different transport modes and improve connections (within the meaning of, for example, an increase in the frequency of public transport routes);
- improve the economic efficiency of transport system operations (Nosal, Starowicz 2010).

Mobility management is described as actions connected with the planning, organisation, coordination and control of the movement of people and goods through the use of available human, financial, material, and information resources with the aim of affecting attitude, demand, and transport behaviours and leading to the use of alternative transport modes to cars (Nosal, Starowicz 2010).

Mobility management includes the promotion of sustainable transport and the management of the use of cars, through a change in the attitudes and behaviours of travellers. Sustainable mobility in cities, improvements of the environmental conditions in urban areas, public health and well-being can be achieved through the creation of conditions and incentives for a shift from the use of private vehicles to public transport, walking, and cycling (Elias, Shiftan 2012). Such a shift takes place when public urban transport is widely available and the quantity and quality of its services meet the expectations of the public. An increase in the number of pedestrian journeys will also occur, provided that the safety of these pedestrians is ensured and the attractiveness of urban spaces for them is enhanced (Baron et al. 2019).

Advocates of sustainable mobility propose the concept of public urban transport 2.0, aimed at increasing its modal share (the so-called modal shift) and promoting shared mobility. Change in the structure of urban journeys is believed to be a more important issue than that of electromobility,

with indications showing that true changes in this area may lead to a 20% reduction in CO_2 emissions (Holden et al. 2020).

It is proposed that sustainable mobility plans should be implemented by:

- quantifying the various elements of a sustainable transport system, i.e., identifying the essential needs and aspirations of the movement of people within the urban environment;
- describing the resources used by the transport system and their quantities;
- harmonising the elements of sustainable development (using modelling techniques) for use in the planning and designing of sustainable transport systems (Zuidgeest, Witbreuk, Van Maarseveen 2000).

The relationship between mobility instruments and individual transport behaviours and their change in the direction of sustainable mobility is analysed by specialists, researchers, and practitioners (Shiftan, Geerling, Stead 2012).

An important element of the formation of sustainable mobility is the establishment and acceptance of chosen, defined progress and regression monitoring indicators on the path to achieving sustainable mobility goals. The subject literature includes various research approaches to sustainable mobility in urban areas (Campos, Ramos, De Miranda E Silva Correia 2009; Litman 2021). The level of sustainable mobility is decided by, inter alia, the share of ecological transport in the modal split, the sustainable mobility strategy implemented in the city in question, the development of car sharing, financing of the public bike-sharing system, and the intelligent card system. Conversely, its effects are decided by safety (the number of road accident deaths), the level of atmospheric, water, and earth pollution, the motorisation indicator, and the average travel speed (Ciaston-Ciulkin 2016).

The comparative analysis method, through the use of composite sustainable mobility indicators for chosen European cities, has allowed for the analysis of three measures of sustainable mobility: economic, social, and environmental. It has enabled the classification of cities according

to the factors which contribute to the greatest degree to the achievement of sustainable development in transport; the wealthiest and biggest cities usually have the most sustainable transport systems. Research has also indicated certain opportunities for the improvement of the transport system through an increase in the share of public transport and the avoidance of urban sprawl (Alonso, Monzón, Cascajo 2015).

One concept for the implementation of sustainable mobility, in which public urban transport is positioned as the key pillar of urban transport, is Mobility as a Service (MaaS). MaaS radically changes the way the passenger transport market functions. In the literature, it in presented as one of the most revolutionary trends in the sector since the start of mass production of passenger vehicles in the early 20th century. In MaaS systems, users and their needs are indeed a key variable in the planning and functioning of the transport sector. The implementation of the MaaS model offers a personalised, comprehensive range of transport services, tailored to the declared needs of its users (Zawieska 2018). Thanks to this approach, the system is not limited only to public mobility. It can also be applied to the transport of goods, especially in urban areas.

MaaS services may be designed and serviced by a public or private entity based on a licence (for a specific time). MaaS services conducted by a public entity, being a *de facto* public monopoly, facilitate the implementation of the applied regulations and ensure access to services on the basis of public value. Public authorities are assured access to information indispensable for shaping mobility policies, including infrastructure. Another reason for the MaaS model to be maintained by a public entity is seen in the role public urban transport (managed by public authorities) plays as the backbone of the system of sustainable mobility. It secures access to databases containing a substantial volume of journeys. The public monopoly within MaaS may restrict the number of service providers and flexibility of the system by creating bureaucratic barriers for entry and disregarding user preferences, especially those who are not users of public transport. It is likely that MaaS will be dominated by public services. In such circumstances, private entities may create

a competitive MaaS model, exclusive of public transport, based mostly on passenger cars and bicycles. There are concerns that some legal solutions may restrict the scope of possible actions performed by a public entity, restricting it exclusively to the functions of a given tier of public authority (EMTA 2019).

Research conducted in London showed that MaaS influences a broader perception of the available possibilities when choosing a travel mode, and it may contribute to a decrease in private car use (Matyas 2020). The literature concerned with MaaS implementation (Butler, Yigitcanlar, Paz 2021) indicates that:

- demand is restricted by a lack of effective cooperation between the authorities and private entities providing mobility services and complex solutions supporting the integration of subsystems, inclusive of business support;
- MaaS provides an attractive solution for elderly residents who use public transport and some private car users;
- implemented solutions translate to a decrease in the volume of travelled kilometres, parking frequency, and giving up private vehicle ownership (usually, there is another car in the household);
- MaaS solutions in individual countries are characterised by features that correspond to the nature of the solution within the scope of mobility and the applicable law;
- MaaS should not be treated as a separate instrument of urban sustainable mobility policy.

The model's aims may be achieved only through its integration with other tools such as low-emission zones, pedestrianised areas, street parking restrictions, and resident mobility management (Polis 2017).

2. Public urban transport as a mobility service

Coordination of the development of a transport network and urban planning constitutes a precondition for the sustainable development of urban areas. Beside the visions of a city's 'coherence' with transport that are promoted in the strategic documents of individual countries, local examples of change implementation in the concept of urban development are of utmost importance. The experiences of many cities indicate the significance of ideological conflicts regarding spatial development and the development of transport networks, and the divergence of interests and their impact on the implementation of specific development visions. Certain past decisions can have a significant influence on urban and transport policies within cities, making it impossible for the authorities to adjust without delay to the strategic changes occurring in other cities (Gallez et al. 2013).

Beginning in the 1950s, the boom of motorisation in developed countries led to adjustments in urban planning in order to accommodate increasing car traffic and the growing demand for parking spaces. Urbanists and urban traffic engineers quickly noticed that car transport requires the planning of more space per capita in comparison to active transport modes (bicycles) and public transport (Leurent et al. 2024). Within 60 years, the belief that private cars play the leading role in meeting the transport needs of urban residents was abandoned in favour of the vision that maintaining certain urban values goes hand in hand with sharing roads among various transport modes, and that mixed-use urban space should serve as the starting point for road planning (Pousin 2005). In the 1970s, following a referendum in Bern, a decision was

made to close two central areas of the city to car traffic. In the mid-1970s, in Strasbourg, the procedures of planning transport infrastructure were altered following the so-called Agglomeration Act. The purpose of the changes was to pedestrianise a large central area of the city.

In the 20th century, in the West (in Poland in the 21st century), owning a car was no longer a luxury but became attainable for every average family. This resulted in overburdening urban road networks with traffic, which led to many problems with the functioning of the cities. Apart from congestion, there was a notable increase in noise pollution and emissions from transport. An increasing number of central areas within cities were adjusted to accommodate the growing car traffic (the roads were broadened; new parking spaces were constructed). These actions were taken at the expense of other road users as well as public spaces and green zones. Despite good access to central areas by transport, their attractiveness slowly decreased (Gadziński, Goras, eds., 2019).

It seems that an important reason for the growing significance of private cars in urban travel in Poland – one that has been underemphasised in the literature for many years – is the process of spatial planning. This process approves the development of residential areas with low-rise buildings that are not constructed alongside the existing public transport infrastructure. As a result, it is difficult to provide public transport services to these residential areas, which in practice translates to an increased use of private cars. Also, the increase of significance of passenger cars has its source in the location of large shopping centres and other objects generating traffic at a substantial distance from the urban areas with more dense development and public transport infrastructure. These locations provide economies of scale, but generate an increase in the number of individual journeys (Grzelec, Hebel, Wyszomirski 2020).

The advocates of sustainable urban planning are critical towards solutions which take into account such features as, for example, street network planning that reduces walking distances, the creation of congested and burdensome collector and distributor routes, resulting from an imposed hierarchy rather than interconnected networks, compounded

by suboptimal street designs and dendritic, hierarchical systems that prioritise car owners and users (Parham, Jones 2020). Already in the 1990s, the cities of Bern, Basel, Zurich, and Karlsruhe became cities where the processes of coordinated plans for their development and transport networks as well as construction of shopping centres and services in the vicinity of transport hubs, led to more sustainable usage of different transport modes (Donovan 1997).

Implementation of the policies of sustainable mobility was becoming increasingly based on the results of research into optimising the use of urban space. In India, a heterogeneous microsimulation model allowed for an evaluation of urban space usage. It showed that 66% of examined road users were bus passengers, yet they occupied only 26% of the road surface (Thamizh, Vedagiri 2010). A similar study conducted in Berlin, which compared the share of road surface with its utilisation by different road users, found that car users had, on average, 3.5 times more road space available to them than those who did not drive or ride in a car (Creutzig et al. 2020). In Melbourne, it was established that pedestrians generating a 56% share in multimodal trips could use only 33% of the road surface that was dedicated to pavements. At the same time, the study showed an oversupply of infrastructure in relation to some types of sustainable mobility. For example, the share of bike paths in the city amounted to 12% of road surface, whereas cyclists had a share of only 2% in travel (De Gruyter, Zahraee, Young 2022).

In many cities, the restriction of car traffic brought about the desired effects. The following cities serve as an example of restricting car usage: Gothenburg, Marseille, Berlin, Karlsruhe, Gelsenkirchen, Halberstadt, Konzen near Aachen, Castelnau-le-Lez near Montpellier, and Stuttgart (Wesołowski 2008). Restrictions on passenger car use in cities, and indeed restrictions imposed on car users, may prove counterproductive in the long term unless they are preceded by substantial improvements in the quality of public urban transport and the voluntary acceptance of changes in travel behaviour by the majority of residents, leading to an increased share of trips made by public transport, walking, cycling, and car sharing.

One-sided actions of local authorities reduced to restricting the freedom of choice between various transport modes (directed primarily against private passenger cars) may have a negative effect on economic development, especially within the automotive market.

Shared mobility is seen as a potential remedy to the difficulties brought about by individual transport modes (Currie 2018; Standing, Standing, Biermann 2019). Intermodal interchanges, MaaS and other ways of sharing mobility may persuade residents to resign from travelling by private car (Liyanage et al. 2019; Spickermann, Grienitz, von der Gracht 2014). However, some researchers point to challenges that render these forms of mobility less likely to become widespread. Among such causes they name: individual beliefs and mobility culture (Bergman, Schwanen, Sovacool 2017; Clements, Kockelman 2017) as well as individual decisions regarding mobility, determined by economic factors (Manski 2000; Nijkamp, Kourtit 2013). Shared mobility does not take into account many factors connected with comfort (such as no zone restrictions to travel).

In addition to academic publications, the vision of replacing private cars with carsharing, based on the paradigm of giving up car ownership for the sake of accessibility to mobility services, became the subject of numerous debates at the World Economic Forum. At the current stage, it is difficult to perceive such debates as a benchmark for transport policies in democratic countries, where property ownership and the right to possess it remain fundamental pillars of personal freedom. It should also be remembered that in democratic countries, public authorities and their actions are subject to validation through general elections. Decision-makers' reliance on media and poll-driven popularity – characterised by highly volatile expectations – and their susceptibility to pressure from public opinion, often representing small but well-organised activist groups, frequently lead to decisions guided not by the strategic objectives of transport policy but by political goals in the strict sense. This may lead to a very populist understanding of sustainable mobility and attaining its aims, or even to a complete abandonment of its goals. On the basis of a report from 2020, produced by The European Court

of Auditors, it can be said that the value of spending on mobility within cities that was funded by European structural and investment funds, increased from 11.2 billion euros in the period 2007–2021 to 16.3 billion euros in 2014–2020 (ECA 2020). The majority of infrastructural and rolling stock investments into public transport in Poland have not yet produced a proportionate change in the transport behaviour of residents as per the aims of sustainable mobility (Wolański 2022).

A rational solution would be the creation of a substitute, complementary public transport subsystem that would be capable of providing a level of comfort comparable to that of using privately owned cars and one that would meet all mobility demands. The example of Singapore is a model success born out of coordinated actions taken simultaneously by the government and reflected in the transport development strategy (Spirin, Zavyalov, Zavyalova 2016). Screening research from 2018 revealed a direct correlation between the quality of services as a measure of the accessibility of public transport and the intention of using the services (Mugion et al. 2018).

Public urban transport is perceived as a type of transport that may help to organise a sustainable mobility system that meets the transportation needs of local communities. This type of transport is much more effective in comparison to individual transport. This results from its lower land intensity, emissivity, and energy consumption per user (Beshah, Kitaw, Berhan 2013; Newman, Kenworthy 1999).

The distinctive nature of public urban transport as a field of management and a service of general interest creates difficulties in clearly defining its concept and in unambiguously situating it within both the vertical (sectoral) and horizontal classifications of transport (Wyszomirski, ed., 2008). Within Poland's legislation, there are varied terms referring to public urban transport such as, for example, municipal transport, communal municipal transport, and commune public transport.

In Poland, the tasks of local authorities concerning the operation of public urban transport are outlined in the respective legislation. Local governments cannot opt out of performing these tasks on the grounds

of financial constraints. They are also not authorised to privatise public transport precisely because they are assigned to govern it. It is, however, possible to delegate the execution of the tasks to a private entity (Moszoro 2010). In the functional structure of a city, public urban transport serves as an 'urban product', that is, a component of the city's overall offering directed towards its users (i.e. residents, tourists, investors). In some cases, it also, to a large extent, determines the image of a city. Trolleybuses may serve as a good example of this. In some European, countries trolleybuses are rare, therefore cities in which they operate are perceived as unique (Wyszomirski, ed., 2008).

Local authorities often face serious financial obstacles in the process of improving the quality of public urban transport. It has been demonstrated that improving the financial stability of public transport helps to realise its potential environmental and social benefits, as it increases accessibility to its services. In Germany, over the two decades from 1990 to 2010, the quality of public urban transport improved significantly. This was reflected in increased employee productivity (between 1998 and 2006, the number of kilometres operated per employee rose by 31%), reductions in unit costs and public subsidies (passenger revenue per vehicle-kilometre increased by 21%, while budgetary subsidies per passenger fell from €0.57 to €0.39), and a notable rise in passenger numbers (an increase of 22%) (Buehler, Pucher 2011).

The need to subsidise public transport from local authority budgets arises from its recognised utility, its role as an instrument for achieving transport and social policy objectives, and, in recent years, the rising costs associated with increases in fuel and energy prices as well as the introduction of modern, environmentally friendly vehicles. Unconventional sources of financing for this type of transport are used in many cities (Table 1).

Table 1. The share of alternative assets in the budget or public transport costs

Category	Example	Share in the (annual) public transport budget or in the investments
Tax paid by the employer	Versement (France)	33% of transport companies' budget (e.g., 20% of RATP budget in Paris).
	Portland (USA)	In 1985, 66% of the local transport authority's budget was financed from this source.
Ownership tax	Vancouver (Canada)	In 1999, 99% of operating budget was financed from this source.
	San Francisco (USA)	50% of expenditures for the new infrastructure and 5% of the operations budget was financed from this source.
Developmental fees	San Francisco (USA)	In 1996, 2% of the operating budget of urban rail (Muni) was financed from this source.
Parking fees	Heathrow (England)	0.3% of total expenditures of the airport, including large infrastructural projects, were financed from this source.
	Amsterdam (Netherlands)	Total revenue from parking covered about 1% of total tram infrastructure costs (Ijtram).
Road usage charge	San Francisco (USA)	49% of the operating budget of a bus and ferry company was financed from this source.
Local motorisation charge	Washington State (USA)	In 1986, 26% of the local transport organiser's budget was financed from this source.
Consumption tax	Reno (USA)	In 1997, 66% of operating budget of a local transport company was financed from this source.
	Fort Worth (USA)	In 1996, 71% of the operating budget of a local transport company was financed from this source.

Table 1 (cont.)

Category	Example	Share in the (annual) public transport budget or in the investments
	Atlanta (USA)	Revenues from taxes were divided in the following way: 50% was allocated to the operating budget (53% of the transport company's budget); and 50% financed new infrastructure

Source: (Ubbels et al. 2001).

This type of transport is characterised by subsidies. This results from the fact that public urban transport:

- meets the goals of sustainable mobility, including the operation of routes that are persistently unprofitable, whilst sustaining the prices of fares at a level acceptable to the residents even at times when the revenues from ticket sales do not cover the costs of providing transport services;
- meets the goals of social policy that assume providing access to public urban transport through the introduction of discounts and free travel entitlements for chosen groups of residents.

In the light of economic theory, subsidies for public urban transport are justified by the existence of economies of scale (Mohring 1972; Pedersen 2003)[3] and by the fact that the congestion and environmental costs generated by private vehicle users are not internalised. Moreover, local authorities often fulfil revenue redistribution goals by subsidising public transport. These funds are allocated for particular groups of residents: children, youth, elderly, and disabled. However, it is notable that the low demand elasticity for private transport in relation to public transport ticket prices

[3] A different stance is held by van Reeven, who using microeconomic models proves that the economies of scale are not necessarily enough to justify subsidising public urban transport. If consumers do not use the timetables (in circumstances where services are frequent), then the frequency ensuring maximisation of profit is identical to the frequency providing maximum welfare and may be used by them to their advantage (van Reeven 2008).

decreases the effectiveness of subsidies, seen as a mechanism used for the optimisation of the division of transport tasks within a city. Research conducted at the beginning of the 20th century in the cities of Spain has proven that the impact of income redistribution on the decrease of income inequality is minor, especially taking into account the relatively weak influence of consumption of public transport services on the budgets of average households (Asensio, Matas, Raymond 2003).

Due to the particular nature and public utility of public urban transport resulting from attaining the goals of sustainable mobility policy through the use of its services, some researchers and policymakers advocate that it should be funded entirely from a city's budget (free public transport). According to them, this type of funding would better correspond with the goals of sustainable mobility. The traditional mode of operation of the transport system within cities does not envisage charging private car users with the external costs, nor does it take into account the gradual depletion of natural resources. In support of free public urban transport, claims are substantiated that the act of waiving charges is merely the same as increasing the level of its subsidisation. We are simply shifting from approximately a one-third, half, or two-thirds subsidisation of total costs to a complete, 100% subsidy covering all outgoings (van Hulten 2015). Proponents of free public transport often overlook, when advancing environmental and social arguments in its favour, that public transport services are the outcome of entrepreneurial activity, entailing all the consequences of running a business, including fixed and variable costs, capital investment, and the maintenance of infrastructure throughout its life cycle. Such considerations fail to recognise that the trend towards expanding free access to public transport, as well as the range of its services, is typically not accompanied by a corresponding increase in budgetary resources to offset the resulting deficit. Examples of rich cities that offer free public transport (Geneva) are incomparable to the situation of many cities found across the European Union. On the other hand, leading examples of cities that introduced free public transport in the last dozen or so years, cited by the supporters of the concept as model solutions, did not stand the test

of time (Świder 2024) (free public transport 2013). It is vital to remember that attaining the goals of sustainable mobility requires a long-term, stable policy of financing urban mobility. Financing public urban transport services solely from the budget does not provide for such stability. A change of political priorities on the part of the authorities or resulting from changes in the government most often leads to an abandonment of the goals and assumptions of a given policy or its complete re-modelling, causing financial sources to be re-allocated from free public transport to other public utility goals. An example of such a turn of events can be seen in the Belgian city of Hasselt. In light of the above facts, financing public urban transport services through the market, provided that the services satisfy the most important travel demands, seems to carry a smaller risk from the perspective of supply stability. Firstly, transport preferences and behaviours do not change overnight, in contrast to political priorities. Secondly, changes in residents' transport behaviour should stem from increased ecological awareness and attitudinal shifts grounded in individual autonomy, rather than – as is too often advocated – through restrictions, regulatory pressures, or structural and coercive measures imposed on residents. The path towards changes in transport behaviour and systems can be shaped by marketing research and, beyond the market context, by education and the intergenerational transmission of values, including environmental awareness.

The instruments required to enhance the competitiveness of public urban transport can be grouped into three main areas of action: regulation, organisation, and market adaptation. The regulatory sphere is primarily the domain of public authorities. Market adaptation falls within the remit of service providers, while the organisational sphere constitutes a shared arena for joint actions undertaken by public authorities, public transport boards, and operators. The difficulties in reaching a definitive definition of public urban transport in the Polish context translate directly into challenges for its practical operation. State regulations sometimes create difficulties in conclusively classifying certain transport services as urban transport, particularly when these services extend into suburban areas.

This, in turn, affects the organisation, financing, and integration of public passenger transport.

The evolution of regulations governing public urban transport has made some political authorities inclined to exercise direct control over this form of public service and to expand their competencies across strategic, tactical, and operational decision-making, despite the appointment of specialised entities for this purpose (Grzelec 2013b). Under such circumstances, the service offer of public urban transport is shaped not by traffic studies, marketing research, or economic and financial analyses, but rather by the pursuit of political aims.

The role of public urban transport in shaping sustainable mobility stems from the fact that (Newman, Kenworthy 1999):

- companies and residents align their decisions regarding the location of headquarters and the choice of dwellings with the availability of a high-quality public transport offer;
- residents using public transport tend to combine individual trips into single journeys, thereby reducing their overall number;
- households using public transport give up car ownership;
- public transport users complete their journeys using a combination of public transport, walking, or cycling.

The large carrying capacity of public transport predisposes it to play the primary role in meeting urban mobility needs. Mutual interactions between public transport and private cars can, however, in extreme cases, result in a significant deterioration in service quality. This, in turn, risks triggering the so-called 'vicious circle' of urban public transport, whereby the number of passengers opting for car travel increases cyclically, while the number of public urban transport passengers decreases.

The challenges in realising the potential of public urban transport as a means of achieving sustainable mobility goals arise from the fragmentation and lack of integration among the entities responsible for a city's transport operations, planning, and urban design, as well as from the conflicting interests of these entities. This limits their capacity to address the factors that determine the attractiveness of public urban transport

and its competitiveness relative to private cars. In some cases, favourable outcomes for this type of transport service can be achieved through changes to legal regulations and the organisational framework of the system (Hrelja, Khan, Pettersson 2020). It is important to deepen the understanding of cities' experiences where significant positive outcomes have been achieved in using public transport as an instrument of sustainable urban mobility policy, combining theoretical knowledge with practical experience (Grzelec, Hebel, Wyszomirski 2020).

The effective use of public transport as a tool for advancing sustainable mobility depends on the prerequisite of universal access to its services. In most countries, public transport is regarded as a public utility service, and the principle of accessibility is implemented within this framework. The definition of accessibility is typically narrowed to two principal categories: spatial accessibility, which relates to reaching the location where the public transport service is provided and is measured in terms of time or distance (Cheng et al. 2018). The other category of accessibility is connected to a person (a passenger, a resident). This second category is concerned with activities undertaken by people who travel in space using available resources and technologies (Miller 2007). Analysing the resources required for travel makes it possible to distinguish a subcategory of accessibility, namely economic accessibility, which refers to residents' purchasing power and determines their ability to undertake journeys by specific means and transport modes. In the sustainable mobility plans (SUMP), accessibility to public transport services is defined as accessibility to: stops and stations, rolling stock, public space, and information (Holve 2023).

In 2016, Lättman and colleagues proposed broadening the conventional assessment of accessibility by incorporating measures that capture residents' subjective evaluation of accessibility and link it to their transport behaviours (Lättman, Friman, Olsson 2016). Increasing the accessibility of public transport services leads to higher levels of daily activity among residents, provided that the increase is accompanied by a greater modal share of public transport in overall trips. Active lifestyle can be directly

influenced by providing accessible public transport modes, especially to the low-income groups and minorities (Besser, Dannenberg 2005). The connection between the accessibility of public transport and employment have long been researched (Dujardin, Selod, Thomas 2008; Ozbay, Ozmen, Berechman 2006; Sanchez, Shen, Peng 2004; Yi 2006), yet some researchers manifest elevated cautiousness in forming definite correlative connections in this scope. For example, British studies have demonstrated that a 10% difference in bus travel time between areas is correlated with a difference in employment levels of as little as 0.13–0.30%, depending on the type of area. Higher values were observed in more urbanised areas, which typically have better-developed public transport networks and higher levels of usage (Johnson, Ercolani, Mackie 2017).

Social inequalities regarding mobility and access to basic goods and services constitute elements of social policies aimed at combating social exclusion. A Geographic Information System (GIS) is being used in research focused on social exclusion connected to transport. GIS allows for the identification and evaluation of the connection between particular social circumstances, public transport accessibility needs, and provision of those services (Fransen et al. 2015). In Poland, analyses of accessibility of public transport were carried out in such cities as Poznan, Cracow, and Warsaw. The isochronic analysis of accessibility of the public transport network in Poznan revealed that the city lacks radial tram lines that would secure fast connections between the city's districts, especially in its northern part (Gadziński, Beim 2010). The research in Cracow confirmed the earlier results showing discrepancies in the accessibility to urban public transport (measured by the density of the network and frequency of services on individual routes). A much higher density ratio is, of course, identified in the city centre of Cracow (Bárta 2020). The Warsaw research revealed that the attractiveness of public transport is lower in comparison to the trips completed by car and bike, taking into account the time of travel, speed and accessibility. The greatest potential benefits are associated with metro and rail networks (Mościcka et al. 2019).

It is important to stress that sustainable development is also concerned with fears associated with the exploitation of current resources and its goal is to sustain their levels for further generations. From the point of view of economics, sustainable development is connected to the idea of optimisation of resources, with the provision that transport is planned in a way that allows for better accessibility and capability to reach the desired location with a reduced use of resources (Vega 2011). In this context, sustainable development and accessibility to transport services may be mutually contradictory. With respect to transport infrastructure, sustainable development calls for consideration of the value of shared public space, whereas the accessibility principle at times treats that same space as an obstacle to be overcome (Tyler 2017).

3. Characteristics of the public urban transport market

Demand on the public urban transport market results from the existence of transportation needs (mobility). A mobility need is defined as a person's willingness or necessity to relocate from one place to another using a transport mode. In part, mobility needs are satisfied without the use of vehicles, namely by walking; some are satisfied through use of so-called micro-mobility means, such as scooters, or Segway vehicles. Not all mobility needs manifest themselves on the market.

The type and volume of the mobility needs of residents are varied. This results from their varied levels of activity. When planning for mobility needs, the needs and expectations concerning mobility must be constantly identified since they are diverse and change dynamically in time (Kostakis, Pandelis 2009). Part of the mobility needs will not be satisfied and will therefore not translate into demand for public transport. Most commonly, the reasons those needs are not met are as follows: incompatibility of the service offer to demand (too few services, unsuitable route, unacceptable price, lack of sufficient information on services); and cancellation of travel for reasons unrelated to market phenomena (e.g., illness). In the market context, namely the dependency between demand and supply, mobility needs constitute potential demand that turns into effective demand provided the passengers possess adequate purchasing funds. Having a certain level of purchasing power enables mobility needs to be met through alternative transport modes, provided that, under the given circumstances, these modes function as substitutes for one another. Public urban transport faces its strongest competition from private cars (and, in the Polish context, to a lesser extent from motorcycles, electric

bicycles, and mopeds) and, to some degree, from car-sharing services. When travelling at short distances, public urban transport is substituted or complemented with cycling, Personal Light Electric Vehicles (PLEV)[4], and walking. To sum up, from the point of view of issues discussed in this monograph, mobility needs in the public urban transport market may be divided into the following categories:

- met by public urban transport;
- met by individual transport modes and walking;
- unfulfilled needs.

The first from the above categories of mobility needs constitutes the effective demand for entities providing public urban transport services. The other two are defined as potential demands, however, not in the full scope. Only some of the needs that can be qualified as belonging to those categories can be met by public transport services. In circumstances where other ways of travel are complementary to public transport (i.e., reaching a terminus loop or a bus stop), a mobility need will partially translate into effective demand. Research into transport behaviours in the city of Rumia, Poland (in the agglomeration of Gdańsk) revealed that the share of multimodal trips with the use of public urban transport is very little. Trips completed by car and a public transport mode constitute a share of only 0.3%. The research did not identify a single instance of a bicycle being used as a complementary mode of transport. It is also symptomatic that the share of public urban transport in the city of Rumia amounts to only 15.1% (MZKZG 2023).

Park and Ride systems are one of the most effective elements of influencing multimodal travel within cities. In Amsterdam, about 10% of city centre travel is conducted with the use of this system. In Munich its share amounts to 15% and in London to 12% (Mills, White 2018; Sargious, Janarthanan 2011; Zijlstra, Vanoutrive, Verhetsel 2015).

The definition of travel is broader than that of only a ride. Travel is a door-to-door movement that consists of (Wyszomirski 1997):

[4] PLEV: scooters, including electric scooters, monocycles, Segways, etc.

- reaching a stop;
- waiting for a vehicle;
- ride on board;
- transferring to another service;
- arriving at the destination from the stop.

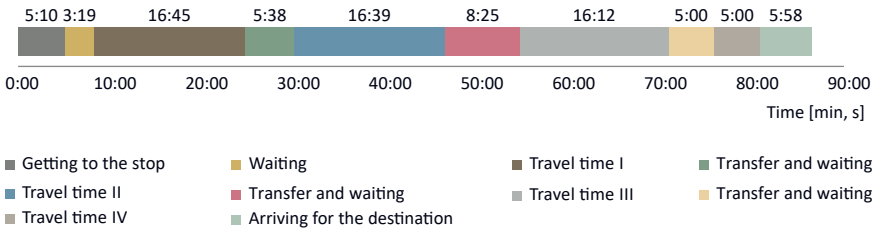

Figure 1. Average duration of different stages of travel using public urban transport in Gdynia in 2018 [minutes]

Source: Own work on the basis of results of marketing research carried out by the Public Transport Board in Gdynia.

Figure 1 presents the duration of travel using public urban transport in Gdynia in 2018 at each stage of the journey. The average access time to a stop was 5 minutes and 10 seconds. The average waiting time for a vehicle, depending on the number of transfers, ranged from 3 minutes and 19 seconds to 8 minutes and 25 seconds. The in-vehicle travel time ranged from 5 minutes to 16 minutes and 45 seconds, again depending on the number of transfers. The average time taken to reach a destination amounted to 5 minutes and 58 seconds.

The particular nature of supply on the public urban transport market is characterised by:

- transport services involving the carriage of passengers as an exchange commodity;
- operators (transport companies) as producers of services and organisers of public transport; and households as customers purchasing these services;

- local spatial range limited to the boundaries of a single city or several cities within an agglomeration, including suburban areas that are organically connected to the urban core.

The public urban transport service, characteristics and methods of provision are a matter for marketing research and activities that are thoroughly discussed in Chapter 4 of this monograph.

Supply on the public urban transport market is created by the infrastructure and transport means (public transport rolling stock). The supply of this form of transport, aimed at meeting mobility needs, is characterised by:

- simultaneity of service production and consumption;
- bidirectionality of services production;
- regularity of services production.

The simultaneity of production and consumption of public urban transport services is expressed in the simultaneity of:

- production and consumption time;
- place of production and consumption;
- production and consumption volume.

This characteristic necessitates aligning the volume of supply with the maximum levels of demand observed during peak periods. Since transport services cannot be stored, they cannot be produced in advance, during off-peak hours, to later be offered to consumers. Effectively, the carrying potential of the public urban transport is completely utilised only at particular times (Wyszomirski, ed., 2002).

The degree of supply utilisation is measured by the average number of passengers on board public urban transport vehicles. This is expressed as the ratio of passenger-kilometres completed during a given period to the number of seat-kilometres provided. The index is calculated using the following formula (Wyszomirski, ed., 2002):

$$W_{pz} = \frac{\sum_{1}^{n} P_i l_i}{C \sum_{1}^{n} l_i K_i} \quad (1)$$

where:

n – stands for the total number of route segments;

P_i – stands for the number of passengers on a section and in the direction from 1 to n;

l_i – the length of the section and;

C – number of seats on board the vehicle;

K_i – number of vehicles covering the section, for which the value P_i was established.

The average vehicle occupancy rate of public urban transport vehicles for the whole 24-hour period oscillated between 30% and 35%. During peak times, this figure rises, oscillating at approximately 50%. This means that in public urban transport, circa two seat-kilometres have to be offered per one passenger-kilometre.

The infrastructure of urban transport comprises elements from multiple branches of transport, with characteristics shaped by the need to meet the mobility demands of urbanised areas. It consists of the following:

- roads and streets, including all their permanent facilities, used for the organisation of vehicle and pedestrian traffic;
- metro, rail, and tram tracks;
- electric network supplying power to the metro, rail, trams, and trolleybuses;
- power substations;
- stops, stations, and transport hubs;
- bus, trolleybus, and tram depots;
- car parks.

Supply in the context of transport modes may be more or less diversified on the public urban transport market. Carriage services may be provided by one or more types of transport modes.

Assuming that individual urban transport includes solely the travel of one person, the following journeys may be counted as part of this type of transport:

- spontaneous pedestrian movement;
- PLEV, which since the beginning of the 21st century have been used mainly for amusement purposes (scooters, longboards, Solowheels, Segways);
- bike rides (excluding tandem bikes);
- travel by mopeds, motorbikes, and electric bikes, provided they are used only by one person;
- travel by car, provided the only person travelling is the driver.

Public urban transport consists mainly of journeys completed by vehicles that by definition are designed to carry a larger volume of passengers, namely:

- minibuses;
- midibuses;
- buses;
- trolleybuses;
- trams;
- urban rail;
- metro;
- cable car;
- water trams, car and passenger ferries;
- personal rapid transit means.

Public urban transport may include pedestrian travel completed in an organised manner (i.e. walking of an organised group of children on a route from home to school) and journeys involving more than one person:

- on a tandem bike;
- on motorcycles, mopeds, electric bikes (provided they are equipped with passenger seats);
- private cars.

From the point of view of functionality and sustainable mobility policy aims, it is important to divide public urban transport according to the criterion of the type of propulsion used for the journeys undertaken:

- human-powered mobility (walking, cycling, using scooters);
- combustion engine vehicles;
- electric engine vehicles.
- the mode of vehicle access allows the following types of transport to be distinguished: private, completed by vehicles in order to meet the mobility needs of their owners;
- public, completed by vehicles provided to users in order to meet their mobility needs.

The abovementioned division is arbitrary. From the perspective of sustainable urban mobility policy objectives, attempts to establish a strict taxonomy delineating clear boundaries between different modes of transport are largely futile, as each form of movement must be analysed individually. For instance, bicycles may be classified both as human-powered and, increasingly, powered by electric or even combustion engines (although the latter are typically custom-built and should not be equated with standard e-bikes). A similar definitional challenge arises in distinguishing between public and private transport, as the former category encompasses car-sharing schemes. Private transport, meanwhile, can also be used to meet the mobility needs of individuals other than the driver (including in cases of carpooling). Its classification as private transport ultimately depends on the mobility needs of the vehicle owner, the passengers they carry, and any person to whom the vehicle is lent (Grzelec, Hebel, Wyszomirski 2020).

The way in which the public urban transport market is organised and functions is an important determinant concerning the scope and frequency of marketing research. In monopoly or oligopoly markets, marketing research is usually carried out in situations where securing a profitable (monopolised) position and competitive advantage on the market largely relies on knowledge of the shifting preferences of consumers.

Public urban transport is characterised by specific market conditions. Transport service providers typically operate as monopolists, transport services are classified as public utilities, and the principles of universal accessibility, pursued through transport and social policy objectives, necessitate subsidisation. For monopolistic service providers, many of which are public entities, these conditions create the possibility of delivering services in a manner that insufficiently reflects residents' transport preferences and expectations regarding acceptable service quality. The goals of sustainable mobility, which by definition should support the development of the public urban transport offer, often become a pretext for using this mode of transport to pursue particular political interests and questionable ideological or activist agendas, especially when considering its effectiveness measured by passenger growth. The practical value of some publications is limited, as their proposals for changes to the service offer fail to take into account the feasibility of implementation within the realities of a functioning market and a democratic system of governance.

Table 2 presents the analysis of the market behaviours of various entities that has been divided into four models for the organisation and management of public urban transport. Model 1 occurs when the operator or operators active in the market are wholly or partly publicly owned. When there is more than one operator active on the market, each of them manages the service offer independently. Tariff agreements may be established within this model. Model 2 assumes the operation of a public transport board and one operator. The model is characterised by a lack of competition at the level of service provision and division of management functions between the public transport board and the operator. Model 3 is characterised by the public transport board and competing operators. Model 4 is based on deregulation of the market, where independent carriers compete for passengers.

Table 2. Operating models of the entities active in the market that supply transport services

Management components	Model 1	Model 2	Model 3	Model 4
Management strategy	The longest possible route network	The longest possible route network	The longest possible route network	Paying marginal costs over a short space of time
Pricing policy aims	Satisfactory level of cost coverage through fare revenues	Satisfactory level of cost coverage through fare revenues	Satisfactory level of cost coverage through fare revenues	Profit
Pricing policy terms	Cross-subsidising of routes	Cross-subsidising of routes	Cross-subsidising of routes	Prices based on marginal costs of routes

Source: compiled based on (Costa 1996).

Monopolies on the public urban transport market are an obstacle to the achievement of the goals of sustainable mobility. A typical monopolistic situation occurs at the level of realisation of carrier services when those services are provided by one entity. According to the model of market entities' behaviour, a monopolist works towards reaching economic goals through using their position on the market. When public transport is subsidised, certain macroeconomic conditions often lead to pressure from the monopolistic provider to secure increased budgetary subsidies without making any changes to the volume or quality of services offered. A monopolist may therefore shift the inefficiencies of market operation onto the burden of public funds (Grzelec, Hebel, Wyszomirski 2020).

The downfalls of monopoly in the context of public urban transport, including the restrictions in attaining the goals of transport policy, in the mid-1980s, became the premises for a search for new organisational solutions for this type of transport. These solutions called for opening the market to private operators and using competition as a means of improving service quality. The widest scope of deregulations concerning

public urban transport took place in Great Britain. The expectations of authorities connected with the deregulation of public urban transport in the United Kingdom regarded an increase in supply; a decrease of subsidies, including cross-financing of services, cutting back on costs, and the implementation of innovative and diversified services (Mackie, Preston, Nash 1995). These expectations were based on theoretical assumptions suggesting that competitive markets provide for a more effective mix of prices than in a monopolistic reality; and that bus services is, to a large extent, a contestable market (Fernández, Muñoz 2007).

Initially, deregulation brought positive results, namely a decrease by a third of costs connected to operations of public transport, which stemmed directly from competition and the adjustment of the service offer to demand (Mackie, Preston, Nash 1995). Later, however, the model began to manifest it shortcomings. The following may be named as the most significant (Preston 1999; Savage 1993):

- tariff disintegration resulting from carriers using their own, individual tariffs and restricting the discounts to segments of passengers with high price elasticity of demand;
- need to contain costs, coupled with the awareness of potential failure and the risk of losing to competitors, prevented high levels of investment. In consequence, the rolling stock was often found in a poor technical condition due to necessary cut-backs in investment;
- unprofitable routes were discontinued, creating a situation when mobility demands were only partially met;
- between 1985 and 1989, the number of journeys on bus transport, with the exception of London, which was not deregulated, decreased from 4 to 22%.

The introduction of a spokesperson representing the interests of the passengers and public authorities, focused on attaining the complex goals of sustainable mobility policies, was one of the premises for the separation of organisational functions from transport operations. The economic benefits of the solution, consisting of the separation

of organisation from transport provision, the appointment of a public transport board, and the introduction of competition between the operators, resulted from the nature of competition as a mechanism of enforcing high efficiency of actions in the face of the threat to the position on the market. A company pressured by competition must strive to best address the needs of the consumer. In the context of regulated public urban transport, where the organisation activities are separated from transport operations, it is the organiser, representing public authorities, who becomes the immediate buyer of the services provided by the transport company. In the context of regulated public urban transport, where the organisational activities are separated from the transport operations, the direct purchaser of the transport services provided by the transport company is the organiser (PTB) representing the public authorities. Competition on the market in the scope of providing transport services allows the organiser, who purchases transport services, for the verification of their costs (Grzelec 2013b).

In the public transport model featuring an appointed public transport board and a monopolistic operator, a monopsony can also be observed. This is the role played by the public transport board. What thus emerges in the market is a specific situation in the transactions between these two entities: a bilateral monopoly, in which there is only one provider of transport services and a single purchaser (the public transport authority). Research conducted by Wolański revealed that separating organisational activities from transport operations in the case of a monopolistic municipal carrier proves more costly than when the monopolist acts simultaneously as both organiser and operator. The possibility for the public transport board to influence the quality of the services provided by a monopolistic operator of services in the face of their strong position, both formally and informally (especially if the operator is also owned by the city) is significantly restricted. It is relatively higher when the public transport board and operator are companies. It gets worse, on the other hand, when the public transport board operates as a budgetary unit with a limited autonomy in decision-making (Wolański 2011).

The downfalls of the way in which public transport boards operate in Poland result mostly from the ineffective yet commonly accepted organisational structure of budgetary units of these entities (Grzelec 2011). The need to operate within budgetary structures typically results in the performance of routine tasks, ingrained in employees' habits, and a tendency to select the easiest, albeit lawful, means of implementation. The measure of employees' activities is their legalisation, and not positive market results in the form of high customer assessments. Additionally, there is a danger of taking on tasks that exceed financial and organisational possibilities. "There is this irrational misconception that taking on a grand task makes its executor important. This phenomenon, often referred to as 'budget attachment', involves taking on tasks beyond actual capacity, later invoking the argument of continuity to justify ever-increasing budget allocations, which seldom reflect the true priorities of the community" (Pakoński 2001: 21).

A notable study into the inclination to implement marketing strategies taking into account the organisational pattern of the company and the position of public urban transport on the market in Poland was conducted by Mendryk. In the years 2006–2007 and 2010–2011 she examined in the above-mentioned context the actions of 18 public urban transport organisers (public transport boards) and 77 public urban transport operators in Poland. The research results revealed that 78% of operators and 79% of organisers segmented the market solely in spatial terms, disregarding material and subjective dimensions, 83% of operators and 68% of organisers preferred using defensive strategies. The dominating actions in shaping services were coordinating service timetables – a strategy declared by 85% of operators and 90% of organisers. The strategies concerning prices were dominated by mimicry (comparison of fare prices to those in other cities of similar size). Only 9% of operators and 25% of organisers supported their fare proposals submitted to public authorities with comparative cost analyses of public urban transport versus private car travel.

For a better understanding of the results, they could be viewed in the context of research conducted by Public Transportation Agencies and Specialised Transportation Agencies in the USA. A marketing plan is adopted by 65% of entities, and in 20% of the cases the person responsible for marketing holds a director's position. Amongst services provided by external companies, the prevailing type of companies contracted are those working in design, production, marketing and research (Cronin, Hightower 2004).

4. Marketing research sources, scope, methods and tools in the context of public urban transport

The typical scope of marketing research, according to the classification adopted in marketing textbooks, is inclusive of (Siripipatthanakul, Chana 2021):

- external and internal conditions influencing the operations of public urban transport and the entities providing services;
- tools of influence on the market, defined as a marketing composition that consists of actions connected to shaping the services, prices, distribution, promotion, personnel, customer service process, and physical evidence concerned with building the image of service providers;
- company's performance results.

Research into the conditions of operations of a public urban transport company can be divided into research on the external conditions influencing the organising company and/or the service provider, and research into the internal conditions (Wyszomirski, Grzelec 1998).

Results of research into the external conditions provide information on the company's surrounding environment. Such results allow for the identification of specific trends and phenomena that influence its operations. Thanks to the findings of such research, the company can adjust to the surrounding environment. On the other hand, the results of research into the internal conditions provide information on the company's resources and business competencies. They allow for the evaluation of the potential for the company to operate effectively on the market.

Research into the external conditions that influence the company's operations concerns economic, political, legal, technical and technological, cultural, and social determinants. External conditions are also shaped by the structure of the market (including the number and size of competitors and the threats they pose) as well as by phenomena related to consumer preferences and behaviours. The external conditions that shape the environment in which public urban transport operates are determined mainly by sustainable urban mobility policies, as set out in SUMPs, and by electromobility goals. Those conditions are accompanied by changes in the so-called mobility culture and in the perception of particular transport modes, both from an ecological perspective and, more broadly, from the perspective of comfort associated with urban life.

Research into phenomena concerning entities offering public urban transport services consists of research into:

- techniques and technologies for service provision, including primarily the range of vehicles used within the public urban transport network, electronic ticketing systems, and passenger information services (such as trip planners and real-time departure information displayed at stops and stations);
- shaping the range of public urban transport services. Including primarily their integration with services provided by other transport modes that form part of the sustainable mobility subsystem;
- systems of organisation of public urban transport services. Including primarily the efficiency of market segmentation models concerning public urban transport and the organisational forms of transport boards and operators;
- financial, metrical, and human resources within the entities providing public urban transport services, including financing sources of this type of transport effectiveness of various financing mechanisms for operational and investment activities.

Research into the external conditions relative to the entities consists of:

- research into general economic, political, legal, technical, technological, cultural, and social determinants;

- research into competitors, including analysis of their activities and programmes. This research concerns primarily the main competitor of public urban transport, namely private cars. In situations where organisational activities are separated from transport operations and competition is introduced in the provision of transport services, operators contracted by the organiser should conduct competition research aimed at increasing their own market share;
- research into market needs and demand.

Amongst research into external phenomena, the research into transport needs and demand is of particular importance due to their specific nature.

Research into a company's tools of market influence focuses primarily on aspects related to transport needs, potential and effective demand (including non-price elasticity, such as income elasticity and supply elasticity of demand), residents' transport preferences (including desired characteristics of public urban transport), residents' transport behaviours (including the modal split), and residents' satisfaction with service quality (aligning the quality offered with the quality expected by users).

Research into prices in public urban transport focuses mainly on the price elasticity of demand (including the impact of free public urban transport on demand) and the profitability of various tariff solutions, including tariff integration. Analyses of distribution are concerned with research into the channels of distribution of services connected with purchasing tickets. They examine the ease of purchasing tickets as part of so-called intensive distribution and the effective use of various tools to this end. Research into promotion makes it possible to determine the effectiveness of actions undertaken to support sales and the methods of promoting services.

Research into the results of operations of companies typically consists of:

- studies on attainment of the SUMP goals using specified indicators of their completion;
- studies on results connected with offering services on the market;

- studies on the market share of public urban transport, and within its submarkets, studies on the share of entities organising and delivering transport services;
- research into the image of public urban transport and entities providing services.

Performance indicators connected with offering public urban transport services are expressed in natural units (passenger volume, share of loyal passengers, share of public transport in urban travel), quantitative indicators (revenues from ticket sales), and qualitative indicators (level of customer satisfaction with services, evaluation of quality of service).

The main indicator of the efficiency of marketing activities leading to sustainable mobility is the share of public transport, including public urban transport, in transport. Data on the structure of usage of transport modes in various cities cited in academic publications and reports has to be treated with caution due to varying methods of survey and analysis, resulting in specific errors in structural indicators (fractions). Sustainable mobility plans should indicate the desired share of individual transport modes, taking into account the goals of sustainable mobility and considering:

- level of satisfaction with transport needs expected by residents;
- transport mode preferences;
- minimisation of the negative impact transport has on the natural environment;
- potential to fund sustainable transport from the budget.

In public urban transport markets with competing service providers, it is vital to research and analyse the impact of the supply structure on the financial effectiveness of the system. Efficiency studies and analyses in this area are conducted similarly to those applied to distribution channels, treating operators as intermediaries in the provision of services.

Research into the image of public urban transport provides information on how it is perceived by residents and, consequently, on the factors

influencing their attitudes towards this segment of the sustainable mobility market.

The above context allows for the division of the sources of information used in market research into internal and external sources. Those, in turn, can be divided into primary and secondary sources (Kaczmarczyk 2002).

The particular nature of the organisation of supply on the public urban transport market blurs the line between internal and external sources. Let us take as an example a market with regulated competition where the role of the transport organiser is performed by the public urban transport board, which is responsible for the quality and quantity of services, and the services themselves are provided by operators[5] contracted by the board. In such circumstances, the organiser can include in the internal sources not only documents, reports, and sales reports analyses drafted by the board, but also documents produced by contractors, namely the contracted operators and other outsourcing companies. Such a classification of marketing information sources will be justified by a holistic approach to the public urban transport service offer. A full evaluation of the quality and quantity of services and the reasons for discrepancies between the planned and delivered quality are possible to identify and, consequently, alter, under the provision that all available sources of information connected to the planning, execution, and monitoring of the parameters of services provided by the public transport board and operators alike, shall be taken into account.

[5] In everyday speech, the terms 'operator' and 'carrier' are used interchangeably. In the literature on the subject and in Polish law, an operator is a transport company that provides transport services after winning a tender organised by a public urban transport board, whilst a carrier is an entity active on the market and usually operating as an in-house entity publicly owned and employed on the basis of Regulation (EC) No. 1370/2007 of the European Parliament and of the Council of 23 October 2007, on public passenger transport services by rail and by road (OJ EU L 315/1, 03.12.2007).

For public urban transport, the following can be named as some of the internal sources of secondary marketing information:

- ticket sales reports, broken down into types, channels of distribution and sales brokers, as well as sales periods;
- ticket inspection reports broken down by areas where inspections were carried out and by individual inspectors;
- reports from the traffic control centre on compliance of the services provided with the conditions set out in the transport agreement, including deviations from established timetables (unrealised or partially realised services) and punctuality. Reports on explanations provided by operators regarding the reasons for timetable deviations, as well as driver performance checks carried out by specialised staff, with a breakdown by operator and individual driver;
- passenger (or wider: stakeholders) complaints, requests and proposals, submitted in writing;
- synthesis and analytical reports from the ITS (Intelligent Transportation System) regarding deviations from timetables, with a particular focus on delays on particular route sections.

Primary internal sources of information, defined as findings of marketing research obtained independently by the organiser of transport as a result of providing services or by the operator, include:

- transport needs;
- demand;
- preferences and transport behaviours of residents;
- level of satisfaction from the services provided;
- quality of services (e.g., mystery passenger method);
- other, concerning changes to the transport offer.[6]

[6] In this scope, good practices were established by the Public Transport Board in Gdynia, which verifies the requests to alter individual routes or change timetables at particular stops made by residents, city councillors, and district councils using marketing research. Requested changes to the offer are evaluated by the passengers (the research is carried out at bus stops). This enables the organiser to verify the relevance of these changes.

The secondary internal sources forming the system of marketing information for public urban transport are comprised above all of:

- reports and analyses of comprehensive traffic surveys with public transport traffic models;
- industry reports regarding public urban transport (in Poland, such reports are published by such entities as Warsaw Chamber of Commerce of Urban Transport [Izba Gospodarcza Komunikacji Miejskiej w Warszawie]);
- reports from market research and analyses carried out in other Polish cities, the European Union, and globally;
- national, regional, and municipal statistical data collected and published by the city, commune, and regional authorities, Eurostat data, reports and publications of UN agencies;
- academic articles and publications on sustainable urban mobility;
- press articles and media reports.
- documents, decisions, acts, and regulations, both national and EU.

The primary external sources comprise marketing research obtained after organiser commissions (or pays) external entities to carry out such research. The scope of such research usually includes:

- transport needs;
- demand;
- preferences and transport behaviours of residents;
- level of satisfaction with the services provided;
- quality of services (i.e. mystery passenger method);
- tests and experiments, i.e. fare system tests.

Due to the mass character of the public urban transport services, marketing research is usually carried out using a sample. Research carried out on whole populations usually concern smaller communities (e.g., employees of companies dealing with mobility, stations, stops). Studies into the volume of effective demand are carried out increasingly often on entire populations provided that public urban transport vehicles are equipped with suitable passenger counting devices or access to mobile device operators' databases is ensured. Research on large populations

(residents of cities, communes, regions or states) is carried out using a representative sample.

In randomly selected samples, probability theory is applied within the framework of statistical inference. The method is based on a mathematical representation of the correspondence between the sample and the population it is supposed to represent. Social and experimental sciences define a random sample, used as the basis for reasoning, as either a subset of individuals randomly selected from a predefined population (to which the later findings will apply) or a randomised controlled experiment in which the evaluated individuals are randomly assigned to one of two groups: the experimental group (exposed to a stimulus) and the control group (Szreder 2021).

The following aspects decide whether a sample is deemed representative (Davern 2008):

- a complete list of data, including information on all individuals in a population, enabling the use of a sampling frame in which each unit has a non-zero (though not necessarily equal) probability of being selected;
- using a randomised pattern for sampling individuals;
- collection of data for each individual chosen for sampling – no exceptions.

In the great majority of studies, only the first condition of random sampling is met, often with considerable expenditure of effort and resources (Jabkowski 2015).

Complex research into mobility needs, demand, preferences and transport behaviours (as well as its equivalents referring to urban transport *en massè* in the shape of comprehensive traffic surveys aimed at modelling the traffic in cities and agglomerations) are usually carried out using random sampling. The results of research carried out by the Public Transport Board in Gdynia (PTB) quoted in this monograph are based on random sampling research carried out within households. In this research, the residents meeting the required parameters laid out in the sampling frame are the sampling unit. The sample is a stratified random sample.

Selected residents are chosen proportionally to the population of individual districts, gender, and age. Such sampling is justified by the specific nature of public urban transport services related to spatial movement and the fact that approximately 40–50% of passengers travel to their place of residence. Gender and age are statistically significant determinants of needs, behaviours, and transport preferences (Haustein, Siren 2015; Loukaitou-Sideris 2014; Tyrinopoulos, Antoniou 2013; Weinberg 1979).

For a number of years, the team lead by the author would choose a sample on the basis of a list of residents registered in Gdynia (personal address sampling). In the 21st century, the main issue connected to conducting the study (bias in the non-random sampling) can be seen in the discrepancies between the persons chosen for the sample who, according to official records, should reside at the given address, and factual circumstances resulting from the common practice of property rental. This causes the need to create a backup list of selected residents (and addresses) that could be included in the survey for the sake of meeting the assumed volume of the sample. Another mistake with the completion of the sample for the study is connected to refusals and the above-average professional activity of some residents. The highest probability of conducting the interview, resulting from the availability of the respondent, is found among respondents over 65 years of age. The results of the analyses, however, prove that the oldest respondents are also most likely to refuse participation in the study (Jabkowski 2015). In such cases, it is also necessary to include respondents from backup lists in order to carry out the intended sample (Helbin, Wołek, Wyszomirski 2015). "The consequences of such errors, such as respondent refusals, deficiencies in the sampling frame (coverage errors), content-related inaccuracies, or data processing errors arising at later stages of the study, constitute some of the most significant challenges faced by statisticians today. Many researchers, who are conscious of these errors, make efforts to convince the recipients of the results that a sufficiently large sample levels or nullifies the consequences of their impact" (Szreder 2021: 19).

One of the consequences of completing surveys using respondents from the backup lists in research by PTB was an increase in the sample of people with lower mobility, which, in turn, resulted in an increase in the share of people using public urban transport. Towards the end of the second decade of the 21st century, the data protection legislation and the pandemic additionally hindered the research process concerning conducting interviews in households.

Given the difficulties in constructing a randomised sample based on a list of residents, an increasing number of entities have opted to collect samples using either cluster sampling (all residents of a randomly selected household[7]) or the random route method. The method involves choosing addresses at random, providing starting points for the interviewers. Later, when conducting the interviews, they choose their route and the residential buildings and apartments according to specific instructions (Adams, Brace 2006). Some researchers regard this method as more effective than reaching respondents by additional pooling of 'substitute' respondents in case of the absence or refusal of the originally selected respondent that was well suited to the profile of the research carried out within a localised area (Górny, Torunczyk-Ruiz 2011). Random route procedures are justified and applied when choosing a sample within blocks of flats (from randomly chosen addresses) or households (from randomly chosen residential buildings), however, aside from facilitating fieldwork, they have questionable value in the random and representative selection of individuals for research samples (Jabkowski 2015). Although this method yields a demographic distribution of the sample that corresponds to the population, it is likely that unexamined variables are significantly biased. The main assumption of the random route is that every household has an equal probability of sampling. In practice this may prove to be overstated. Simulations carried out by Bauer have proven that the random route samples may lead to unequal probabilities

[7] This is the method that has been applied for years in Poland when carrying out comprehensive traffic surveys (CTS) in households.

of household sampling (Bauer 2014). The results of research carried out in Sopot in 2018 and 2024 by the author of this monograph did not confirm the results of the aforementioned simulations for two groups: single-family and multi-family households. The differences in sample spread in both instances proved to be statistically immaterial. There was, however, a significant change regarding a characteristic vital for the research into transport behaviour of residents, namely a decrease in the share of households where a car is owned, which could not be used as a component in the sampling process. This change in this characteristic can be partially explained by demographic and housing changes in Sopot between 2002 and 2024 of a significant number of Ukrainian refugees (relative to the total population), the majority of whom were renting their own flats by 2024. However, this does not fully explain the 7% drop of the share of households that own a car that was noted in Sopot in the years 2018–2024.

In instances when a sample cannot be randomised, the researchers turn to non-randomised sampling (quota sampling, convenience sampling, judgement sampling).

Sometimes non-randomised samples are treated as representative in their subject matter under the provision that the ratio in choosing respondents is representative of the structure of a given population. The most common criteria taken into account are demographical (gender, age, education) and geographical (place of residence). Such samples are an example of quota sampling. If such samples are treated as being representative it is assumed that there are no variables, apart from those taken into consideration as a criterion of sample structure, which would significantly influence the results obtained on the basis of the sample. Overlooking a variable which would, in this case, have an influence on the transport needs, preferences, and behaviours will lead to the results differing from the real-life parameters, characteristic of the whole population. When executing a quota sample, the interviewer independently establishes which respondent fulfils the criteria, which in certain circumstances can be a source of errors.

Some researchers are convinced that an increase in the size of the non-randomised sample allows for an equal inference with regards to the whole population as in randomised sampling. "Large sample size deceives some researchers into thinking that it guarantees an accurate and credible inference regardless of the quality of observations in the sample. They most often forget that the main categories of non-randomised errors are not functions of the sample size. (...) It is a fact that the increasing size of a sample increases the capacity of a statistical test to correctly differentiate between a true and false hypothesis. On the other hand, it should be noted that although sampling error decreases with an increase in the number of observations in a sample, this principle should not be extended to overall inference error, as its other non-random components are not subject to this relationship"[8] (Szreder 2021: 11). This partially results from the tendency in recent years to attempt to validate research findings by establishing statistical significance (*p-value*), whilst at the same time forgetting that the non-randomised sample selection bias may, to a greater extent than sampling error, influence the determination of the significance of discrepancies, which are the basis for the rejection of the zero hypothesis.

In the 21st century, data production and storage processes provide new possibilities for shaping production processes. It is estimated that in 2025 the volume of data stored in binary form is going to reach 175 zettabytes (Reinsel, Gantz, Rydning 2017). Big Data analyses concern the possibility to use stored data for pattern identification purposes which may provide priceless information and may be used to study demand and transport behaviours. In the context of public transport, big data analysis is commonly implemented in ITS where: the data is stored; analysed (carried out using such methods as supervised, unsupervised, enhancement, deep learning, and ontology-based methods); and solutions are implemented aimed at solving particular traffic problems (usually

[8] The test strength, apart from the sampling error, does not take into account any other errors which may apply to the results in a sample (Szreder 2021).

congestion). Botte et al. (2019) conducted comprehensive research of ITS literature.

A wide range of measurement methods and techniques is applied in marketing research in the context of public urban transport. Some research implements relatively rare methods which correspond with the specific nature of a given research and decision problem. This monograph presents the most important and frequent of those methods, grouping them together according to the research topic connected with the service (Table 3).

Marketing research is concerned with the characteristics of services, volume of demand for those services, structure of demand, transport behaviours of residents (including consumers of public urban transport – passengers), preferences, and level of service satisfaction as perceived by the users.

The choice of research method is determined by the aim of the marketing research (Hair et al. 2013). The mass nature of the services, as well as their spatial character, also influences the choice of research method.[9] Measurements of the volume of demand for public urban transport services may be carried out using alternative or, in some cases, complementary methods. Example: Calculation of the estimated passenger volume (travel volume[10]) for a given city (transport network) is possible when using secondary sources of market information, such as ticket sales reports. Such data is, however, insufficient to calculate the total passenger volume as it is incomplete (inexhaustive – it does not include all necessary information). Sales reports include the number of sold tickets with varying validity ranges.

[9] More on the topic of the rules, advantages, and disadvantages of individual measurement methods can be found in: (Kaczmarczyk 2002).

[10] Passenger volume is often mistakenly confused with travel volume, whilst statistics is concerned with the number of rides. One journey may consist of multiple rides as long as the passenger changed the transport mode (transferred) during his journey from point of origin to destination.

Table 3. Methods of marketing research in the context of public urban transport with corresponding issue, scope, location of research and research frequency

Research topic	Scope	Methods	Location of research	Frequency of research
Transport needs	Identification of transport needs Identification of reasons and motivation behind making a journey	**Surveys, interviews**	Depending on the research aim: households, places of work, schools, universities, institutions, and other origins and destinations of travel	Comprehensive research every 2–5 years Research regarding particular aspects, repeated every 2–3 years in order to monitor changes
Demand	Estimated or real volume of demand across: transit corridors, routes, services, stops, service areas (i.e. cities, communes, districts, residential areas, metropolitan areas)	**Observations, recording**	Public urban transport vehicles, stops, stations	Recommended: continuous studies Comprehensive research of the transport network every 1–3 years
Demand	Estimated volume of demand across: a residential area, a city, city communes, metropolitan areas	**Secondary internal sources, interviews**	Transport organisers, households	Comprehensive research every 2–5 years
Demand	Volume of demand related to the service of specific traffic sources	**Surveys, interviews, observations, recording**	Sources of traffic (e.g., schools, places of work, hospitals, institutions, etc.)	Depending on demand

Table 3 (cont.)

Research topic	Scope	Methods	Location of research	Frequency of research
Demand	Structure of demand according to a specified criterion (i.e. tickets used, entitlements to reduced and free fares)	Secondary internal sources, surveys, interviews, recording	Households, vehicles	Comprehensive research every 1–3 years Depending on demand
Transport behaviours	Ways in which an urban trip was completed Share of individual transport modes in modal split Travel directions, time of execution and duration of travel Travel destinations	**Surveys, interviews, observations, recording**	Households, vehicles, stops, stations	Comprehensive research every 2–5 years
Transport preferences	Transport demands (desired characteristics of public urban transport) Reasons for choosing particular transport modes Standard of comfort	**Surveys, interviews**	Households, places of work, schools, institutions, etc.	Comprehensive research, every 2–5 years or ad hoc, depending on demand
Level of satisfaction with the services provided	Level of fulfilment of transport demands Service quality evaluation	**Surveys, interviews**	Households, places of work, schools, institutions, etc.	Comprehensive research, every 2–5 years or ad hoc, depending on demand

Source: Own work.

Usually, public urban transport organisers offer single fare, short-term, and long-term tickets. Single fare tickets are valid for one trip, so the number of tickets sold will represent the number of trips (passengers) completed using these tickets. Short-term and long-term tickets usually do not limit the number of trips which can be made in the given timeframe (hourly tickets, 24-hour tickets, monthly tickets, term tickets, annual tickets). In this context, in addition to the number of tickets sold, it is important to determine how often they were used in their validity period. In practice, this means there is a need to complete additional research (e.g., on boards of vehicles, at points of distribution, on the internet) based on which the volume of completed trips by the passengers holding periodic tickets of a given face value is calculated (the price they were sold at). It is advised that the number of trips be averaged for a given face value rather than the type of ticket, due to the varied spatial validity of periodic tickets (i.e. they may be valid in a certain zone or across the entire network). Spatial validity strongly influences the number of trips completed on the basis of such a ticket, i.e. during one day (Grzelec 2013a). Such research is usually completed using direct standardised interview method, and less often in a form of a survey (due to a low return index). The average number of trips for a given type of ticket is established by some analysts using the pattern method by using the data from marketing research concerning usage of periodic tickets in various cities, or by drawing the data on transport mobility from statistical data. It is, however, a risky solution due to the specific characteristics of transport behaviours in individual cities (Grzelec 1997).

Due to the complex nature of some factors (characteristics, transport demands, qualities of public urban transport) the conduction of in-depth interviews, both group and individual, is advised. Identification of individual experiences of chosen residents is usually the aim of in-depth interviews, as well as the mechanisms and motives for making decisions concerning certain transport modes. It also aims to describe complex characteristics which consist of many varied factors. The task of the moderator (the person conducting the interview) is to uncover the motives behind

behaviours and to understand the views and emotions associated with mobility decisions. In-depth interviews are more suited to developing an understanding of the attitudes and motivations of an individual.

Table 4 presents selected instruments, together with their corresponding methods as well as the scope and frequency of research carried out on public urban transport.

Questionnaires are the most universal marketing research instruments. Their use in market research is involves asking a question concerning a given quality and obtaining an answer from the respondent.[11] The following are the most common questionnaire-based marketing research techniques:

- PAPI (paper and pen personal interview), until recently, the most typical questionnaire-based interview where the respondent's answers to questions asked are recorded on a paper questionnaire;
- CATI (computer-assisted telephone interviewing). Interview conducted over the phone where the interviewer is asks questions and enters the answers into a computer script. The script allows for partial automation of the questionnaire, e.g., by filtering the questions asked or randomising their order;
- CAWI (computer-assisted web interview), where the data for quantitative research is gathered via an online questionnaire completed by the respondents.

Paper questionnaires, so popular in the 20th century, are now being substituted in research carried out using direct interviews and surveys with electronic questionnaires. These days, the questionnaires are uploaded to a tablet or, in the case of simple questions, an iPhone or smartphone. This allows for the automatization of measurements where the questions are chosen according to the answers given (live filtering).

[11] More on the measurement process and principles of questionnaire design can be found in: (Kaczmarczyk 2009).

Table 4. Marketing research instruments in the context of public urban transport services, together with their corresponding topics, scope, and research frequency

Research topic	Scope	Methods	Instruments	Frequency of research
Transport needs	Identification of transport needs Identification of reasons and motivation behind making a journey	Surveys, interviews	**Questionnaires**	Comprehensive research every 2–5 years Research regarding particular aspects, repeated every 2–3 years in order to monitor changes
Demand	Estimated or real volume of demand across: transport corridors, services, stops, service areas (e.g., cities, communes, districts, residential areas, metropolitan areas)	Observations, on board data recording	**Observation forms, record forms, counting gates, video recording systems, electronic ticket systems (trip planners)**	Recommended: continuous studies Comprehensive research of the transport network every 1–3 years
Demand	Estimated volume of demand across: a residential area, a city, city communes, metropolitan areas	Secondary internal sources, interviews	**Desk research instruments, questionnaire**	Comprehensive research every 2–5 years

Table 4 (cont.)

Research topic	Scope	Methods	Instruments	Frequency of research
Demand	Volume of demand related to the service of specific traffic sources	Surveys, interviews, observations, recording	**Questionnaires, observation forms, record forms, counting gates, video recording systems, electronic ticket systems (trip planners)**	Depending on demand
Demand	Structure of demand according to a specified criterion (i.e. tickets used, entitlements to reduced and free fares)	Secondary internal sources, surveys, interviews, recording	**Desk research instruments, questionnaires, observation forms, record forms, counting gates, video recording systems, electronic ticket systems (trip planners)**	Comprehensive research every 1–3 years Depending on demand
Transport behaviours	Ways in which an urban trip was completed Share of individual transport modes in modal split Travel directions, time of execution and duration of travel Travel destinations	Surveys, interviews, observations, recording	**Questionnaires, in-depth interview guides, observation forms, record forms, counting gates, video recording systems, electronic ticket systems (trip planners)**	Comprehensive research every 2–5 years

Table 4 (cont.)

Research topic	Scope	Methods	Instruments	Frequency of research
Transport preferences	Transport demands (desired characteristics of public urban transport) Reasons for choosing particular transport modes Standard of comfort	Surveys, interviews	**Questionnaires, in-depth interview guides**	Comprehensive research, every 2–5 years or *ad hoc*, depending on demand
Level of satisfaction with the services provided	Level of fulfilment of transport demands Service quality evaluation	Surveys, interviews	**Questionnaires, in-depth interview guides**	Comprehensive research, every 2–5 years or *ad hoc*, depending on demand

Source: Own work.

In survey methods, an electronic questionnaire may be placed on internet portals, websites, or sent via email. Similarly to CATI and CAWI methods, when designing a questionnaire, it is possible to account for the need for accurate word entry by the interviewer and to pair the questionnaire with a dictionary, as well as selecting names from dropdown menus, presenting animated videos, pictures, and drawings. A correctly designed electronic questionnaire facilitates and shortens the process of data reduction.

Observation and record forms used for example in measuring the volume of passengers and concurrently recording their structure can also be created in an electronic form, uploaded to a tablet (or similar device). In this case, however, the peculiar environment for conducting surveys (public urban transport vehicles and stops) must be taken into account. It may be that while conducting a survey on board a moving vehicle, it is easier to record the answers on paper rather select the appropriate field on a tablet screen using a finger or stylus. The choice of place used for conducting observations influences the transparency of a survey and its accuracy. Restrictions on the use of this method arise from the limitations of human senses and the predispositions of observers conducting the research. Measurement error when using this observation method increases proportionally with the number of passengers assigned to each observer. The benefits of using electronic record forms correspond to those of electronic questionnaires.

Gates, cameras, and electronic ticket systems mounted on board vehicles or at entrances to platforms are modern measuring instruments used in public urban transport marketing research.

Automated systems measuring demand in public urban transport were introduced in the 1970s. The scope of their implementation has rapidly increased in recent years. At present, automated measuring systems are characterised by their multifunctional qualities. The measurements include Automated Vehicle Location (AVL), Automated Passenger Counting (APC), and Automated Fare Collection (AFC). However, these are often systems designed to perform specified and relatively narrow functions to the benefit of transport authorities and operators. They automatically integrate

passenger counting with the location of a vehicle (Rosetti 2000). The lack of integration of subsystems means the data obtained during automated measuring of demand may be inaccurate both in its volume and structure. Specific limitations also arise from the system's intended functionality.

The manufacturers of automated measuring systems used for counting passengers provide devices based on different technologies of varying accuracy. Such solutions include scales installed on vehicles, pressure mats and stairs, photocells, cameras, and e-ticket systems.

The scales installed on board vehicles provide data on the weight of an empty vehicle and a vehicle with passengers on board. The conversion factors used to calculate demand applied in this case are a source of relatively large measurement error and are therefore used only rarely (Kovács, Nádai, Horváth 2008). The essence of this concept lies in calculating the actual weight of the vehicle based on driving dynamics, vehicle energy data, and track geometry, which necessitates the installation of an additional measuring device.

Measuring instruments in the form of a specially designed pressure mat or steps conduct measurements when pressure is applied to a sensor. In addition to counting the passengers, these are also used to improve security, e.g., by blocking the doors.

Entrance gates quipped with photocells are installed above a vehicle's doors. An analysis of the accuracy of an automated measurement of passenger volume using entrance doors, as well as data provided by the manufacturers of such devices, estimates that the measurement error (namely the difference between the total number of passengers getting on and getting off) may amount to ±15% (Lebedeva, Mikhailov 2017). This error largely depends on the calibration of the measuring devices.

The use of cameras for an automated count of passengers is still being perfected in order to decrease the measurement error caused by resolution, the changing background and lighting conditions, the person's positioning, and image scale. The results of tests in relation to this are presented in the literature on the topic (Lebedeva, Mikhailov 2017). Modern passenger counting techniques comprise three components,

namely: person recognition, person tracking and calculation (Mukherjee et al. 2011). Passenger counting systems based on a tracking function performed by one camera provide 96.5–99% accuracy (Yang 2010). With this method, accuracy drops as the number of passengers increases and the camera shakes in motion (Li et al. 2017).

Electronic tickets, used as a measuring instrument, regardless of the technology and storage medium, are usually used to measure the volume and structure of paying passengers. This means that the passengers entitled to travel on free fares and fare dodgers are not registered. Passengers who subscribe to the first group may be included in measurements provided that they are obliged to carry a card (electronic free fare card) and register their trips. However, implication of this solution in practice and its execution is rather difficult as part of passengers entitled to free fares are minors, elderly and disabled residents.

Using contemporary ticketing systems as a tool for measuring the demand causes concerns of a legal nature. They are connected to the obligation of registering trips by passengers holding tickets entitling them to unlimited travel during the validity period (short- and long-term tickets). Whilst the introduction of the requirement to register trips by all passengers does not cause formal concerns, its enforcement, seen in penalty fees imposed for failure to do so, was already debated by the Polish Office of Competition and Consumer Protection which ruled penalising passengers who hold a valid periodic ticket but fail to register their trip is out of question. Proposals to vary the prices of periodic tickets for passengers who would commit to registering their trips and, in return, pay less for their periodic ticket, and for passengers who would not wish to register their trips and pay a higher price, were also questioned by solicitors who pointed to the public nature of tariffs in public urban transport. Leaving the registration of trips completed using periodic tickets to the goodwill of passengers would render the collected data incomplete, and a sample obtained in this way would be non-randomised (convenience sampling) and more than likely consist of very few registered rides, making it impossible to estimate the population sample.

A similar issue can be seen with regard to the registration of every trip by all passengers entitled to free fares. In some cities of Poland, a solution to this problem was implemented in the shape of a free ticket (with a 100% discount) that these passengers had to collect to ride. However, it must be stated that a requirement to register every trip by passenger who are entitled to free carriage (with the assumption that they are to collect a free ticket in the ticket machine, be issued a special card, or install an application on their smartphones) is difficult to enforce due to social considerations enumerated earlier on. At present, the above solution is in operation when travelling with Polish Rail. Its implementation in urban transport (within agglomerations) would be connected to the necessity of registering at least one entrance on board a vehicle, which, taking into account much higher ratios of changes during a journey, could be met with firm resistance on the part of the passengers. To sum up: using electronic ticketing systems for the purposes of data collection in the context of demand is possible, however, it seems that the introduction of the rules requiring every trip to be registered would be difficult and troublesome and, in some cases, would raise legal concerns or bluntly breach the law. On the other hand, using incomplete data regarding the demand and its structure (without the possibility to estimate the lacking data) is, from the point of view of planning the service offer, rather irrational.

Tickets purchased via mobile apps, including smartphones, are also a form of electronic ticket. Most recent solutions in this scope assume an interactive exchange of data between a mobile device and a database system – namely, using the Wi-Fi signal of a mobile device to estimate the passenger volume (Myrvoll et al. 2018). This would allow the type of ticket held by a passenger to be established. Those systems are currently undergoing tests and require adjustments to solve formal and legal issues connected to data protection.

5. The public urban transport services offer as the subject of marketing research

The characteristics of the public urban transport market are determined by the nature of the subject of the transaction, namely, transport services. It is the characteristics of shared urban transport that primarily decide its features as a market offering. The most important specific features of services, which decide, *inter alia*, the range of marketing actions carried out, are presented in Table 5.

Table 5. Characteristics of services and their consequences for marketing activities

Characteristics of services	Consequences for marketing
Intangibility – the service cannot be measured, shown before purchase, patented, or transported.	Focusing activities on: – minimising purchase uncertainty by creating and providing customers with material proof, e.g., pamphlets, catalogues, information booklets, programmes and service quality guarantees – presenting the benefits of purchasing the service – providing the customer with reliable information on the quality of services – despite a lack of opportunity to present these services – breaking down barriers associated with a lack of understanding of the nature of services

Table 5 (cont.)

Characteristics of services	Consequences for marketing
Perishability – a service does not exist outside the process of its delivery; it cannot be stored or inventoried, and there are difficulties in synchronising supply with demand.	– implementation of actions that reduce the negative effects of demand on certain seasonal services, e.g., a reservation system, pre-purchase, discounts
Inseparability – the processes of production and consumption occur simultaneously and in the same place; the customer often participates in the service delivery process and comes into direct contact with the service provider.	– recognising staff as a valuable part of marketing – educating and training staff to provide professional service – building lasting relations with clients – focus on ensuring favourable conditions for the provision of services and their availability – eliminating queues, shortening waiting times, and service duration – conducting marketing research
Inconciliation – the quality of services depends on many uncontrolled factors and the quality of work of staff, the difficulty of standardising services.	– intensification of activities that build the brand of a service company (single services rarely have their own brands) – creation of franchise networks – developing customer service procedures – implementing ISO 9004-2 norms – development of service quality standards – monitoring the quality of services offered by competitors
Inability to acquire ownership of the service – acquisition of ownership – services	– implementing a pricing policy that considers the customer's expected value-for-money ratio – and providing tangible proof of reservation or service delivery

Source: (Czubała et al. 2012).

The public urban transport service should be offered, taking into account the importance of the individual characteristics of its quality (attributes) for passengers.

According to Redman, the attributes of public transport can be divided into the physical, the survey of which is possible without the participation of the passenger, and the perceived, the assessment of which is the result of a subjective assessment by individual passengers (Redman et al. 2013) – Table 6.

Table 6. Public transport service attributes

Type	Attribute	Explanation
Physical	Reliability	The extent to which the actual service is provided according to the timetable
	Frequency	How frequently the service is offered during a given period
	Speed	Travel time between specified points
	Availability	Level of service accessibility for the highest number of people
	Cost	Costs associated with making the journey
	Information	Information about routes and transfer hubs
	Connections	Simple connections and ease of transfers
	Vehicles	Technical condition of the vehicle (mechanical aspects) and frequency of breakdowns
Perceived	Comfort	Travel comfort, defined by the availability of seating, driver service, and noise levels
	Safety	Sense of personal safety and safety of the journey itself
	Convenience	Ease of use and impact on travel convenience
	Aesthetics	Attractiveness of vehicles, stops, and stations from an aesthetic perspective

Source: (Redman et al. 2013).

Based on the norms of the EU Standardisation Committee, eight attributes of public transport quality can be distinguished (Table 7).

Table 7. Public transport quality norms according to the EU Standardisation Committee

Attribute	Explanation
Availability	The range of services offered in terms of geographic coverage, timing, frequency, and transport modes
Accessibility	Ease of access to the public transport system, including transfers to other transport modes
Information	Systematic provision of information about the transport system to support travel planning and execution
Time	Important aspects for travel planning include travel time, punctuality, and vehicle frequency
Customer Service	Adaptation of services to passenger needs, staff friendliness, and response to complaints
Comfort	Levels of crowding and cleanliness of vehicles and stops
Safety	Ensuring safety throughout the entire journey
Environment	Environmental impact of the services

Source: (Anderson, Condry, Findlay 2013).

A comprehensive set of indicators of public urban transport quality was devised by Starowicz and includes the following 26 indicators (Starowicz, Gretkowska 2003):

- frequency of services;
- competence and customer service culture;
- direct connections;
- ease of making connections;
- information on board the buses;
- distance to and from the bus stop;
- travel conditions on board the buses;
- waiting conditions at bus stops;
- travel comfort;

- travel time by public urban transport;
- frequency of routes;
- information at the bus stops;
- availability of the bus in a given place and at a given time;
- variety of transport options;
- legibility and ease of remembering the travel timetable;
- price of single tickets;
- price of periodic tickets;
- speed of travel;
- availability;
- punctuality of routes;
- certainty of completing the planned journey;
- personal safety of passengers;
- impact of noise, vibrations, and exhaust fumes;
- services offered on weekdays;
- services offered on Saturdays;
- services offered on Sundays and on holidays.

A further developed list of quality indicators (62 in total) determining the choice of transport mode was provided by Parkhurst et al. They identified several groups of determinants influencing choice: basic factors such as travel time and the location of the destination; logistical factors including frequency, punctuality, reliability, and transfers; factors related to the travel environment like the influence of fellow passengers, cleanliness, and vehicle equipment; and finally, motivations of travellers connected with the very possibility of choosing a particular mode of travel, such as the inability to travel on foot, the need to transport goods or shopping, and the relationship between the potential costs incurred and the quality of the journey (Parkhurst, Kenny, Goodwin 1992).

In research conducted in the Upper Silesian conurbation, Sierpiński also considered cleanliness, the possibility of transporting bicycles, and a place for luggage as attributes of transport service (Sierpiński 2016). In research carried out by Cheba and Saniuk in Gorzów Wielkopolski the list of attributes includes courteous service provided by drivers,

friendly ticket inspection, as well as clean stops (Cheba, Saniuk 2016). The examples presented indicate that the list of transport demands (i.e., attributes of public transport services) is not exhaustive. Consequently, the quality of services should be regarded as a multidimensional phenomenon.

A single, universally applicable ranking of transport demands for public urban transport can also not be established, as it is determined by the specific conditions governing transport in a given city. Thus, establishing a hierarchy of transport demands for a specific city enables the proper development of sustainable mobility for its residents. After analysing the results of various studies conducted in Polish cities, Zajfert concluded that these passenger demands are decisive, as they translate into tangible benefits that reduce both the cost and duration of travel. However, demands of a qualitative nature are of relatively minor importance (Zajfert 2018).

A common mistake made by public urban transport service providers, such as local authorities, transport management bodies and operators, is assessing the quality of transport services solely through averaged demand intensity indicators (e.g., the number of services per hour, vehicle-kilometres per capita, or stops per city or district etc.), rather than through an evaluation of individual service attributes as perceived by users or user segments (Rietveld 2005).

Supply indicators (i.e., the costs of providing services in specific transport sectors) can be used to enhance the expected quality level of services associated with a particular attribute. Research conducted in eleven German cities has shown that replacing bus connections with rail connections has led to an increase in the reliability and speed of services. These changes increased the number of public transport journeys in the examined cities from 15 to 38 per capita, amounting to a total increase of more than one million journeys (Redman et al. 2013). In Tyne and Wear in the UK, improvements in punctuality (following the introduction of bus lanes), service frequency, and travel comfort resulted

in a 40% increase in the number of journeys within the first two years (Hensher, Mulley, Yahya 2010).

Public transport is generally perceived to be safer than travelling by car (Paulssen et al. 2014). Safety is, however, often not ranked. It is regarded as an attribute whose fulfilment is both essential and self-evident.

A pyramid of attributes relating to stations and public transport stops, based on Maslow's hierarchy of needs, was proposed by Peek and van Hagen (Figure 2).

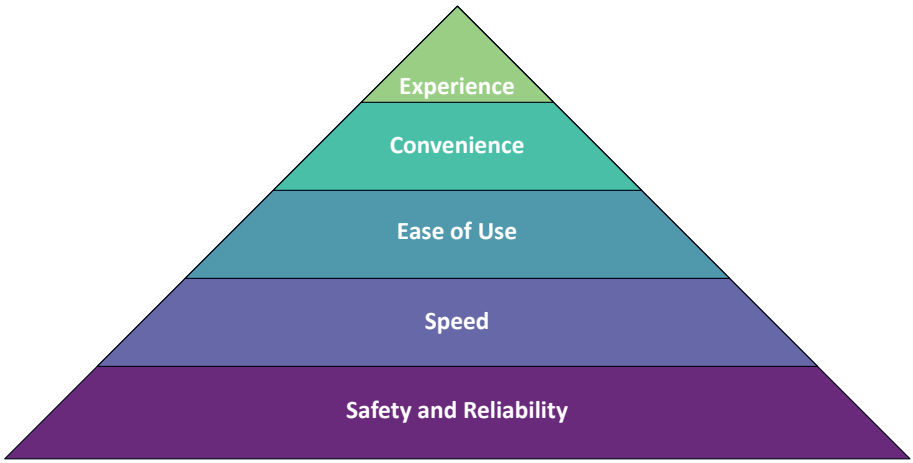

Figure 2. Pyramid of passenger requirements and expectations for public transport stations

Source: (Peek, Van Hagen 2002).

Only when the requirements and expectations at each level of the pyramid are met will the customer perceive the public transport station as a welcoming place for transfers. If the standards at any level of the pyramid are not sufficiently high, the overall assessment is adversely affected. For example, passengers consider it less important if a station is gloomy, provided it enables a quick transfer, than if it is visually attractive but requires long walks between platforms or considerable time to locate suitable connections. Reliability and safety form the foundation of the customer requirements and expectations pyramid. When these fundamental

requirements are not met to the level expected by passengers, fulfilling further expectations may not make much sense (Peek, Van Hagen 2002).

The proximity of origins and destinations of urban journeys to public transport infrastructure and networks can also be regarded as a fundamental determinant of public transport use. This factor is particularly significant in newly built housing estates located in peripheral areas.

Noteworthy conclusions were reached by Walker. He demonstrated that the demand for public transport services is more responsive to changes in service supply than to changes in income or prices. According to his findings, improvements in public transport services themselves have the most substantial influence on changes in demand. For instance, among commuters, demand is most strongly affected by a marked and perceptible increase in service frequency, particularly when combined with changes in branding and promotion of services. An additional external factor contributing to increased demand in this segment is a relatively sharp rise in fuel prices (Walker 2009).

Table 8 presents the results of studies on the average elasticity of public transport demand in the United Kingdom. These results confirm the aforementioned findings, indicating that demand is more sensitive to changes in service supply than to changes in income or prices.

Table 8. Demand elasticities for short-distance public transport travel in selected areas of the UK

Item	Price elasticity	Income elasticity	Supply elasticity
Average	from –0.12 to –0.15	–0.29	0.46
London	from –0.10 to –0.12	–	–
Metro services	from –0.08 to –0.12	–	–
Counties	from –0.17 to –0.19	–	–
Scotland	from –0.14 to –0.16	–	–
Wales	from –0.16 to –0.18	–	–

Source: (Dargay, Hanly 2002).

The significance of ticket price as an attribute of the public urban transport service offering is classified by market segment and its purchasing power. The price level should not be analysed in isolation from the tariff system, including its structure, the ratio of single-ticket prices to short- and long-term ticket prices, the degree of tariff integration and interoperability among subsystems of public urban transport, and mechanisms such as partial refunds for unused long-term tickets. The lack of coordination between price-level measures and other tariff and ticketing schemes may lead to adverse outcomes, including a reduction in demand. Modern ticketing systems should be implemented professionally, taking into account both passenger expectations and their concerns about the changes introduced, as well as the concerns of organisers and operators regarding the impact of these changes on revenues (Wilson 1999).

Currently in Poland (2024), despite the existence of Sustainable Mobility Plans, which at best maintain passenger numbers for this mode of transport, and despite the commitment of European funds to sustainable mobility, this objective has been achieved in only a few cities (typically those of medium size) (Wolański 2022). Not only is the number of passengers declining, but the share of ticket revenues in covering the costs of urban transport is also falling. In many Polish cities this share does not exceed 30–35% (IGKM 2023). Such a low level of cost-recovery for services has prompted the authorities of certain cities and municipalities to introduce free public urban transport. Demand-oriented marketing research, both desk-based and fieldwork, can support rational decision-making. The experience of cities of various sizes in this regard is diverse. In France, free public transport has been introduced in thirteen cities with populations ranging from 10,000 to 110,000 inhabitants (Freepublictransport.Info 2020). In Germany, experiments with free public transport have been conducted in several locations, including two cities with populations of approximately 15,000. Beyond Europe, free public transport has been implemented in the past or is still in place in 39 cities in the United States and 15 in Brazil. One of the largest free-fare initiatives was carried out in Chengdu, China, a city of 15 million inhabitants

(Kębłowski 2018). It is generally considered that free urban transport holds greater potential outside of large metropolitan areas. As an example of the effective introduction of fare-free (FF) public transport, the Belgian city of Hasselt (population 50,000) is often cited. Following the measures implemented by the municipal authorities, the number of passengers increased from 360,000 in 1996 to over 4.5 million, accompanied by a substantial expansion of service provision. The annual volume of vehicle kilometres in the city increased by more than 2.5 times in compared to before the introduction of free fares (Brand 2008). Free public transport was also introduced in Tallinn, the capital of Estonia.[12] Research findings confirm earlier speculations (Storchmann 2003) that all public transport systems adopting FF experience rapid, and sometimes sustained, growth in the number of journeys. However, this growth is typically achieved at the expense of walking and cycling rather than car travel (Börjesson et al. 2015; Thøgersen, Møller 2008). Analyses of the FF project in Tallinn show that the programme's results are limited, since its aims were only partially achieved.

In two studies (Fujii, Kitamura 2003; Thøgersen 2012) it was claimed that fare-free public transport can initially attract car users to public transport services, but that only the maintenance of high service quality can secure such a shift in demand in the long term (Redman et al. 2013; Sen, Tiwari, Upadhyay 2007).

It is widely recognised that the pricing policy of public urban transport services itself will not achieve the objective of ensuring sustainable urban mobility. It should be combined with other measures to increase their effectiveness. Synergies with parking policy instruments are particularly significant, as the cost relationship between public transport and private car use in urban areas plays a crucial role in shaping sustainable

[12] However, press reports from November 2023 indicate that Tallinn's authorities have reintroduced fares for the use of public transport, while Hasselt had already significantly curtailed its fare-free scheme in 2013. Furthermore, at the end of 2024, Berlin decided to withdraw its low-cost public transport ticket priced at €29.

mobility. An important element of the cost of travelling by car is the cost of parking.

Pricing of public urban transport services is used as a means of seeking a balanced modal split. This results in the widespread application of low fares for public urban transport services. At the same time, cross-subsidisation is permitted, whereby revenues generated from private car users are used to subsidise public urban transport services.

It is difficult to formulate general principles applicable to price-setting across all modes of transport and travel. Research conducted by Ricci has shown that applying identical or similar pricing rules for public urban transport services in both urban centres and suburban areas is likely to generate additional revenue when a distance-based tariff is applied in the centre, whereas revenues from suburban travel under such a tariff may fail to cover the full cost of suburban services. Cross-subsidisation can help mitigate such undesirable effects (Ricci 2003).

In many cities, fares for public urban transport services are set by local authorities to ensure affordability for low-income residents who have no alternative travel mode. Fare increases for public transport are often the subject of political disputes, irrespective of their economic justification. Pricing for public urban transport services is often the result of political compromise, with lower fares accepted in exchange for lower service quality. However, it is possible to encourage low-income users to accept higher public transport costs in order to prevent a reduction in service supply (Bank World 2002). Price and service frequency are the most important attributes of public urban transport for low-income users (Eboli, Mazzulla 2008).

Discounts and entitlements to free travel, which are primarily instruments of social policy, also play a key role in shaping public urban mobility through public transport pricing policy. Allowances and entitlements to free travel for social reasons should be linked to the income levels of those using these services. A minimum income threshold can be established for the allocation of such entitlements. In many countries, there is a tradition of granting free or discounted transport to a broad range

of government and local authority officials. Care should be exercised in granting such privileges, as enforcing payment from passengers who are required to pay is becoming increasingly difficult when a large proportion of them travel free of charge (Grzelec, Hebel, Wyszomirski 2020). Where reduced fares arise from the implementation of specific sectoral policies (such as health care, social security, or law enforcement), their costs should be charged directly to the budgets of the respective sectors (Bank World 2002).

In several studies, including Wallin Andreassen (1995), Hensher, Stopher, Bullock (2003), lower fares (ticket prices) and speeds have been found to significantly contribute to improving the perception of public transport quality by customers. However, it is concluded that reducing fares is not an effective solution, as passengers often perceive current ticket prices as too high in relation to the quality of the services provided. Increases in customer satisfaction should first be achieved through improvements in service quality attributes (Hensher, Rose, Greene 2005).

A highly significant role in shaping urban sustainable mobility is played by tariff integration. Integrated tariffs may improve the attractiveness of public transport services. The concept of integrated tariffs is defined in various ways. Abrate, Piacenza, and Vanni (2009) define an integrated tariff system (ITS) as one that allows passengers to use multiple modes of transport (e.g., intercity and urban buses, metro, local rail, ferries) with a single ticket, valid either for a short period (such as two hours or one day) or for a longer period, such as a week, month, or year.

According to Bianchi, tariff integration can be said to occur when it is possible to travel across the entire urban area using the same travel document (not necessarily a ticket) while making use of different transport modes (2012). From the point of view of the transport organiser, the ITS ensures the cooperation of various transport modes. This enhances the convenience of transfers, enabling passengers to use different routes and modes of transport with a single ticket. Moreover, it eliminates certain negative consequences associated with competition between operators (Saliara 2014).

Research on integrated tariffs was conducted by Cascetta and Carteni. These authors noted that the introduction of integrated tariffs improved service quality indicators related to availability (Cascetta, Cartenì 2014). Based on his own research, Douglas concluded that a transparent fare system and a convenient ticketing system are highly desirable from the passenger's perspective. He also demonstrated that tariff integration should be supported as long as it facilitates travel (Douglas 2017). Chowdhury and Ceder observed that integrating fares across a multimodal public transport network facilitates transfers and thereby encourages the use of public transport services. In addition, it reduces the cost of trips involving transfers, thereby increasing the attractiveness of public transport (Chowdhury, Ceder 2013).

Demand for public urban transport services is characterised by a specific response to changes in ticket prices. It is considered to be price inelastic (Webster, Bly 1981). Findings from research on the price elasticity of demand indicate that elasticity values vary significantly across individual passenger segments, types of travel, and journey times (Balcombe et al. 2006). Price elasticity of demand also changes over time; analyses should therefore distinguish between short-, medium-, and long-term elasticity. Most authors define the short term as one to two years, the medium term as five to seven years, and the long term as twelve to fifteen years (and in some cases up to twenty) (Polat 2012). In this case, residents have time to adapt to various changes, such as those in employment and family circumstances, urban travel patterns, and the purchase of a first or subsequent car (Dargay, Hanly 2002).

Price elasticity of demand for public urban transport is greater in response to fare increases than to fare reductions, particularly for commuting trips. The increase and price reduction by the same percentage do not have to cause symmetrical changes in price elasticity indicators. Moreover, price elasticity of demand is greater for lower quality services (Balcombe et al. 2006).

On average, the price elasticity of demand for public urban transport is estimated at –0.3. British studies indicate that for bus transport, price

elasticity is approximately –0.4 in the short term, –0.56 in the medium term, and –1.0 in the long term; for metro services it is –0.3 in the short term and –0.6 in the long term; and for suburban rail it is around –0.6 in the short term (Balcombe et al. 2006).

Litman's analyses (2004), based on numerous studies conducted since the 1960s indicate that elasticity values for various fare levels, operating costs, and service parameters show that the supply elasticity of services has the highest value, amounting to 1.1. This suggests that changes in service supply will lead to more than proportional changes in demand (Table 9).

Table 9. Price elasticity of demand for public urban transport services

Demand response to a change in:	Journey	Price elasticity value	
		in the short term	in the long term
ticket prices	total	from –0.2 to –0.5	from –0.6 to –0.9
ticket prices	peak times	from –0.15 to –0.3	from –0.4 to –0.6
ticket prices	off-peak times	from –0.3 to –0.6	from –0.8 to –1.0
ticket prices	suburban	from –0.3 to –0.6	from –0.8 to –1.0
number of services	total	from 0.5 to 0.7	from 0.7 to 1.1
vehicle operation costs	total	from –0.05 to –0.15	from –0.2 to –0.4

Source: (Litman 2004: 53).

In other research on 23 British cities, the average waiting time elasticity was estimated at –0.64: in the range of –1.17 in the case of adults travelling outside peak hours, to –0.39 in the case of adult passengers travelling within peak hours (Jørgensen, Preston 2007).

If the value of price elasticity of demand stays within the range 0 to –0.99, the price increase results in an increase in revenues.[13] When it is greater than –1, the price increase results in a decrease in revenues. This

[13] As long as the increase of prices does not result in demand shifts: from relatively more expensive single fare tickets to cheaper periodic tickets.

has serious implications from the point of view of managing public urban transport. Such a situation may occur when ticket prices are increasing, whilst the scope of transport services is decreasing.

Apart from the research into the direct impact of price changes on demand in the context of public urban transport as a subsystem, research has to be carried out into the impact of price changes on the volume of journeys completed in using a different means (cross-elasticity of demand). Appropriate price policies in public urban transport should prevent is cannibalisation and, as a result, serve the sustainable development of the entire passenger transport within a city. An unfavourable situation from the point of view of sustainable urban mobility may occur due to the decrease of shares in walking and cycling trips in favour of public transport, for examples, following the introduction of free services for this transport mode (Cats, Susilo, Reimal 2018; Volinski 2012).

Frequency is often a key attribute of these modes of transport, whose technological characteristics provide for a relatively high speed of travel. Research carried out by Bus Rapid Transit (BRT) showed that 75% of projects assume a high frequency of services. In consequence, the passenger volume increased from 38 to 76% depending on the route (Levinson et al. 2003). In Great Britain it was calculated that the elasticity of demand in relation to frequency in bus travel is additionally correlated with an indicator of $e = 0.4$. This served as a basis for an estimated 20% increase in passenger volumes in bus travel on one route in Winchester, with the assumed increase in the number of buses from 4 to 6 (Wall, McDonald 2007). A change in the frequency of services should be thoroughly considered so not to disturb the coordination of various services and, in consequence, the quality assessment of the entire public urban transport offer (Friman 2004).

Increasing the speed of public urban transport vehicles travelling on roads and railroads is of fundamental significance in reducing travel time. In bus transport (especially on express services) and trolleybus transport, an increase of speed may be achieved by allocating lanes for public transport vehicles. Another way to reduce travel time between stops

is to introduce a signal priority system that automatically activates a green light for buses and trolleybuses as they leave the stop and merge into traffic. Another solution is to grant public urban transport vehicles priority at intersections. The latter solution is also successfully used to increase the speed of trams.

Simulation research carried out in Warsaw revealed that the introduction of priority systems for trams decreased delays by up to 25% and lowered energy consumption by up to 23% which, in turn, led to a decrease in pollution of 3% (Czerepicki et al. 2021). In Seoul, separated central lanes for Express Buses (BRT) increased their speed from 11 to 22 km/h (Pucher et al. 2005). In Vilnius, the introduction of bus lanes in the main areas of the city, comprising 75% residential areas and places of work, and a simultaneous decrease in the number of stops, increased the speed by 6 km/h on average (Burinskienė, Gusarovienė, Gabrulevičiūtė-Skebienė 2014). It is notable that an increase in vehicle speed should be accompanied by a reduction in the waiting time for a vehicle's arrival (Pucher et al. 2005). This can be achieved by improving coordination of timetables between services and public transport types on junctions and at interchange stops as well as certain routes travelling in main transport corridors.

The significance of the accessibility attribute was discussed in depth in Chapter 1. It was proven that it is the main factor determining the possibility of making use of services. Chien and Qin arrived at notable conclusions regarding accessibility. By modelling the number of public urban transport junctions on a theoretical, 3-mile route, they have proven that it is not the length of a route that decides the optimal number of junctions, but the assessment of the time and speed with which the passengers may reach the junction, as well as the volume of demand (Chien, Qin 2004).

In the subject literature, comfort is usually identified as a general idea of the quality of travel on public transport. A study carried out in Chicago, has proven a 5% increase of passenger volume over 5 years (15 million trips per annum) as a result of improvements to the travel comfort, comprising: vehicle cleanliness, safety, ease of boarding the vehicle,

and a more effective complaint handling system. Another study carried out in the same city has shown an improvement of the quality of service as a result of an increase of frequency. Increasing vehicle density leads to the improvement of: the feeling of safety, accessibility of destinations, temperature on board of vehicles, and ease of boarding and getting off a vehicle (Foote 2004).

Table 10 presents ten main factors defining comfort in metro stations in various countries.

Table 10. Ten main indicators of comfort on metro stations measured by CoMET and Nova Metros

Indicators	Share [%]
Accessibility of escalators and lifts	71
Quality of service provided by staff	53
Delays measured for acceptable thresholds of 2 and 5 minutes	53
Cleanliness of stations/trains	47
Crowding	47
Information provided at stations	47
Accessibility of ticket purchasing services/indicator of failure frequency of ticket machines/time devoted to purchasing a ticket	47
Waiting time for a vehicle	47
Service punctuality based on delay thresholds of 2 and 5 minutes	35
Accessibility/failure frequency of access gates	35

Source: (Anderson, Condry, Findlay 2013).

Customer satisfaction research revealed that comfort, comprising of a vehicle's cleanliness, available space, and temperature, significantly influences the overall evaluation of the quality of bus services (de Oña et al. 2013). Other research by (Jain et al. 2014) has shown that the persons commuting to a place of work were inclined to pay more in exchange

for a better public transport service, as the cost of travel was not considered an important criterion.

Convenience, which in the Polish language is often treated as a synonym for comfort, is defined by some authors as the ease and simplicity of using public transport (Redman et al. 2013). In Haifa, after simplification of the tariff system, introduction of zone tariffs, and a correspondence tariff, 30% of the respondents indicated that the number of trips they complete by bus increased. In some EU documents, convenience is defined as a passenger's perception of overall experience and effort put into gaining access to the basic benefits connected with using public transport. They may include: total travel time, cost, comfort, safety, and carbon footprint. Issues with providing a desired level of comfort may concern such problems as crowds, vehicle cleanliness, appropriate AC / ventilation adjustments, and proper functioning of the vehicle (Hunkin, Krell 2020).

Research carried out by the author of this monograph in 2024, using in-depth group interviews with two groups of students, has shown that within the social and professional group, the notion of travel comfort by urban public transport includes various categories of service quality characteristics for this type of transport, which are primarily associated with:

- possibility to take a comfortable seat (respondents referred to the size of a seat and its softness);
- appropriate temperature on board;
- noise caused by other passengers (loud music, conversations, including phone conversations) and, to a lesser extent, by the vehicle;
- directness of a connection (this characteristic, similarly to convenience, is ranked as one of the ten most important characteristics in quantitative research. This means that failure to meet this requirement may lead to worse assessments of the travel comfort);
- number of passengers on board the vehicle.

Among other factors that influence comfort are:

- possibility to hold onto a rail or handle by standing passengers (it was noted that this is not always possible when there are high volumes of passengers on board);
- other passengers, especially their behaviour and personal hygiene;
- vehicle cleanliness;
- facilities improving the experience for passengers using mobile devices, such as charging ports;
- vehicle's technical condition, including the fact that it is new;
- driving technique used by drivers and tram operators.

Air conditioning should be installed on board the vehicles if the temperature is to be kept at a satisfactory level for passengers, but even then, maintaining steady conditions is hard to achieve as the doors open at every stop. To save energy, some cities have introduced the practice of opening doors only on request. Table 11 presents the results of residents' preferences with regard to the temperature on board public urban transport vehicles in Gdynia (2018). The average desired temperature on board is 20°C. Taking into account the measure of dispersion, a comfortable temperature ranges from 18 to 22°C.

Table 11. Passengers' preferences regarding temperature on board vehicles (2018)

Temperature	Number of answers	Percentage [%]
15°C	10	0.54
16°C	17	0.93
17°C	44	2.40
18°C	**283**	**15.41**
19°C	**251**	**13.66**
20°C	**627**	**34.13**
21°C	**196**	**10.67**
22°C	**234**	**12.74**

Temperature	Number of answers	Percentage [%]
23°C	68	3.70
24°C	30	1.63
25°C	18	0.98
No answer	59	3.21
Total	**1837**	**100.00**

Source: Own work.

Complex market research into preferences and transport behaviour of residents has been carried out since 1994 by PTB, and also since 2009 by the Public Transport Metropolitan Association of Gdańsk Bay, studying the standard of comfort understood as the expectation of certain conditions during travel, determined by the number of passengers on board (Figure 3).

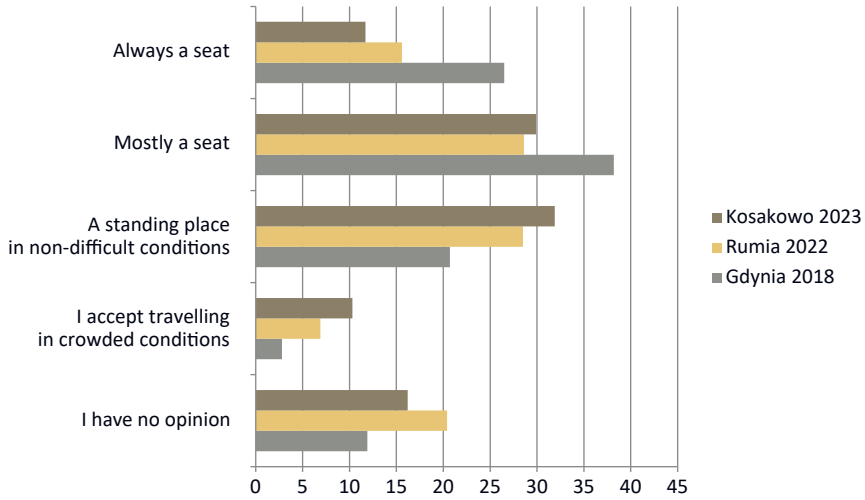

Figure 3. Expected standard of comfort during travel on board public urban transport vehicles in Gdynia (2018), Rumia (2022), and Kosakowo (2023)
Source: (MZKZG 2023; 2024; ZKM 2018).

The results of this research made it possible to determine the existence of statistically significant differences in the expected level of travel comfort, arising from variations in travel duration among residents of neighbouring communes within a single agglomeration, as well as among segments distinguished by their transport behaviour in choosing a particular transport mode.

In Britain, the influence of information on the comfort and ease of using public transport was studied in Winchester. It was found that intensification in the provision of information to the benefit of trip planning did not have a significant influence on the numbers nor on passenger satisfaction levels (Wall, McDonald 2007). The low importance of information among passengers was confirmed in research conducted in Gdynia in the years 2010–2018. Among ten characteristics, information has always scored the lowest in every study conducted. Based on research conducted by PTB in 2018, it can be stated that there are no major differences in the overall importance of the information attribute among the general passenger population across segments distinguished by the way an urban journey is completed, namely, passengers who always travel by car, mostly travel by car, travel equally by car and public transport, mostly travel by public transport, and always travel by public transport, as well as across segments distinguished by motorisation status: persons from car-free households, from households that own a car, and the main car users within a household.

The importance of the information characteristic, especially for people travelling on varied routes and rarely using public urban transport, may change in a situation when trip planners are introduced and include complex information allowing for trip planning on a given route, and the choice of different variants of a trip connected with the time, cost, vehicle type, etc.

Research conducted by the author of this monograph in the student segment, a social group that is most likely to use modern technological solutions, shows that trip planners are becoming the main tool of information on long, multimodal and *ad hoc* journeys. The expected functionalities

are basically the same as those that are currently offered by applications for trip planning. Attention has been given to the need to expand trip planners and provide information on route disruptions on a chosen journey, including propositions to change the route within the amount paid or for a surcharge.

An increase in supply does not automatically translate into an increase in the demand for services (Fujii, Kitamura 2003). Merely providing certain services with specified parameters by the organiser (and operator) of public urban transport is not equivalent to passengers perceiving them in a way that leads to the purchase of those services (i.e., completing a journey).

The general level of satisfaction with the journey is a reaction to the service attributes. General satisfaction from a journey is sometimes defined as cumulative satisfaction (Suzuki et al. 2014), meaning that it is composed of accumulated elements. Public urban transport services comprise journeys that differ in the way they were completed, their duration, accompanying passengers, comfort, and other factors. Passengers combine their empirical and emotional experiences when asked to express their overall level of satisfaction with completed journeys. Although most research on journeys focuses on the characteristics of service quality that may influence overall satisfaction, it is equally important to identify bottlenecks or the critical (minimum) level of a given service quality attribute. Failure to satisfy a given quality characteristic cannot be compensated by other characteristics (Sukhov, Olsson, Friman 2022). Failure to satisfy the demand for frequency in its minimal expected degree cannot be compensated by a low ticket price or even free public urban transport services.

The complex character of the issues in connection with quality encourages their comprehensive evaluation in the context of urban transport. The cycle of actions connected to shaping quality creates the quality loop of public urban transport. The following are named as its parts (Rudnicki 1999):

- demanded quality, usually defined by the local authorities both in the categories of specified and unspecified expectations;

- planned quality, which the organiser intends to provide for passengers, including allowances for unforeseeable circumstances. It depends on the expected quality level, external and internal pressures, budgetary constraints, and actions taken by competitors;
- experienced quality, meaning the quality actually delivered by the organiser, encompassing not only normal operating conditions but also disruptions, whether attributable to the organiser or not;
- perceived quality, experienced by the passenger. Its impartiality is distorted by many factors.

Actions connected to shaping the transportation offer include a complex set of instruments allowing for the adjustment of the individual parameters of the offer to passenger expectations. Desired quality is the level of service preferred by the customer. Target quality expresses the level that the transport organiser plans to achieve. Provided quality is the quality experienced daily, during normal conditions. All disruptions, regardless of whether they were caused by the organiser or not, are taken into account. Experienced quality expresses the quality level perceived by the passengers of public urban transport. It is determined by the personal experiences of passengers, other people's opinions, and the scope of information received. Required and perceived quality constitute the basis for the formulation of the indicators of customer satisfaction. Planned quality and provided quality constitute the basis for the evaluation of the performance of tasks by the organiser and operators (when these two aspects are separated). The required, provided, and perceived quality are described by indicators reflecting the passenger's point of view, where the perceived quality usually expresses the subjective opinion of passengers (Rudnicki 1999).

A model solution related to the quality loop for shaping the quality of public urban transport services was proposed by Starowicz (Figure 4). The model, consisting of three circles, graphically illustrates actions aimed at improving service quality. The overlapping areas represent the mutual interactions of organisers, operators, and passengers that influence service quality.

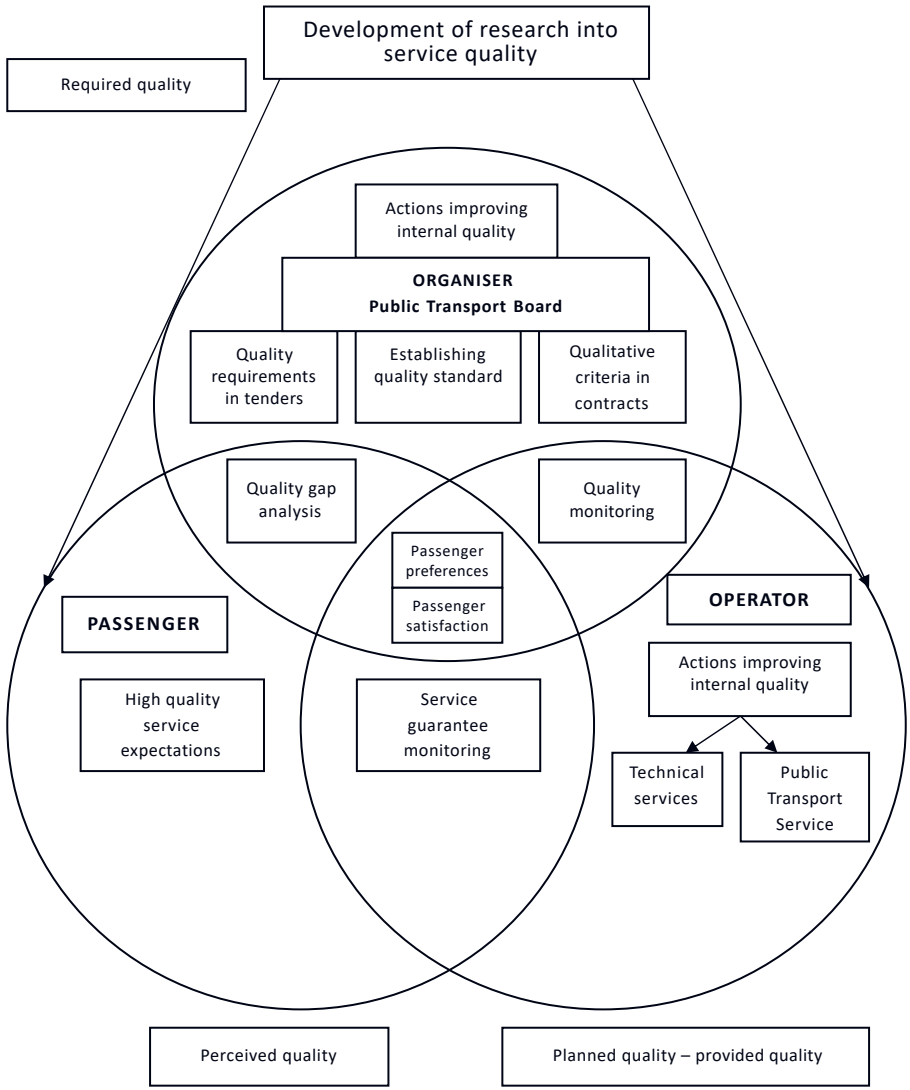

Figure 4. Transport quality shaping model

Source: (Starowicz 2001).

One of the main implementations of satisfaction assessment is seen in monitoring the quality of services in public transport and providing the operators with incentives to sustain or increase their levels. Customer satisfaction assessments are a useful tool for regular monitoring of the performance of companies selected through tenders, as well as for evaluating external factors such as weather, strikes, infrastructure disruptions, and other events beyond the organiser's control. Customer satisfaction survey results are often linked to bonuses and penalties in contracts with tendered companies (Börjesson, Rubensson 2019: 220).

Notable research results were presented by Friman and Fellesson. They analysed data regarding public urban transport services customer satisfaction from six European cities: Stockholm, Oslo, Helsinki, Copenhagen, Barcelona, and Vienna. Comparing the number of vehicle-kilometres per resident in each of these cities (an objective indicator) with the overall level of satisfaction with public urban transport services (a subjective indicator) did not reveal a statistically significant correlation between the two (Friman, Fellesson 2009). The absence of a correlation between the actual supply of public transport services and overall satisfaction indicates that the latter is based not solely, or even primarily, on objective measures. "More" public transport does not automatically mean a higher number of satisfied customers (Schneider, White 2004).

Research into correlation between customer satisfaction with particular characteristics and impartial characteristics indicators (services volume/h, available room, speed) proved to be more difficult to intuitively or theoretically explain. The absence of correlation between the supply of transport services and meeting the demand for frequency may depend on difficulties in adjusting supply to demand (transport may be secured but not at a required time and/or place). The absence of discrepancies between the perceived and provided availability of space may result from the fact that insufficient frequency is compensated by the increased cubic capacity of a vehicle in cases studied. On the other hand, the negative, and seemingly counterintuitive, correlation between average speed and travel duration may reflect the influence of journey type: a long journey may

still be perceived as time-consuming, even when made in a fast vehicle. Transport systems with a large share of long-distance journeys to workplaces may, therefore, receive lower scores for perceived travel duration than systems consisting mainly of city buses, which are comparatively slower and used primarily for short distances (Friman, Fellesson 2009).

Rather popular, though simplified, is the micro-economical approach that assumes customer choices and behaviours result from the comparison of costs and benefits, and all aspects of choice may be expressed in those two categories. As a result, in their choices, people are led by the principle of maximisation of usefulness, as per the principles of rational choices made by *homo oeconomicus* (Zafirovski 1999). When choosing a particular way to travel (transport mode), residents are guided by the principle of minimisation of personal involvement (e.g., the cost of travel, time to reach the stop) and maximisation of personal benefits, which include such notions as minimisation of the duration of travel, maximisation of travel comfort, and dependability. Transport behaviours are, therefore, the result of both substantive factors, such as travel duration, cost, gender, and age, and non-substantive factors, including dependability, safety, image, and attitudes toward a given travel mode (Chen, Li 2017). The principle of maximisation of usefulness ignores, however, the assessments resulting from cognitive processes and the ability of humans to subjectively evaluate the characteristics of services. Hybrid choice models (HCM) have been in use since the 1980s. They take into account the influence of variable attitudes on decision-making processes. They use psychometric data, individual attitudes, and observations, as well as their influence on the choice of how to complete a journey. Models that take into account those variables can more precisely explain behaviours regarding the choice of individual transport modes and the influence individual parameters have on those choices (Yáñez, Raveau, Ortúzar 2010).

Human behaviour does not conform to a fixed pattern; instead, it undergoes modifications and is constantly evolving (Van Cranenburgh, Chorus, Van Wee 2012). Transport behaviours are based on individual

preferences, attitudes, and perceptions of the attractiveness of travel by various transport modes (Gardner 2009). Influence on transport behaviours and the choice of public transport mode, results from own beliefs and social norms, as well specific pressure exerted by the environment (Bamberg, Hunecke, Blöbaum 2007). It was established that personal beliefs are based on two correlated, yet separate, processes: an anticipated sense of guilt and perceived social norms. The consciousness of the influence of urban residents' attitudes in fulfilling mobility needs should be the key factor influencing investment decisions made by public authorities. Conditioning investment decisions only to the belief that the increase of accessibility of public urban transport is a sufficient determinant of passenger volume growth often leads to an ineffective use of assets. An increase in demand for public transport requires an understanding of passengers' experiences connected with the use and assessment of the transport offer (Beirão, Sarsfield Cabral 2007).

A value is created by a belief that a given behaviour is more beneficial for an individual person or society. Values reflect basic adaptation qualities and serve as the basis for attitudes and behaviours. Although attitudes and behaviours are susceptible to change and evolve over time, values form a set of more stable and enduring beliefs that transcend specific objects, situations, and issues (Schwartz 1992). Research into transport behaviours is dominated by the study of attitudes. The need to take into account the influence of values is stipulated by Zhao (2009); Choo, Mokhtarian (2004). Decisions which initially may seem irrational can often be explained by values (Páez, Whalen 2010). Paulssen and colleagues give an example of a person who values the feelings of power, control, and pleasure. Such a person will travel by car even if it means that choosing this transport mode for a given trip is more expensive, and not necessarily faster or safer. This results from experiencing the feeling of control and freedom (the latter being a value on its own) that such individuals associate with driving a car (Paulssen et al. 2014).

In the marketing campaigns of car manufacturers, this transport mode is promoted as a symbol of control over one's life, power, and a source

of high self-esteem (Steg 2005). Moreover, it has been proven that people are using cars not only as a direct result of their transport needs but also as an expression of their own choice (Handy, Weston, Mokhtarian 2005). In this context, the de-marketing of cars is proposed as a means to promote alternative modes of transportation. This could be achieved by bringing attention to the negative aspects of car travel in urban trips and decreasing the strength of affective connotations drawn from advertisements (Dimoula 2018). Affect refers to situations in which consumers express their attitude toward an object, situation, or phenomenon in terms of liking or disliking it. When people expect that the positive outcomes associated with a given behaviour will outweigh the negative ones, the likelihood of that behaviour occurring increases (Ajzen, Fishbein 2021). For example, when the number of late arrivals at work caused by tram delays increases, the tendency to switch to car travel rises. Conversely, if traffic congestion significantly lengthens car travel times while delays on buses using dedicated lanes are minimal or non-existent, the likelihood of switching to bus travel increases. This likelihood increases the more an individual's transport behaviour is influenced by travel time and the more comfortable public transport travel becomes.

A customer's perception of quality (perceived quality of services) depends on the personal experience they have with a service, information they obtain on the service, and their unique qualities such as gender, age, social status (de Oña et al. 2016).

Analyses of the reasons behind the decrease in passengers on public transport in Southern California have shown that one of the main factors which convinced passengers to stop using public transport at a time when cars were more readily available was the low assessment of personal safety on public transport (Siemer, Rajah 2024). In other research from that same city it was proven that the rapid increase in the number of homeless people contributed to the decrease of passengers using public transport (Manville, Taylor, Blumenberg 2018).

Encouraging residents to change their mode of transport is considered to be the main strategy of sustainable mobility within cities. In this context,

it is proposed not only to rank the various attributes of urban transport but also to calculate willingness to pay (WTP) for a better quality of service, namely, a higher level of performance of individual attributes (Lunani, Vasudevan, Kumar 2022). For example, research conducted by Dutch and Belgian researchers has proven that passengers would be willing to pay to improve the quality of vehicle equipment in order for it to meet their requirements (i.e. comfortable seats that would allow them to work) (van der Waerden, Couwenberg, Wets 2018).

In various statistical and econometric models based on utility, it is assumed that passengers faced with a set of alternatives choose the option that maximises utility. Choices are modelled as a function that maximises the overall utility of the mobility pattern within the available alternatives (Bhat 1995). In this context, the possible travel options constitute the set of all alternatives known to the respondents. This means that the passenger considers various elements: contextual factors, available alternatives, and the subjective values assigned to them, before making the journey. The most common tool is multinomial logit modelling, which is characterised by a well-defined mathematical structure and easily interpretable results. It makes it possible to estimate the impact of different variables on the choice of transport mode and to identify the optimal way to travel based on the utility function. The logit model was used, *inter alia*, in research conducted in Budapest to analyse the determinants of transport mode choice. It was found that the most important variable was the "distance of travel." The next in the ranking were: "travel time" and "travel destination" (Al-Salih, Esztergár-Kiss 2021).

Change of place of residence may be an important factor in changing the way urban travel is conducted, including the tendency to switch from a car to public urban transport (Bamberg, Rölle, Weber 2003). Since owning a car is often positively correlated with income levels (Bamberg, Rölle, Weber 2003), and public transport services are an alternative to using private cars, it seems clear that young people and individuals with low-income are more likely to use this transport through necessity than choice. Therefore, their assessments of performance attributes

are often more negative than those of users who have relative freedom in choosing a mode of transport.

The impact of demographic factors on the rank and assessment of the performance of the attributes of urban public transport is also suggested by research on public transport users in Melbourne (Thevathasan, Balachandran 2007). Furthermore, experience from previous use of public urban transport services influences the assessment of service requirements (Tyrinopoulos, Antoniou 2008).

Improving the quality of public transport may be less important in certain cases than increasing the cost of using private cars. Increasingly, public authorities are reaching for tools that limit the use of private cars. The commonly include parking fees, entrance fees to the central urban zone, and clean transport zones. Research conducted in 2001 in Trento, Italy, found that introducing a toll system would significantly more effectively reduce the use of private cars than increasing the speed of public transport vehicles (Fiorio, Percoco 2007). The main reasons for the choice of public urban transport by Sopot residents with access to a car are shown in Figure 5.

The three main reasons for the use of public transport by residents with access to a car are associated with certain difficulties connected with its usage: difficulties with parking at the destination (17.9%), parking fees (17.6%) and road congestion (12.8%). Only 7.5% of respondents from this segment indicated they were satisfied with the quality of public transport. It should be noted that on an assessment scale from 2 (lowest) to 5 (highest), public urban transport in Sopot was rated 4.1 in the analysed segment, while the average rating of the public transport offer was 3.7.

Research conducted among employed persons in one of Sweden's medium-sized cities (82,000 inhabitants) shows that car users would increase their use of public transport if travel times were shorter, service frequency higher, and ticket prices lower (Eriksson, Friman Gärling 2008).

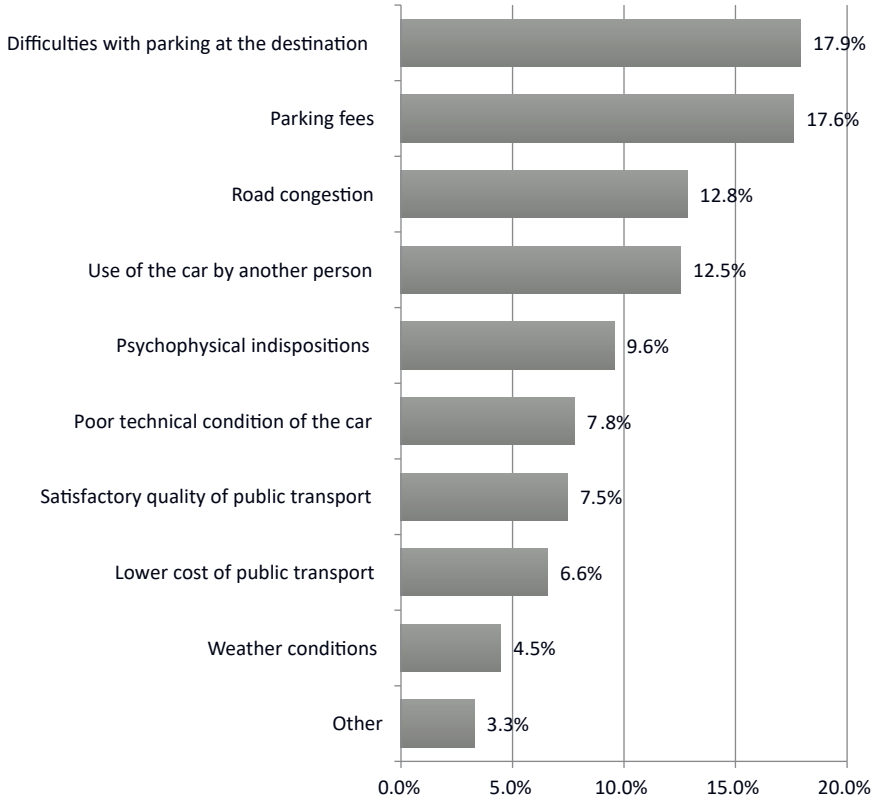

Figure 5. Ranking of reasons for the use of public transport by persons with access to a car in Sopot (2018), *n* = 145

Source: (MZKZG 2018).

Analysing the effectiveness of the "Quality Partnerships"[14] programme in Manchester, there was a lack of reliable data on shifts in demand between cars and public transport. The poor marketing related to the implementation of this project was also indicated as well as the lack of sufficient information on the benefits of public transport (Davison, Knowles 2006).

[14] Programmes based on cooperation between local authorities, transport boards and operators to improve the quality of public transport services

As part of research carried out in Krakow to exam the compliance of respondents' opinions on the validity of individual factors in transport decisions, an analysis of the ranking of factors affecting the use of urban public transport, taking into account the level of availability of a car in the household, was based on the Kendall's W coefficient. The study demonstrated consistency of opinion on this subject at a significance level of 99%. Based on the sum of weights for individual factors, a hierarchy was established, ranking them from the greatest to the least influence on the choice of public transport (Table 12).

Table 12. Ranking of factors influencing the choice to travel by car according to the car access criterion (Cracow, 2013)

Public transport attributes	All public transport users	Having access to a car for personal use	Having shared access to a car together with family	Having no access to a car
	Attribute position in the ranking			
Punctuality of services	1	2	1	1
Consistency of travel time	2	3	2	3
Safety onboard the vehicle	3	4	3	4
Frequency of services	4	6	6	2
Direct connection	5	1	4	5
Safety at the stop	6	8	7	6
Frequency of routes	7	10	8	7
Lower cost of travel than by car	8	7	5	9
Stop accessibility	9	11	12	8
Congestion on roads	10	9	10	10
No possibility to park at the destination	11	5	9	12

Table 12 (cont.)

Public transport attributes	All public transport users	Having access to a car for personal use	Having shared access to a car together with family	Having no access to a car
	Attribute position in the ranking			
Shorter travel time than by car	12	12	11	11
Car not available on the day required	13	13	13	13
Risk of car theft or damage	14	14	14	15
Greater travel comfort than by car	15	15	15	14

Source: (Ciastoń-Ciulkin, Nosal 2014).

A similar analysis carried out for the ranking of attributes of the public urban transport services among the Gdynia residents also revealed statistically significant similarities among the segments distinguished according to the criterion of access to a car within the household (Table 13).

Table 13. Ranking of attributes of public urban transport services according to Gdynia residents (2018) according to the access to a car criterion

Attributes of public urban transport services	Frequency of occurrence [%] $n = 556$		
	Main car user in the household	Person from a household with a car who is not the main car user	Persons in a household with no car
Directness	14.5	14.5	16.3
Frequency	17.1	17.4	19.1
Availability	13.0	13.8	13.5
Reliability	9.3	11.4	8.2

Table 13 (cont.)

Attributes of public urban transport services	Frequency of occurrence [%] $n = 556$		
	Main car user in the household	Person from a household with a car who is not the main car user	Persons in a household with no car
Low cost	9.5	9.9	10.5
Speed	10.6	9.9	7.2
Punctuality	16.3	14.8	16.6
Rhythmicity	3.6	2.9	2.4
Information	0.7	0.6	0.4
Convenience	3.2	3.3	2.5
Other	0.2	0.1	0.2

Source: Own work.

It has been suggested that a relatively simple approach – ranking two-dimensional correlation coefficients from highest to lowest – may be the most effective technique for determining the relative importance of travel attributes from a customer's perspective (Weinstein 2000).

As noted by Wolański, the drawback of ranking declared service attributes (stated choice) lies in the limited practical capacity to account for a large number of quality attributes. As a rule, such rankings are limited to the basic attributes related to time and price. This limitation does not stem from mathematical constraints but rather from the limited perceptual capacity of survey respondents: when presented simultaneously with several attributes, they tend to focus only on the most important ones, disregarding the rest. Overlooked attributes may include improvements to ticket availability (via vending machines or staff), seat availability, passenger information, and vehicle equipment (Wolański, Jakubowski 2014). In such cases, it is recommended that Integrated-Hierarchical Information Integration research be conducted. This approach involves dividing

attributes into groups, designing separate experiments for each group, and including within each experiment only attributes related to a specific dimension (e.g., service information). All groups are subsequently combined into a single model by means of a bridging experiment, which treats each group as a single attribute. This bridging experiment may take the form of a choice experiment, in which respondents select one of several options, or a typical stated-choice study (Louviere, Timmermans 1990).

Furthermore, the presence of city bikes and docking stations near public transport stops and stations encourages residents to adopt multimodal travel behaviour, thereby ensuring continuity of journeys and improving accessibility to destinations, including places of work and study (Zhao, Li 2017).

During the SARS CoV-2 pandemic, mobility restrictions affected travel demand and influenced the transport preferences of urban residents. In the first and second phases of the pandemic, schools, shops, restaurants, and cinemas were closed, public events were banned, and remote working from home became widespread. All these measures are collectively referred to as social distancing. In the first phase of the pandemic, some countries (e.g., China, Italy, Spain) enforced social distancing by imposing lockdowns (either regionally or nationwide), whereas others (e.g., the Netherlands, Sweden, the United Kingdom, and the United States) adopted less stringent approaches (De Vos 2020).

Pandemic-related restrictions led to the increased use of Big Data and enabled cross-sectional research to be conducted simultaneously across multiple cities and countries (Barbieri et al. 2020). Nevertheless, identifying changes in traveller behaviour and preferences, including following the end of the pandemic, required the use of questionnaires. Such surveys were more expensive and time-consuming and involved relatively small sample sizes.

Measurements in Budapest showed that, following announcement of the pandemic, traffic volumes fell by 34–37% (depending on the route). Public transport passenger counts in week 13 indicated a 90% decline

in the number of passengers. The time spent outside the home decreased from 6.63 hours (23 March 2020) to 2.92 hours (31 March 2020). In the second half of March, the number of walking trips decreased by 50%. Car-sharing data showed that in the same period the number of vehicle rentals decreased by 15–20%. During the pandemic, the modal share of cars in traffic increased from 43% to 65%, while the share of public transport fell from 43% to just 18% (Bucsky 2020).

Research conducted in London after the first wave of travel restrictions, once transport behaviour had largely returned to pre-pandemic levels, showed that travel time savings should not be achieved at the expense of higher ticket prices. The increase in ticket prices showed a stronger negative utility compared to the reduction in travel time. In commuting trips, passengers expressed a clear expectation for specific information, such as the name of the next stop and the extent of any vehicle delay. Expanding the range of information provided to passengers during their commute to work did not increase the utility of the service (Ulahannan, Birrell 2022). This suggests that the return to unrestricted transport behaviour is accompanied by a reversion to the standard perception of the usefulness of individual service attributes.

In the Gdańsk agglomeration, a study of transport behaviour conducted across 14 cities and municipalities during the pandemic revealed that, aside from an increase in cycling, travel behaviour patterns did not change significantly across the different phases of the pandemic. The modal split remained largely unchanged throughout the pandemic, regardless of fluctuations in the intensity of mobility restrictions (Table 14). The number of journeys, however, decreased significantly, especially during the initial phase of the pandemic (Grzelec et al. 2023). Based on the research findings, potentially unfavourable changes in the modal split considered detrimental to the objectives of sustainable mobility were identified following the end of the pandemic, including an increased share of private car travel. These changes should be counteracted through improving the quality of public transport services (Grzelec et al. 2023).

Table 14. Analysis of the frequency of use of specific types of mobility in the Gdańsk agglomeration from March to June 2020 compared to the pre-pandemic frequency

Travel mode March–June 2020	Travel mode before the pandemic (n = 3000)						
	Car*	PT**	Bike	Carsharing	Walking	Car PT	Other
	[%]	[%]	[%]	[%]	[%]	[%]	[%]
Car*	**1417 (94.4)**	39 (3.8)	3 (2.2)	1 (6.3)	1 (0.8)	128 (68.1)	4 (17.4)
PT**	25 (1.7)	**864 (85.3)**	4 (3.0)	0 (0)	0 (0)	3 (1.6)	2 (8.7)
Bike	5 (0.3)	6 (0.6)	**125 (92.6)**	0 (0)	2 (1.6)	3 (1.6)	0 (0)
Car-sharing	1 (0.1)	1 (0.1)	0 (0)	**12 (75.0)**	0 (0)	1 (0.5)	0 (0)
Walking	6 (0.4)	24 (2.4)	3 (2.2)	0 (0)	**115 (92.7)**	2 (1.1)	0 (0)
Car/PT	31 (2.1)	33 (3.3)	0 (0)	1 (6.3)	0 (0)	**40 (21.3)**	0 (0)
Other	1 (0.1)	0 (0)	0 (0)	0 (0)	1 (0.8)	0 (0)	**3 (13.0)**
No travel	15 (1.0)	46 (4.5)	0 (0)	2 (12.5)	5 (4.0)	11 (5.9)	14 (60.9)
Results	χ^2 (7) = 9210.59; $p < 0.001$	χ^2 (7) = 4924.49; $p < 0.001$	χ^2 (7) = 792.94; $p < 0.001$	χ^2 (7) = 59.00; $p < 0.001$	χ^2 (7) = 731.23; $p < 0.001$	χ^2 (7) = 583.40; $p < 0.001$	χ^2 (7) = 55.26; $p < 0.001$

PT – public urban transport; * private or for work; **including rail transport

bold – Statistically significant changes in the choice of means of transport before and during the pandemic

Source: (Grzelec et al. 2023).

The decrease in the number of public urban transport passengers and its share in travel following the lifting of restrictions during the pandemic have been confirmed by comprehensive surveys of the preferences and transport behaviour of the residents of Rumia (MZKZG 2023) and comprehensive traffic surveys carried out by other authors in Gdańsk (KBR 2022). In Gdynia, the number of passengers on public transport run by PTB is yet to return to pre-pandemic levels. According to PTB data, 78.4 million passengers were transported in 2019, while in 2023 this figure was 70.1 million. This indicates a further decrease in the share of public urban transport in travel in the Gdańsk agglomeration, where the overall mobility indicators have returned to those of the pre-pandemic period.

6. Use of selected marketing research results in shaping the public urban transport services offer

6.1. Economic and financial efficiency of market segments

The level and method of financing transport activities is a factor determining the economic efficiency and quality of services provided. Overlooking or downplaying economic considerations as part of the operation and investment activities of public urban transport leads to an increasing burden on public budgets in covering the outlays and costs of this form of transport. Additional sources of public urban transport financing should be sought, in addition to the revenues from ticket sales and budget surcharges. Potential solutions are provided by examples from different countries where this transport is financed, among others, from fuel taxes, driving license fees, parking fees, registration fees (Sobański 2000), and corporate taxes.

The Sustainable Mobility Goals for many decision-makers are sufficient for the departure of public urban transport from solutions characterised by high (in given conditions) economic and financial efficiency in favour of spectacular actions that provide political benefits and whose impact on the change of transport behaviour towards sustainable mobility is negligible or none. Among the actions in this area that may be considered contentious are:

- broadening access to free public transport;
- introduction of free public urban transport;

- lowering ticket prices without conducting applied analyses on price, income, supply and cross elasticity (e.g., regarding the interrelation between ticket prices and fuel prices);
- the implementation of electromobility (purchase and operation of electric buses) in a situation where cost-benefit analyses show its inefficiency or low effectiveness (The depreciation of more expensive electric and hydrogen buses increases amortisation costs, which translates into higher transport service rates and ultimately leads to a reduction in the cost-recovery of public urban transport services).

The introduction of electric vehicles for most passengers simply means the one-to-one replacement of a vehicle of a specific size without a noticeable improvement in quality and therefore a significant effect on their transport behaviour.

PTB is one of the few organisers in Poland conducting operational and economic analyses of public urban transport for municipalities, routes and services. Such marketing research has been consistently carried out in Gdynia since 1992. A team led by Wyszomirski and the author developed a methodology for conducting research and analysis of the demand and operational efficiency of public urban transport, which after modifications resulting, *inter alia*, from the use of counting gates to measure demand, is also used in other cities in Poland. This paper presents the methodology, selected research results and their use in the cities and municipalities surrounding Gdynia, where the PTB organises public urban transport.

The main objective of these studies is to determine the level of subsidies for services provided by municipalities served by the public transport system and organised by PTB.

In addition to the formal objective, which is the ability to determine the amount of the budget subsidy in the municipal budget, the supplementary objectives of marketing research on economic and operational efficiency are:

- identification of the size and structure of demand on individual routes and services in a given commune (and consequently their cost-recovery), which allows for making rational decisions regarding changes in the transport offer (increasing frequency or the withdraw of services, and sometimes routes);
- forecasting changes in demand as a result of changes in the transport offer, including in particular changes in ticket prices, the range of eligibility for reduced-fare and free travel, the supply of transport services;
- analysis of the impact of the supply structure (intensity of competition in the provision of transport services) on the cost-recovery of services and, consequently, on the possibility of increasing the transport offer under the given conditions of budgetary funding.

Operation and economic performance studies consist of three components: research on demand size research (number of passengers), passenger structure and the use of short- and long-term tickets.

The conditions for the implementation of the tests on the operational and economic efficiency of public urban transport, limiting the accuracy and representativeness of measurements, are:

- volume the supply of services, excluding the possibility of the continuous measurement of demand in the event that not all vehicles have measurement instruments, i.e. counting gates (or cameras constituting a passenger counting system);
- need to submit a draft budget to municipal councils (and cities) by the end of November of a given year, which in the event of possible changes to the transport offer (and the need to consult them), determines the date of submission of the application for a budget grant (including an appropriate marketing research report, which is the basis for applying for a specific grant amount) and the period for carrying out measurements in the months March–May;
- limited financial resources, which constrain sample sizes despite high variability in demand parameters.

An alternative to the calculation of budget subsidies by municipalities on the basis of the results of marketing research is their calculation based on the average costs and revenues from tickets per 1 car-kilometre in the public urban transport network. The significant variation in passenger numbers and demographic structure across individual routes, services, and service areas (i.e. the various cities and municipalities within the agglomeration) means that using aggregate average measures can introduce substantial errors in calculations – both overestimating (inflated ticket revenues) and underestimating (lost ticket revenues) – when applied to a specific commune (Table 15).

Table 15. Annual revenues from public urban transport tickets calculated based on the aggregate revenue index for the PTB network and the results of marketing research in 2023

Municipality/ city	Ticket revenue calculated based on aggregated unit revenue amounting to PLN 3.75 per vehicle-kilometre [PLN per vehicle-kilometre]	Unit revenue from tickets calculated based on marketing research [PLN per vehicle-kilometre]	Difference (1–2) [PLN]	Difference (3 : 2) × 100% [%]
	1	2	3	4
Commune of Kosakowo*	2,778,817.29	1,793,517.99	985,299.30	54.93
Rumia	3,438,788.13	4,747,127.66	1,308,339.53	–27.56
Sopot	2,956,948.73	2,833,916.07	123,032.66	4.34
Commune of Szemud	611,307.15	268,887.77	342,419.38	127.34
Commune of Kosakowo	293,120.89	112,549.06	180,571.83	106.43
Commune of Kosakowo	1,021,839.33	641,479.65	380,359.68	59.29

Source: Own work.

Taking as a reference point the results of marketing research, it can be concluded that using the aggregated unit revenue to calculate the amount of revenue from ticket revenues for municipalities served by PTB, inflates revenues from 4.34 to 127.34% depending on the commune. In one case (Rumia), revenues calculated using the simplified method were understated by 27.56%. Only in one case (Sopot) can it be assumed that the revenue calculated using the simplified method of revenue is within the limits of acceptable error. The presented differences in revenues are the result of different real unit revenues per 1 vehicle-kilometre which characterises public urban transport in individual municipalities (Table 16). Revenue deviations from average commune revenue for the PTB network (PLN 3.75) amount to PLN –2.31 to 1.44 per vehicle kilometre depending on the commune. The considerable variation in per-passenger revenue also makes it inappropriate to use this average network-wide measure to calculate ticket revenue for individual municipalities, and consequently, to determine the amount of budget subsidy corresponding to the financial deficit (Table 16).

Table 16. Average unit revenue from tickets in municipalities served by PTB in 2023

Municipality/city	Average revenue from tickets [PLN per vehicle-kilometre]	Average revenue from tickets [PLN per passenger]
Commune of Kosakowo	2.43	0.78
Rumia	5.19	1.00
Sopot	3.67	0.75
Commune of Szemud	1.65	0.94
Commune of Kosakowo	1.44	0.39
Commune of Kosakowo	2.36	0.56

Source: Own work.

It should be added that the described regularities are important when each commune subsidises public urban transport in its own area (within its administrative boundaries).

Demand surveys are conducted by PTB for all services on routes serving a commune on a given day. In the absence of the possibility of recording demand on a continuous basis (only some vehicles are equipped with counting gates) the tests are performed on the selected weekdays, in addition to Mondays and Fridays (i.e. days that are characterised by relatively high deviations of demand) in the period from March to June.

Table 17. Fluctuations in weekday passenger numbers on selected public urban transport routes in Gdynia, determined using data from gate counting devices (2024)

Indicators	Number of passengers on route numbers				
	150	**141/190**	**133**	**128**	**282**
Days of the week					
Monday	8644	1719	3809	4701	340
Tuesday	8575	1727	3780	4434	319
Wednesday	8699	1658	3929	4638	359
Thursday	8516	1873	3757	4660	364
Friday	8274	1713	3808	4614	386
Average $\overline{X}$	8542	1738	3817	4609	354
Calculations					
Standard deviation (σ)	140	72	59	92	23
Unbiased estimator ((ŏ))	149	77	63	98	24
$\frac{(ŏ)}{\overline{X}} \times 100\%$	1.7	4.4	1.7	2.1	6.8
$x_{and\ max} - \overline{X}$	157	135	112	92	32
$x_{and\ min} - \overline{X}$	–268	–80	–60	–175	–35

Source: Own work.

Since the data presented in Table 17 relates to measurements of the number of passengers from only one week (five measurements), the value of the standard deviation was adjusted to the size corresponding to the unloaded estimator.

The data from the measurement of the number of passengers made on selected lines using gates of all weekdays of the week indicate that the values of standard deviations (average deviation of the number of passengers on individual days of the week from the average number of passengers) are, depending on the route, from 1.7 to 6.8% of the average number of passengers. The presented classic dispersion measures allow the financial consequences of basing revenue calculations on sample measurements to be calculated. For example, assuming, in simple terms that the annual actual number of passengers on weekdays on route 150 (Table 17) corresponds to the product of the average number of passengers and the number of weekdays in the year and that the average revenue from one passenger is PLN 1,[15] then the annual value of revenue from tickets on this route will amount to PLN 2,200,920. In extreme cases, when the measurement is carried out on one of the days with the highest deviation from the average, then the revenue will lower by PLN 69,680 (3.1%), or higher by PLN 40,820 (1.8%). Based on five measurements, and taking into account the values of the unbiased estimator for the average number of passengers, the calculated revenues may deviate from the actual figures by ±1.7%. These conditions for estimating revenues resulting from measures of dispersion, representing the different number of passengers on different days of the week, must be taken into account in the calculation of ticket revenues.

The second stage of calculating ticket revenue for a given service, route or service area is to determine the structure of passengers according to the type of ticket held, including entitlements to discounts and free travel. For this purpose, measurements are carried out on public urban

[15] This value corresponds to the unit-based revenue calculated on the basis of studies in 2023.

transport vehicles by way of response recording. As already mentioned, such tests can be carried out using the electronic ticketing system stored on cards and apps, provided that the relevant devices record every passenger's journey and assign to each journey a ticket of a specific face value or a certificate from the applicable catalogue.

In the presented tests, measurements were carried out using the classic recording method, where interviewers check tickets and record the face values of these tickets and free travel entitlements in the appropriate box of a measurement card. Measuring by way of direct interviewers with passengers (targeted selection) also makes it possible to determine the number of journeys completed on the basis of short- and long-term tickets. Based on the data collected, the value of one journey for each ticket type is calculated (the value of a journey completed on the basis of a single ticket corresponds to the value of its face value). The result of the measurements is the structure of passengers on the services studied. The synthetic structure of passengers on selected services of bus route 85 in Rumia is shown in Figure 6. The data indicates a large variation in the structure of passengers according to the type of ticket (entitlements) on individual services. The structure presented on the chart is the result of data aggregation, which means that individual ticket face values have been grouped into fare categories. For example, the subgroup of long-term tickets consists of 33 PTB and PTMAGB tickets, both full-fare and reduced-fare tickets, personalised and bearer tickets. The criterion for synthesising data therefore has a specific impact on the diversity of passenger structure on individual services. Analytical data for the 13:04 and 15:33 services presented (including all 33 ticket face values) indicate that the difference in the share of passengers with a ticket with a given face value on both services does not exceed 2.8%. Taking into account the average share and standard deviation of tickets of a given face value in the total number of services on a given route, the minimum number of services for which the demand structure should be examined in order that any error in the calculation of the share of the relevant face value (fraction) does not exceed ±3% has been calculated.

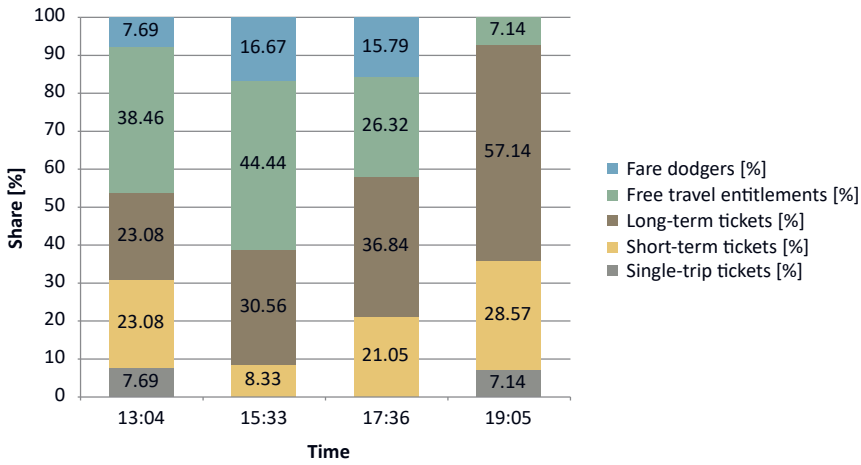

Figure 6. Passenger structure on selected services of bus route 85 in Rumia in 2023

Source: Own work based on the results of PTB.

On the basis of the average and the standard deviation for the number of journeys carried out on the basis of short and long-term tickets with a nominal number of interviews, the minimum number of interviews to be carried out with passengers is calculated so that the error of estimating the average value of one journey for a ticket with a given face value does not show a deviation of more than 10% of this value. Table 18 shows selected parameters for the most common long-term tickets for bus line 85 in Rumia, whose share is 76%. For the analysed line, taking into account the share in the structure of individual face values, the total number of interviews was 843. In practice, the number of interviews conducted by surveyors in selected courses sometimes exceeds 1000.

Table 18. The minimum number of interviews based on the average number of journeys when the average value of one journey for a specific ticket face value

Ticket face value [PLN]	Average value of one trip [PLN]	Standard deviation	Minimal sample size for the face value (no. of interviews)
53	**2.01**	1.558	231
12	**2.5**	1942	117
	8	1.63	14
42	**2.**	1.7	152

Source: Own work based on the results of PTB.

Revenue from tickets on a given service is counted according to formula (2)

$$P_b = \sum_{i=1}^{n} l_i \times w_i \tag{2}$$

where:

P_b – revenue from tickets for a given service

l_i – number of passengers holding a ticket of the *i*-th face value

w_i – value of one trip taken using a ticket of the *i*-th face value

In accordance with the methodology outlined, essential economic and operational indicators are determined for services carried out on individual routes, as well as for routes and groups of routes covering the territory of a given commune.

Appendix 1, Table 1.1 shows the economic and operational efficiency of the individual services on route 85 in Rumia on a weekday in 2023. Revenues for the service on the analysed route range from PLN 2.85 (22:21 service) to 43.47 PLN (11:02 service). The average income from tickets per passenger (including passengers entitled to travel free of charge and so-called fare dodgers) ranges from PLN 0.51 to 2.05 depending on the service. Cost-recovery ratios (the proportion of operating costs covered by fare revenue) were calculated taking into account

the running costs of individual services. On the analysed route, they range from 6.26 to 77.17% depending on the service. Data synthesis for the entire no. 85 bus route in Rumia found that on an average weekday in 2023:

- total number of passengers was 1,605;
- ticket revenue amounted to PLN 1,379.57;
- unit revenue from tickets for 1 vehicle-kilometre of operation amounted to PLN 2.75;
- unit revenue from tickets for 1 passenger was 0.86 PLN;
- cost-recovery ratio amounted to 30.5%.

Table 19 summarises the basic operational and economic parameters of urban public urban transport run by Public Transport Board in Rumia for the entire year 2023.

It highlights the differentiation of the number of passengers per 1 km of route on the individual services, which ranges from 2.4 on the N30 night service to 10.1 on the R express route. The consequence of such a large differentiation of unit demand are the differences in the cost-recovery ratios that characterise individual services. The lowest cost-recovery ratio is on the N30 night line with 19.7%, and the highest is on the R express route at 76.1%.

The service supply structure has a specific impact on economic and financial efficiency. Rumia is served by six operators contracted by the PTB, including two municipal and four private entities. Private operators are contracted based on the results of unlimited tenders. The private operator P.A. “Gryf” currently has the largest share in bus operations (42.4%) The share of other operators range from 2.0 to 21.9%. Competition between operators has a positive impact on costs. During the period of marketing research in Rumia in 2023, the highest rate for 1 vehicle-kilometre, PLN 10.06, was paid to the municipal operator, and the lowest, PLN 7.30. to the private operator. The costs of operating transport routes, as calculated by operators for tenders, are determined by their own cost structures, including the specific operating parameters of a given route, such as the total number of vehicle-kilometres, total

operating hours, transport and operating speed, and the type of vehicle specified in the timetable.

The annual public urban transport budget is calculated as the difference between the sum of all components of public revenue from urban transport serving the commune and the costs of providing this service.

In the conditions of service of the analysed commune (Rumia) by PTB, the revenues of public urban transport in the area of this commune consist of:

- revenues from PTB and MPTAGB tickets, constituting direct revenue;
- proceeds from additional fees (indirect revenue, calculated based on the share of vehicle-kilometres operated by public transport compared with the vehicle-kilometres within the PTB network);
- PTMAGB subsidy to metropolitan tickets (indirect revenue);
- penalties imposed on operators (indirect revenue);
- budgetary subsidy calculated and accepted by the commune in the previous year and valid for a given financial year.

The costs of public urban transport are:

- costs of services purchased from operators by PTB;
- overhead of PTB's internal costs.

Table 19 shows the operational and economic parameters of public urban transport in Rumia in 2023.

Table 19. Economic and operational parameters of public urban transport in Rumia in 2023

Item	Amount [PLN]	Share [%]
Total revenue, including:	**9,570,234.49**	**100.0**
– ticket sales	4,747,127.66	49.6
– additional charges	121,984.20	1.3
– MPTAGB subsidy	84,585.57	0.9
– penalties applied by PTB	203,334.05	2.1
– municipal budget contribution	4,413,203.00	46.1

Table 19 (cont.)

Item	Amount [PLN]	Share [%]
Total production and sales costs of services, including:	**9,286,547.33**	**100.0**
– invoiced transport costs	8,391,051.01	90.4
– organiser's costs	895,496.32	9.6
Revenue costs	**283,687.15**	–
Prior year result	**2,011.90**	**0.0**
Current year result	**285,699.05**	**3.4**

MPTAGB – Metropolitan Public Transport Association of Gdańsk Bay; PTB – Public Transport Board

Source: The economic and operational situation of public transport in Rumia in 2023 in light of marketing research findings. PTB research report. (MZKZG 2023).

6.1.1. Results from research on the number and structure of passengers

With the results of demand marketing research, the public transport organiser and the municipal authorities have the basis for making rational decisions, i.e., justified by the volume of demand and economic indicators regarding changes in the offer of public urban transport services. The scope of these decisions may include individual routes, services and reconstruction of the entire network of connections operating within a given commune (so-called optimisation of the offer of public urban transport services).

In a competitive urban transport services market, local authorities, through specialised urban transport management units, should make effective use of tendering procedures for the contracting of transport services. In Poland, using the provisions of the Act of 16 December, 2010 on Public Transport, the majority of cities were provided with large carriers constituting municipal property, and sometimes a monopoly on the transport services market. Restriction of competition negatively

affects the possibility of increasing the transport offer by launching new routes and increasing the frequency of services on existing routes. Based on data from the Chamber of Commerce of Urban Transport, it can be concluded that in 2023 the average cost per vehicle-kilometre for private compared to municipal bus operators was (IGKM 2023):

- from 40 to 90% in Warsaw;
- from 92 to 100% in Cracow;
- from 63 to 90% in Poznan;
- 65% in Gdańsk;
- from 63% to 78% in Radom.

The proportions refer to a comparison of the average purchase prices of transport services from operators and do not represent the factors that determine the price per vehicle-kilometre, such as: bus type by the propulsion criterion (electric or internal combustion), vehicle size (mini, midi, standard, articulated), the scope of operations under the contracted task, and the required vehicle age at the time of signing the transport contract. The author's own analyses of the price of 1 vehicle-kilometre contracted by PTB for comparable vehicles and tasks indicate that private operators provide services at costs that are 16–35% lower than those of municipal operators. Municipal operators often provide services at average rates, regardless of the type of vehicles (e.g., electric and internal combustion buses, which are differentiated only according to vehicle size). The absence of market verification for the purchase prices of services for electric vehicles hinders the analysis of the economic justification for operating these vehicles on individual tasks, especially since some cost-benefit analyses show that for the Polish energy mix the economic and social benefits for electric buses are lower compared to internal combustion buses with Euro 6 engines (Jagiełło 2021).

Original simulation analyses for the partial PTB market covering the Sopot area showed that with the participation of municipal operators in servicing this city at the level of 45%, the takeover by the municipal bus operator of all bus lines in Sopot would result in an increase in operating costs by 12%. However, assuming that private bus operators

would take over the service in Sopot on the bus lines of the municipal operator at the highest price offered by them (private operators), the cost of service to the city would decrease by 2%. These calculations assume that the share of the municipal trolleybus operator, amounting to 32% and the price per vehicle-kilometre on the services it operates) would not change.

In the context of operating costs, urban transport organisers should use the results of marketing research to determine the allocation of vehicles with appropriate capacities to specific routes and tasks, ensuring that passenger-acceptable levels of travel comfort are not exceeded. The travel comfort on public transport vehicles is determined based on the results of surveys on the preferences of residents (Figure 7).

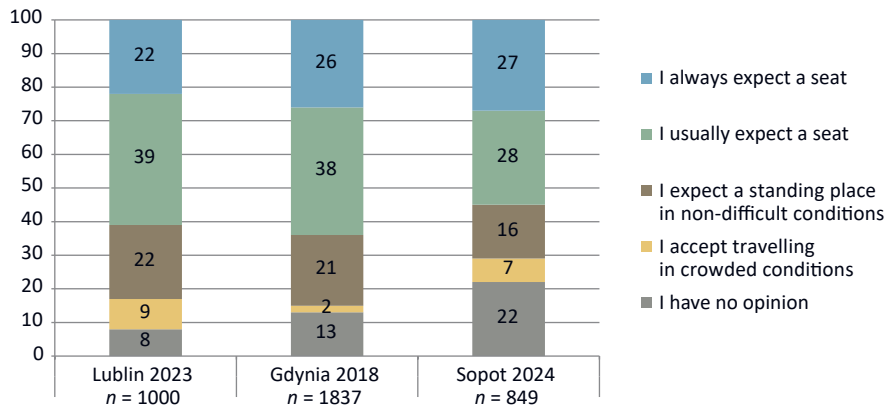

Figure 7. Expected level of travel comfort determined based on the results of marketing research [% of residents]

Source: ("Preferencje i zachowania komunikacyjne mieszkańców Sopotu w 2024 r." 2024; "Analiza rynku komunikacji miejskiej w Lublinie..." 2023; "Preferencje i zachowania komunikacyjne mieszkańców Gdyni w 2018 r." 2019).

Based on the results of the surveys of travel preferences and the volume of demand across individual services, a limit for the number of passengers in the vehicle, which does not reduce the perceived level of travel comfort, can also be determined. Such services with the highest number

of passengers (marked in red) should be marked for each route, similarly as shown in Table 1.1. of Appendix 1. In cases where exceeding the passenger limit is not incidental (school trips, sports fans, concert participants and other non-cyclical events) and repeat themselves, the possibility of increasing the capacity of the vehicle should be considered by swapping the vehicle for another with a higher capacity or, in justified cases, by increasing the frequency at certain times.

The database on the size and structure of demand for public urban transports serving urban districts or rural municipalities may also be used in modelling the financial consequences of changes to the transport offer, such as a change in ticket prices or narrowing and, more likely, broadening the entitlement to free travel.

In 2018, the scope of free travel entitlements was extended in the Gdańsk agglomeration by including primary and secondary school pupils in the group of persons entitled to free travel. This decision, dictated by political considerations, was justified by the possibility of generating additional demand among school pupils and partly also parents taking their children to school. In practice, this hypothesis has not been proven either on the basis of the results of demand research or on the basis of the study of the transport behaviour of pupils, which were presented in Chapter 6.2.

Table 20 shows the number of passengers and the share of passengers entitled to free journeys calculated on the basis of demand marketing research in three selected municipalities of the Gdańsk agglomeration. Data is presented for a short period of time: 2018 – before the extension of the entitlements and the following year (2019), and a long period of time – 2024 (data for the years 2020–2023 were omitted due to the impact of restrictions related to the pandemic).

On the basis of the data, it can be concluded that the extension of entitlements in the short term (the share of eligible persons increased from 6 to 15%) did not affect the increase in the number of passengers (a significant increase in the number of passengers in Rumia and Kosakowo in 2019 corresponds to the size of the statistical margin of error in the studies).

What stands out, however, is the decline in the total number of passengers in the long term (from 1 to 8%) and a simultaneous increase in the share of passengers travelling free of charge compared to 2018 of 9 to 21%. This resulted in a deterioration in the economic and financial efficiency of public urban transport in the analysed municipalities. In the calculations presented in the table, the increase in the share of eligible individuals over a short period of time was assumed as a result of the expansion of the list of entitlements, along with the average revenue per passenger corresponding to the financial conditions in 2024. The calculations of the financial consequences presented should therefore be treated as being cautiously optimistic.

Table 20. Number of passengers and the share of passengers entitled to free travel in Rumia, Sopot and the rural commune of Kosakowo in 2018, 2019 and 2024

Item	Rumia	Sopot	Kosakowo
Number of passengers in 2018	5,536,671	4,153,325	2,008,730
Share entitled to free travel [%]	23	34	16
Number of passengers in 2019	5,753,277	4,130,538	2,109,124
Share entitled to free travel [%]	32	40	30
Number of passengers in 2024	5,077,245	3,835,732	1,990,444*
Share entitled to free travel [%]	33	44	37
Estimated lost revenue from tickets in 2024 [PLN]	441,010	174,909	271,400

*the number of passengers generated by new routes are not taken into account

Source: Own work.

Summing up this part of the considerations based on the examples of the results of the surveys of demand volumes and its structure, it can be concluded that on the basis of the results of marketing research it is possible to conduct analyses of the costs and revenues of public urban transport in relation to the individual services (routes, groups of routes,

service areas, contractor-operators, customers – e.g., those entitled to reduced-fare and free travel), in a manner analogous to that used for typical services and products offered to customers on the market. The public usefulness of public urban transport services should not be a premise for abandoning the assessment of effectiveness of the economic and financial efficiency of the various types of services, including in particular the reasonableness of the decision to launch certain services and the extension of entitlements to concessions or the free use of services. The lack of awareness of decision-makers and residents about the actual costs and the anticipated outcomes of the changes in the offer of public urban transport services leads policymakers to base decisions solely on political and political premises. From an economic point of view, this situation should be treated as a specific example of generating social costs, in which a narrow group of beneficiaries burdens the general public with the costs of irrational decisions.

6.2. Changes in transport behaviour of residents and passengers

6.2.1. Market segmentation in analysing changes in the mobility of residents

Cyclical research carried out on the transport behaviour of residents and passengers in public urban transport creates the possibility of monitoring changes in these behaviours from the point of view of the Sustainable Mobility Goals as set out in SUMP.

For the purposes of urban road traffic modelling and updating the SUMP, comprehensive traffic surveys are carried out (usually every five years). The decision of public urban transport authorities to adapt public transport services to changing needs, behaviour and transport preferences requires comprehensive marketing research to be carried out more often than comprehensive traffic studies. It is recommended that such research is conducted every 2–3 years.

When analysing changes in the transport behaviour of residents, account should be taken of changes in potential factors determining these behaviours, which at the same time often serve as criteria for the segmentation of the potential (residents) and effective (passengers) demand. The criteria for segmentation adopted *a priori* are, *inter alia*:

- sex;
- age;
- socio-occupational status;
- ownership and access to a car within the household;
- income.[16]

Table 21 presents the change in the structure of Gdynia residents during the years 2008–2018.

Table 21. Structure of Gdynia residents during the years 2008–2018

Segments of the population	Share in the population [%]				
	2008 *n* = 1944	2010 *n* = 1975	2013 *n* = 2000	2015 *n* = 2000	2018 *n* = 1837
Sex					
Male	47.1	47.4	47.1	47.0	47.1
Female	52.9	52.6	52.9	53.0	42.9
Age [in years]					
16–20	6.3	6.8	5.7	5.0	4.9
21–30	19.2	17.8	16.8	15.3	13.7
31–40	19.0	19.2	20.7	21.6	21.0
41–50	15.7	14.9	15.7	16.3	18.4
51–60	21.7	20.7	19.2	17.9	15.5
61–70	12.8	15.9	17.0	19.0	20.5
above 70	5.3	5.5	5.0	4.9	6.0

[16] Research on income is difficult as income questions concern sensitive aspects of life.

Table 21 (cont.)

Segments of the population	Share in the population [%]				
	2008 *n* = 1944	2010 *n* = 1975	2013 *n* = 2000	2015 *n* = 2000	2018 *n* = 1837
Socio-occupational status					
Employed	46.9	49.1	53.3	55.8	57.9
Employed	9.1	11.2	11.5	9.4	7.4
Students/pupils	9.6	9.4	8.4	7.9	5.8
Pensioners/disability pensioners	24.3	24.9	22.7	23.3	25.3
Students/pupils	5.3	2.5	1.9	0.9	2.1
Working pensioners/disability pensioners	4.8	2.9	2.4	2.7	1.5
Car ownership status					
Households that own a car	64.0	68.3	73.7	72.2	75.5
Households with no car	46.0	31.7	26.3	27.8	24.5
Main car users in the household	34.2	36.2	43.1	43.0	47.8

Source: Compiled by the author based on PTB report: ("Preferencje i zachowania komunikacyjne mieszkańców Gdyni w 2018 r." 2019).

The statistical analysis for segments distinguished based on the criterion of age showed:

- for the 16–20 years segment: Spearman trend test (STT): a strong negative monotonic trend was observed: correlation: –0.90, statistically significant ($p = 0.037$); Pearson's linear test (PLT): a strong negative linear trend was observed: correlation: –0.91, statistically significant ($p = 0.033$);
- for the 21–30 years segment: STT: a strong negative monotonic trend was observed: correlation: –1.00, highly statistically significant ($p < 0.001$); PLT: a very strong negative linear trend was observed: correlation: –0.97, significant ($p = 0.005$).

– for the 41–50 years segment: STT: positive monotonic trend: correlation: 0.90, statistically significant ($p = 0.037$).

Detailed results of the analysis for statistically significant changes are shown in Table 2.1. of Appendix 2.

A very strong negative correlation is characteristic for the student/pupil segment, which means that the number of students/pupils in the population is decreasing. The Spearman test shows an almost perfect negative correlation, the *p-value* result may indicate some limitations in data accuracy or statistical insignificance (depending on the interpretation of the *p-value*), however Pearson's correlation coefficient confirms the general downward trend.

In the segment of working pensioners, both analyses point to a strong, negative trend, which suggests that the number of pensioners/disability pensioners is also decreasing. This result is consistent in both tests, therefore strengthening its credibility. This is the result of demographic or economic changes, such as limitations on the possibility for pensioners to continue working.

The results indicate marked changes in the age distribution during the period analysed. The number of citizens in the age 16–20 and 21–30 years age groups is decreasing, reflecting the decline of fertility and migration of young people. A clear upward trend characterises the 41–50 and 51+ segments, which is consistent with the population ageing process.

As a result, the number of pupils entitled to reduced-fare trips is decreasing in Gdynia, and if this trend continues, from 2018, so will the number of residents entitled to free travel. This hypothesis will be verified by the results of research conducted in 2024.[17] At the same time,

[17] Further research in Gdynia was planned in 2020. Restrictions related to the pandemic ruled out the possibility of conducting research in households. PTB carried out further research at the end of 2024. For comparison purposes, the results of marketing research on transport behaviour from 2020, which were carried out by telephone interview in Gdynia, have also been presented later in the chapter.

the number of people entitled to reduced-fare and free travel in the 60+ age group is increasing.

Both tests show a strong negative correlation in the segment of persons who do not own a car, therefore confirming the importance of the decrease in the number of such persons. The strong positive correlation in the segment of the main car users proves the statistical significance of the changes.

The results of the statistical analysis of the factors adopted *a priori* as criteria for the segmentation of residents in the years 2008–2018 indicate that the share of residents over 60 in the years 2008–2018 increased by 8.4 percentage points. The identified change may affect changes in the transport behaviour of residents, because the mobility of the elderly differs from the average mobility. The results of the aforementioned studies from 2018 will mean that while the mobility index of residents over 60 is at the average level at 0.20 journeys per day, the same indicator for people 60+ in trips by urban public transport trips is 0.71 p/d (average 0.67 p/d) and in trips by car 0.41 p/d (average 0.93 p/d). An increase in the size of the older age segment may therefore result in an increase in demand for public urban transport services. The identified level of changes in this area in Gdynia will probably not be felt on the scale of the public urban transport network in Gdynia, nevertheless, it may cause an increase in the number of passengers on individual lines, especially those dedicated to the elderly. In Gdynia, seven such routes have been launched. Changes in demand on these lines should be analysed on an ongoing basis, using automatic measurement devices (e.g., counting gates), or periodically using traditional methods (observers on board vehicles). The greater requirements of older people regarding travel comfort should be taken into account.

There was a clear increase in the size of the segment of working residents by 11 percentage points in the years 2008–2018. Changes in this segment are most often positively correlated with the level of economic activity and negatively correlated with the proportion of working-age individuals who remain unemployed. In the long term, the increase

in the share of working people may also be the result of changes in professional activity measured by the gender criterion, which may be caused by lifestyle changes. The segments identified in Table 22 according to the socio-occupational criterion are characterised by diversified mobility.

Table 22. Mobility of Gdynia residents across the identified segments according to the criterion of socio-occupational status in 2018

Segments according to the socio-occupational criterion	Average number of trips per day		
	Walking	Public urban transport	Car
Employed	0.15	0.57	1.29
Studying/in education	0.23	1.68	0.36
Working and in education/studying	0.12	1.72	0.67
Disability pensioners	0.32	0.48	0.31
Pensioners	0.24	0.61	0.39
Working pensioners/disability pensioners	0.19	0.81	0.52
Employed	0.43	0.53	0.55
Average of all residents	**0.20**	**0.67**	**0.93**

Source: Compiled by the author based on: ("Preferencje i zachowania komunikacyjne mieszkańców Gdyni w 2018 r." 2019).

The highest rates of public transport mobility in Gdynia are characterised by pupils and students (1.68–1.72 trips per day), and the smallest by pensioners, disability pensioners and the unemployed – respectively 0.68, 0.48 and 0.53 trips per day. The most unfavourable phenomenon from the point of view of the goals of sustainable mobility is the much greater (by 38%) mobility of residents using a private car compared to those who use public transport. In the largest segment of working residents, this indicator is shaped even less favourably: the average number of car trips in this segment is 2.26 times higher in comparison to public transport. Such a situation constitutes a challenge to the achievement of the objectives of sustainable mobility and should encourage city authorities to create

incentives and promote the use of bicycles and PTD (personal transport devices, e.g., electric scooters) for travel of relatively short distances.

The most important challenge for sustainable mobility policy is the increase in the number of private cars. In Gdynia, between the years 2009 and 2018,[18] the number of registered cars increased from 109,153 to 148,242, i.e. by 35.8%, and by 2023 had increased by a further 13.4% ("Bank Danych Lokalnych" 2024). The presented research results correlate with the Statistical Office data. The share of households that own a car increased from 2008 to 2018 by 11.5 percentage points (approx. 18%). In addition, the saturation of households with domestic cars increased: the motoring index of households in Gdynia increased from 0.81 cars per household in 2008 to 1.01 cars per household in 2018, i.e. by 24%. As a result of these changes, the share of the main car users in the household also increased by 13.6 percentage points.

Table 23 shows changes in the characteristics of residents in the context of two variables: socio-occupational status and access to a car.

Table 23. Changes in the characteristics of residents across segments defined by socio-occupational criteria in Gdynia in the years 2008–2018

Segments according to the socio-occupational criterion	2008 *n* = 1944		2018 *n* = 1837	
	Persons in the household with a car	Main car users in the household	Persons in the household with a car	Main car users in the household
Employed	75.0	52.1	84.8	66.7
In education/studying	72.7	5.4	77.4	9.4
Pensioners	35.2	17.9	56.8	29.3
Disability pensioners	45.6	15.7	45.2	16.1
Employed	52.3	17.6	72.8	22.8

Source: Compiled by the author based on: ("Preferencje i zachowania komunikacyjne mieszkańców Gdyni w 2018 r." 2019).

[18] There is no data in the statistics for Gdynia for the year 2008.

The test for proportions based on data from a 10-year period showed that, apart from the disability pensioners segment, changes in all segments are statistically significant. The share of households that own a car increased from 4.7 percentage points (pupils and students) to 21.9 percentage points (pensioners and disability pensioners). The share of the main car users in the household increased from 4 percentage points (pupils and students) to 14.6 percentage points (employed).

The presented changes in the volume of segments according to the criteria analysed indicate unfavourable trends in the structure of residents, which in turn negatively affect changes in their transport behaviour from the point of view of sustainable measures adopted by the Gdynia authorities.

The transport behaviour of urban residents may constitute a foundation for distinguishing specific segments of customers. One of the methods leading to the identification of segments is the analysis of clusters.

The cluster analysis consists of multidimensional techniques, the primary purpose of which is to group objects that characterise specific features by searching in a set of subset objects called clusters that are both homogeneous and separable. The homogeneity of the collection means that the units belonging to a particular group (coupling) are similar to each other, while at the same time they differ as much as possible in relation to objects belonging to other classes (Kąciak 2011).

Based on the results of research on transport preferences and behaviours of Gdynia residents from 2010 (Hebel 2013) respondents from Gdynia were grouped into four segments with the following respective sizes: 501 (25.4%), 699 (35.4%), 172 (8.8%) and 603 (30.5%).

For example, the largest segment (35% of Gdynia residents) is mainly made up of young people aged: 21–30 years (25.2%) and 31–40 years (20.3%), as well as what distinguishes this segment from the others: residents aged 16–20. The largest state group were working people (45.9%). The smallest share in this segment is that of pensioners (14.9%) or those in school/higher education (14.5%), 38.5% of respondents always use public urban transport, whereas 27.0% mostly use this transport

mode. This segment is characterised by a shorter average time to reach the stop compared to the other three segments (4.93 minutes compared to the average for all residents of 5.03 minutes). For 70.2% of respondents the travel time has not changed in the last 2 years. The three main reasons for the use of a car of urban trips are:

- more convenient (32.9%);
- shorter travel time (22.4%);
- no need to wait for public transport (15.2%).

The three most important reasons given by respondents for the use of public urban transport (despite access to a car in the household) are:

- use of the car by another person (16.8%);
- difficulty parking at destination (15.6%);
- lower cost of travel by public transport (14.6%).

Compared to the characteristics of the other segments, the largest group stands out with the highest proportion of respondents choosing public transport due to the availability of the metropolitan ticket and the satisfactory quality of public transport. The third largest features of public transport for residents from this segment are in the following: directness, frequency and punctuality. Nearly half (40.2%) expect either a standing place in acceptable conditions or, preferably, a seat on public transport vehicles (31.9%), 64.7% of people in this segment rated public urban transport services as good (Hebel 2013).

Table 24 shows the characteristics of segments highlighted by the concentration method.

Table 24. Transport profiles of distinguished segments of the urban transport market in Gdynia in 2010

Characteristic	Profile of distinguished segments			
	Segment 1 *n* = **501**	**Segment 2** *n* = **699**	**Segment 3** *n* = **172**	**Segment 4** *n* = **603**
Most commonly used public transport mode	bus	bus trolleybus Fast Urban Rail (SKM)	bus trolleybus Fast Urban Rail (SKM)	bus trolleybus
Age of respondents	31–40 51–60	21–30 31–40	16–20 21–30	51–60 61–70
Socio-occupational status of respondents	employed, retired	employed, retired, working and in education/studying	employed, working and in education/studying	employed, retired
Mode of travel	always by car	always by public transport	mostly by public transport	always by public transport
Three most important determinants for choosing public transport	1. car used by another person 2. difficulty parking 3. congestion	1. car used by another person 2. difficulty parking 3. low cost	1. car used by another person 2. difficulty parking 3. congestion	1. difficulty parking 2. car used by another person 3. low cost
Most important characteristic of public transport (factor indicated first)	directness	directness	directness	directness
Most important characteristic of public transport (when choosing three factors)	– punctuality – directness – availability	– directness – frequency – punctuality	– directness – frequency – availability	– directness – availability – punctuality

Table 24 (cont.)

Characteristic	Profile of distinguished segments			
	Segment 1 *n* = **501**	**Segment 2** *n* = **699**	**Segment 3** *n* = **172**	**Segment 4** *n* = **603**
The best-performing characteristic of public transport	– availability	– availability	– availability	– availability
The worst-performing characteristic of public transport	– punctuality	– punctuality	– punctuality	– punctuality
Expected standard of comfort	– mostly a seat – no opinion	– a standing place in acceptable conditions – mostly a seat	– a standing place in acceptable conditions – mostly a seat	– mostly a seat – in acceptable conditions
Assessment of public transport in Gdynia	good	good	good	good
Price of bus tickets	neutral	neutral	neutral	neutral
Speed of bus travel	fast	fast	somewhat fast	fast
Bus comfort	comfortable	comfortable	somewhat comfortable	comfortable
Bus cleanliness	clean	clean	somewhat clean	clean
Punctuality	punctual	punctual	somewhat punctual	punctual
Safety on board	safe	safe	somewhat safe	safe
Price of trolleybus tickets	–	neutral	neutral	neutral
Speed of trolleybus travel	–	fast	somewhat fast	fast
Convenience of trolleybus travel	–	convenient	somewhat comfortable	comfortable

Table 24 (cont.)

Characteristic	Profile of distinguished segments			
	Segment 1 *n* = **501**	**Segment 2** *n* = **699**	**Segment 3** *n* = **172**	**Segment 4** *n* = **603**
Cleanliness of trolleybuses	–	clean	somewhat clean	clean
Punctuality of trolleybuses	–	punctual	somewhat punctual	punctual
Safety of trolleybus travel	–	safe	somewhat safe	safe
Price of Fast Urban Rail (SKM) tickets	–	neutral	neutral	–
Speed of Fast Urban Rail (SKM) travel	–	very fast	fast	–
Convenience of Fast Urban Rail (SKM)	–	convenient	somewhat convenient	–
Speed of Fast Urban Rail (SKM) cleanliness	–	somewhat clean	dirty	–
Fast Urban Rail (SKM) punctuality	–	punctual	punctual	–
Fast Urban Rail (SKM) safety	–	safe	somewhat safe	–

The symbol "–" means that 98% of respondents of the segment chose the response: *no opinion*.

Source: (Hebel 2013).

The profiles of distinguished segments can be used to create a marketing strategy based on the objectives of sustainable mobility. From this point of view, it is a challenge to obtain passengers from the first segment, whose number is approximately one-quarter of the city's residents and retain them as regular customers. The most important attributes of public urban transport are, in order: punctuality, directness and accessibility. Particularly notable is the first attribute, since the punctuality

of public urban transport in Gdynia is also the worst-performing attribute. Therefore, building bus lanes can be considered a legitimate marketing strategy aimed at attracting new passengers for public urban transport. Residents in this segment rated the services close to the average; however, it is worth noting that they are individuals who always travel by car. A good overall assessment of public urban transport services and positive detailed assessments are not therefore, in most cases, assessments resulting from their own experience as passengers, but are based on the assessment of others (family or friends). It should therefore be assumed that the actual (resulting from experience) expectations of these persons in relation to the quality of public urban transport services will be different from those resulting from research.

6.2.2. Changes in the modal split

The main objective of the study of transport behaviour of residents in cities is to identify the modal split, namely the share of individual transport modes in urban travel. Research on transport behaviour, leading to the identification of the share of individual means of urban transport in travel, is most often carried out using measurements which employ a technique called “A Day in the Life” (or “One-day Travel Diary”), in which respondents are asked about all trips made on the day before the study. It is recommended that the study of transport behaviours be carried out by means of an interview, as this increases the likelihood of obtaining a complete picture of resident mobility. When analysing each journey, it is necessary to identify the individual stages determined by the possible change of the transport mode. The scope of the travel-specific data should include: journey time, place of start and completion, data on all means of transport used on the trip from origin to destination, motivation (the purpose of travel understood as the fulfilment of a specific need), or additional data on the costs of each ride by individual means of transport or the number of people travelling together in cars.

A summary of data from the classic questionnaire on the study of transport behaviour of the residents of Gdynia was presented in Figure 8.

Based on travel data, information is obtained on:

- intensity of journeys over time, including periods of accumulation of travel at the so-called transport peaks (Appendix 3, Figure 3.1);
- structure of the motivations (destinations) of the journey (Appendix 3, Figure 3.2);
- directions of movements during a 24-hour period and at different times of the day (Appendix 3, Figure 3.3);
- share of individual means of transport in the implementation of urban travel – modal split (Appendix 3, Figure 3.4).

From the point of view of the competitiveness of sustainable mobility modes (public urban transport, bicycles, car sharing, PLEV) changes in transport behaviour should be monitored by comparing them to the modal split established in the SUMP.

As early as the 1960s, it was pointed out that more flexible working hours were desirable for the purpose of mitigating transport peaks (Thompson 1967). Flexible working hours are conducive to liberalisation of the labour market and an increase in the number of self-employed (Nurvala 2015; Thoemmes 2015), so some consider them to be tools for transport demand management (TDM) (Nakamura, Hayashi 2013). However, the possibility of making use of flexible working hours often does not significantly affect the mitigation of transport peaks (Meissonnier, Richer 2021; Munch, Proulhac 2023; Wöhner 2022). In light of the overview of research findings presented in the monograph, it can be stated that a more effective course of action leading to the reduction of congestion related to transport peaks is to lead to modal shifts, namely, the forgoing of certain car journeys, by improving the quality of public transport and its integration with other travel modes considered to be sustainable and pro-ecological.

Interviewer: present the following definition of a trip to the respondent

Trip – moving from point A to point B for a specific purpose, e.g., work.

A trip may consist of several stages (rides or walking trips longer than 0.5 km).

If other matters are dealt with in between, e.g., shopping, giving someone a lift, etc., then it is considered a separate trip with another purpose, resulting in two trips.

Please provide data on all non-walking and walking trips (walking trips longer than 0.5 km, including walking to the means of transport) made yesterday (round trip included).

No.	Dep. time	Purpose	FROM – town	FROM – street / building	TO – town	TO – street / building	Means of transport	No. of people in car (besides driver)*
1								
2								
3								
4								
5								
6								
7								

Interviewer: enter the number of people in the car besides the driver; applies to trips by car as driver (Sk) and as passenger (Sp).

☐No trips – go to E7

Trip purposes:

P – Work; N – School / Study; Z – Shopping; SZ – Professional / Business matters; SO – Personal matters; ST – Social activities; R – Recreation

Modes of transport:

A – Bus; T – Trolleybus; TM – Tram; K – SKM, PR, PKM or other railway; AZ – Company bus/shuttle (closed trip); BUS – Private coach / long-distance bus; PKS – Regional bus transport; Sk – Car (as driver); Sp – Car (as passenger); TX – Taxi; SR – Scooter; R – Bicycle; M – Motorcycle (moped); Pi – On foot

Figure 8. Scope of data in measuring travel behaviour – the 'Previous Day Snapshot' technique (paper questionnaire)

Source: PTB materials.

Table 25. Motivations (destinations) for urban travel of all residents in selected cities and municipalities of the Gdańsk agglomeration

Destinations (travel motivations)	Gdynia 2018 *n* = 1837	Rumia 2022 *n* = 867	Kosakowo* 2023 *n* = 987	Sopot 2024 *n* = 849
Home	45.3	46.7	46.5	47.8
Work	25.8	27.2	28.4	25.9
Shopping	9.2	11.1	9.8	10.4
Personal matters	8.2	5.4	3.6	5.6
Recreation	3.2	0.8	1.7	3.0
Education	3.3	4.6	3.4	3.0
Social activities	1.9	1.9	1.9	2.9
Other	3.1	2.3	4.7	1.4

* rural commune

Source: Own work.

Home is the destination of the majority of urban trips. This is perhaps obvious as home is the main final destination of return trips. The share of workplaces as travel destinations is shaped by numerous macroeconomic factors, both those captured in statistics, such as unemployment rates, the proportion of the working-age population, and the level of the minimum wage, and those identified through primary research, such as the ease of doing business and lifestyle patterns. Table 25 shows the share of travel destinations in selected cities and municipalities of the Gdańsk agglomeration. The share of trips connected with home and work show no difference in statistical significance. Greater differentiation occurs in relation to other travel destinations and results from the demographic characteristics of the area, the level of the motorisation of households and the distance of the commune from the core of the agglomeration, where the majority of metropolitan functions are located.

Table 26 shows the share of travel destinations in the segment of residents travelling always or mostly by private car.

Table 26. Motivations (destinations) for urban travel of the totality of residents and those declaring to travel always or mostly by public urban transport (PUT) and always or mostly by private car (PC) in Gdynia in 2018

Destinations (travel motivations)	Total *n* = 1837	Travelling always or mostly by PUT *n* = 780	Travelling always or usually by PC *n* = 834
Home	45.3	46.3	44.8
Work	25.8	20.9	31.4
Shopping	9.2	9.8	8.2
Personal matters	8.2	9.4	6.4
Recreation	3.2	3.5	3.7
Education	3.3	7.0	0.5
Social activities	1.9	2.1	1.4
Other	3.1	1.0	3.6

Source: Own work.

Figure 9 shows the distribution of travel destinations for three groups of residents: all, public urban transport users, and the main car users in the household.

The Kruskal-Wallis test indicates statistics 0.204 and the value $p = 0.903$. Because the *p-value* is much greater than the typical significance level (e.g., 0.05), it can be concluded that there are no statistically significant differences between segments. The percentage share in each category (total residents,[%]travelling by public transport, travelling by car) is similar in terms of the timetable between different destinations. This means that the motivations of the general public and of public transport and those travelling by car are similar. This is also confirmed by the chi-square test (Appendix 4, Table 4.1), which indicates statistically negligible differences between groups. The exception is the travel destination education, but in the context of all travel destinations in individual segments, it can be concluded that these differences are statistically irrelevant. This is due to the fact that identified travel destinations, such as work, shopping or

recreation, are common to all residents, regardless of the choice of transport mode. Since the data concerns only three groups from a single measurement, they should be carefully interpreted, in particular with regard to the relatively large differences between groups in travel to work and a place of education. The Kruskal-Wallis test analyses the differences in the distribution of values between groups (segments). *P-values* and statistics suggest that differences in distributions between groups are not strong enough to be considered statistically significant. Due to the different ranges of travel shares to work and place of education, a pair comparison test was carried out. Moreover, the results of the Mann-Whitney test between the groups (travel destinations) "Work" and "Education" and other destinations show no significant differences, which means that there were no statistically significant differences.

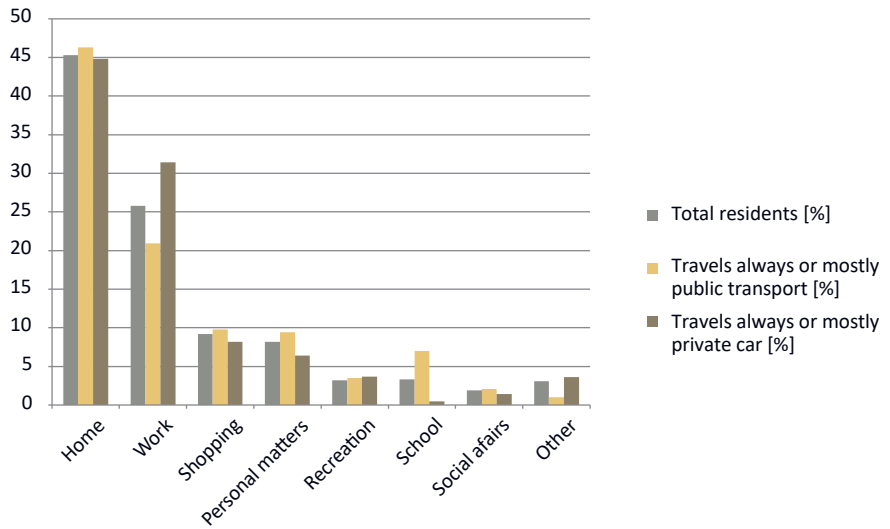

Figure 9. Analysis of the different travel destinations of three groups of Gdynia residents (2018)

Source: Own work.

The study of transport behaviour enables the analysis of the main directions and intensity of trips from origin to destination. Assuming research on an appropriate sample of residents, the results within a given area enable the analysis of demand for trips between districts (or between housing estates). This is a kind of analysis of demand volatility in spatial terms. The travel matrix reflects the spatial variation in demand (Appendix 3, Figure 3.3).

The spatial distribution of demand for public urban transport is often represented using cartograms showing the distribution of demand (passenger pipelines) along the main urban roads – Figure 10. Such tests are most often carried out as part of CTS and include not only the movement of passenger vehicles, but also the transport of cargo. These studies use the methods characterised in this monograph (single methods, interviews and observations) and specific measurements, e.g., cordon surveys and metadata obtained from mobile device operators. The analysis of CTS results is carried out using specialised computer programmes (e.g., Visum).

The modal split of trips by transport mode is essential for achieving the goals of sustainable mobility. It is treated most often as an indicator of the degree of achievement of the goals set out in the SUMP. The modal split in cities of similar size may vary significantly – see Figure 11.

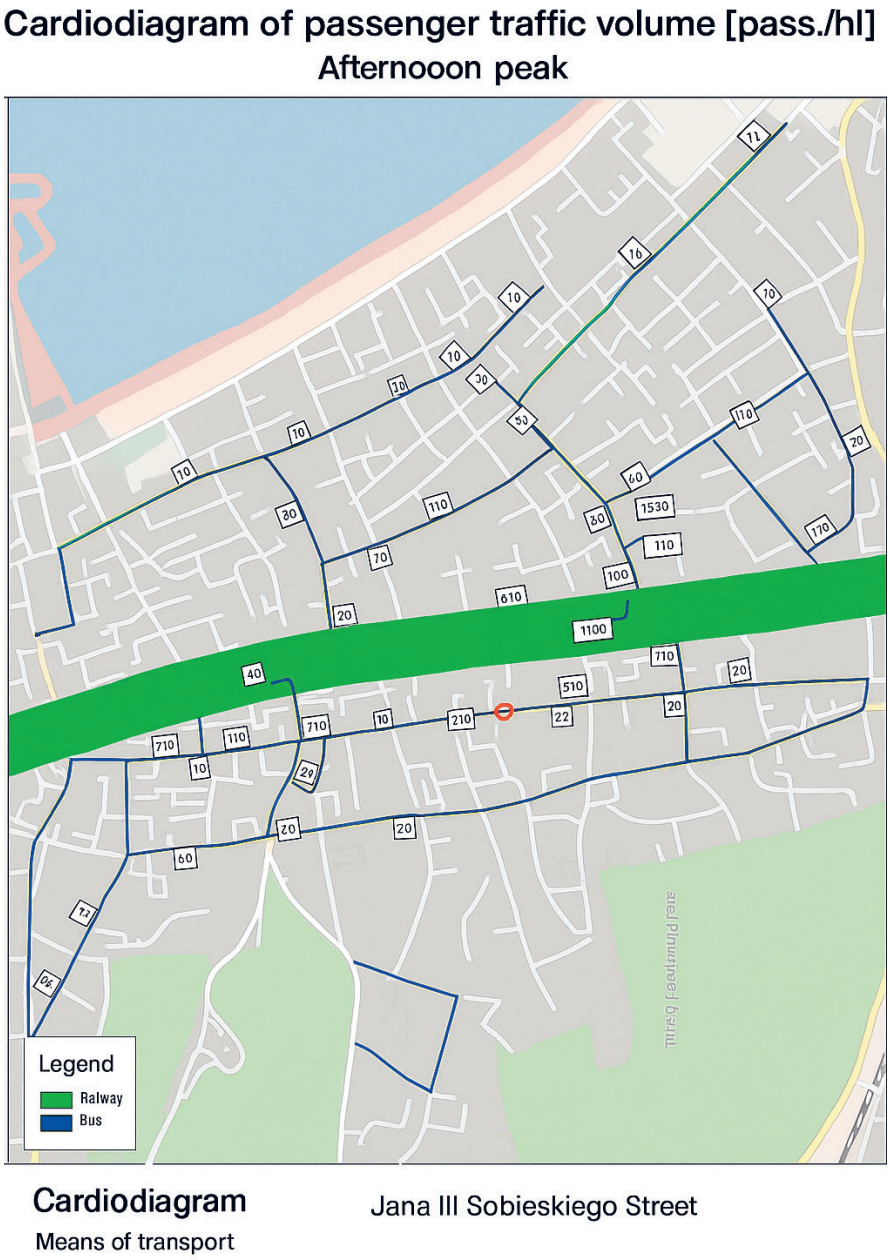

Figure 10. Distribution of passenger flows in Sopot in 2022

Source: Transport Simulation Model for the City of Gdańsk 2022, Gdańsk Development Office 2022 on the basis of results from programme PTV Visum.

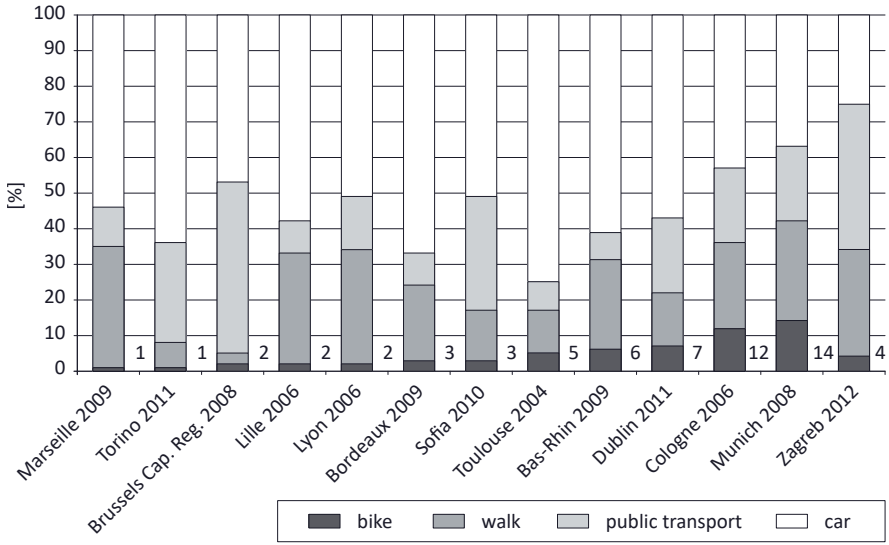

Figure 11. Comparison of modal split for European cities with 0.8 to 1.3 million residents using data from the TEMS database

Source: (Pilko, Tepeeš, Brezina 2015).

Many factors have an impact on the differences in the share of different transport modes deemed sustainable. The share of public transport in trips has been shown to increase with the size of the city (Susilo, Maat 2007; Scheiner 2010). The revenue is positively correlated with the increase in the share of cars (Balcombe et al. 2006; Chen, Gong, Paaswell 2008; Dargay, Hivert, Legros 2008), however, in relation to public transport, the results are not unequivocal. The influence of the city's attributes on the modal split has been examined (Lee et al. 2022), showing the most significant influence on the composition of travel behaviour across socio-demographic groups. Other identified factors in cities are the population density and employment rate, which are positively linked to low-carbon modes of transport. The high fuel tax and low prices of public transport and taxis often make people reconsider whether they really need to own their own car. The authors also point out that bad weather conditions may prevent the use of bicycles. The study of factors determining the mode of travel, including access to a car, age, whether or not

there are children in the household, public transport ticket prices, population density, travel distance, land use, and others has been conducted (Santos et al. 2013).

The share of public transport in selected cities is shown in Table 27, whereas the share of sustainable travel modes in connection with population density is shown in Figure 12. In cities with a relatively high population density, there is a greater preference for non-car transport modes. Short travel distances further encourage this tendency, making walking and cycling more appealing. Higher-density areas are also characterised by intense resident activity, allowing public transport to effectively combine origins and destinations.

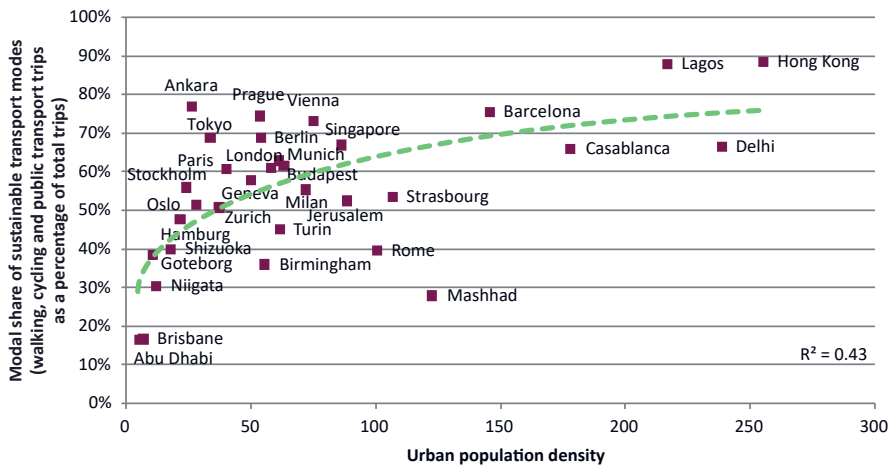

Figure 12. Share of sustainable mobility (public transport, cycling and walking) in selected cities, taking account of population density

Source: (Kenworthy, Laube 2001).

Table 27. Means of urban travel in selected European cities in the years 2010–2018

City	Country	Year of research	Population	Mode of travel [% of trips]			
				Public transport	Car	Bike	Walking
Lviv	Ukraine	2014	729,000	**54**	23	2	21
Belgrade	Serbia	2015	1,659,440	**49**	26	1	24
Warsaw	Poland	2015	1,764,615	**47**	32	3	18
Cracow	Poland	2010	756,183	**46**	28	1	25
Budapest	Hungary	2014	1,744,655	**45**	35	2	18
Poznan	Poland	2013	550,742	**43**	40	4	13
Madrid	Spain	2012	3,233,527	**42**	29	0	29
Vienna	Austria	2016	1,840,226	**39**	27	7	27
Leeds	Great Britain	2010	770,800	**38**	57	1	4
Wrocław	Poland	2011	632,996	**35**	42	4	19
Helsinki	Finland	2013	613,100	**34**	23	11	32
Sheffield	Great Britain	2010	534,500	**34**	55	1	10
Glasgow	Great Britain	2011	592,000	**33**	39	1	27
Sofia	Bulgaria	2010	1,211,348	**32**	51	3	14
West Yorkshire	Great Britain	2013	2,227,400	**31**	63	1	5
Gothenburg	Sweden	2018	572,000	**29**	44	7	20
Turin	Italy	2011	900,000	**28**	64	1	7
Oslo	Norway	2014	634,463	**26**	37	5	32
Vilnius	Lithuania	2011	554,192	**25**	38	1	36

Source: (Grzelec, Hebel, Wyszomirski, 2020) based on EPOMM data, http://www.epomm.eu/tems/result_cities.phtml?new=1 [accessed: 7.01.2020].

Given the different test methodology, including data measurements and analysis, when comparing the modal split, even for cities of a similar size, the assessment of their sustainable mobility policies should be carefully interpreted. For example, in some studies all walking distances are considered to be walking trips regardless of the distance, whereas others only take into account distances over 250 or 500 m, while others still only include trips over a kilometre.[19] The varied walking distances included in the modal split are applied for both urban and rural areas.

Changes in the share of sustainable urban travel are the main measure of the effectiveness of SUMP activities. Table 28 shows the share of individual travel modes in Gdynia in the years 2008–2018.

Table 28. Modal split and bus and trolleybus operations in Gdynia in the years 2008–2018

Mode of travel	2008 *n* = 1944	2010 *n* = 1975	2013 *n* = 2000	2015 *n* = 2000	2018 *n* = 1650*
	Share of types of travel				
Bus	30.0	28.8	25.0	24.6	27.3
Trolleybus	14.8	15.0	14.0	10.5	8.7
Train	7.2	6.3	6.4	4.8	5.5
Bike	0.8	0.4	0.8	1.8	2.4
Car	47.2	48.7	53.1	57.8	55.5
Other	–	0.8	0.7	0.5	0.6
Number of bus vehicle-kilometres [million]	11.88	12.02	11.61	11.50	11.65
Number of bus vehicle-kilometres [million]	4.85	4.86	4.84	4.79	5.15

*excluding walking trips

Source: Own work.

[19] More about the methodological dilemma of modal split research (Krych 2024).

Marketing research on transport behaviour of the Gdynia residents in the years 2008–2018 was carried out according to the same methodology including, *inter alia*, the same sampling method (stratified random sampling) and the same data reduction procedure for aggregating individual trips into journeys. In 2018, walking journeys over 0.5 km were included in research for the first time. For comparison purposes, however, these journeys are not included in Table 28. Irrespective of the analysis of the changes in the correlation between the proportion of trips undertaken by buses and trolleybuses and the service offer as measured by operational work (Appendix 5), the share of sustainable travel modes decreased over the period of 10 years by 9 percentage points, reaching its lowest in 2015.

In the period analysed, bus operations (vehicle-kilometres) showed a negative slope of the trend line (the inclination coefficient of the line was –0.039 at *p-value* = 0.156, which means that the change is not statistically significant). The trend of changes in the operation of trolleybuses is positive (0.022), but also not statistically significant (*p-value* = 0.269). The absence of a statistical significance of the changes in the operational work does not exclude the relationship between this variable and the number of bus and trolleybus passengers. The analysis of Spearman's correlation between the supply (the number of vehicle-kilometres) in bus and trolleybus transport, and the demand measured by the share and number of passengers showed a moderate positive correlation for the buses. The correlation coefficients were 0.6 for buses at *p-value* = 0.285, which means a relatively strong correlation, but is not statistically significant. With regard to trolleybuses, such correlation does not occur (ρ = 0.0).

The lack of a statistically significant correlation between the variables of supply and demand indicates that the supply of services is not a sufficient factor in explaining the changes in the number of passengers, especially in subsequent years. This is confirmed by the results of studies carried out by other authors (Friman, Fellesson 2009; Fujii, Kitamura 2003). Explanations of this phenomenon should be sought in quality factors, such as lifestyle, and assessment of the quality of public transport

services in Gdynia. From the perspective of sustainable mobility objectives, the decline in the share of sustainable transport modes – reflected in the negative slope of the trend curve – is concerning (inclination factor, –2.66, *p-value* = 0.028 (R^2 = 0.84, which indicates a good trend match) – Figure 13.

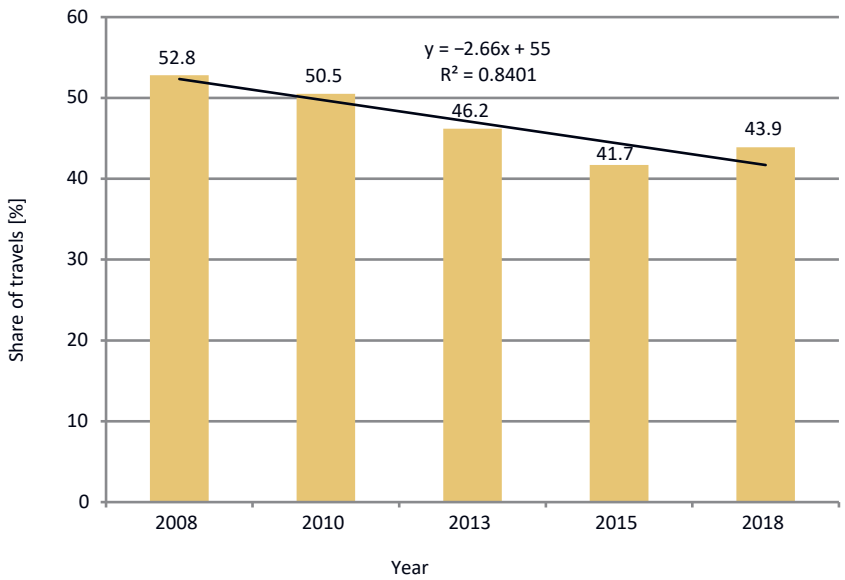

Figure 13. Change in the share of sustainable mobility in Gdynia in the years 2008–2018

Source: Own work.

Gdynia is one of the cities in Poland where investments in public urban transport have not lead to the expected results planned in the SUMP (Wolański 2022). A review of the literature and research on the functioning of public transport in Gdynia indicates that the potential reasons for the decrease in the share of sustainable travel modes are:

- failure to adapt the attributes of services to the preferences of residents;
- low quality of public transport services measured by the level of satisfaction;

- lack of integration of rail and road public transport services (buses and trolleybuses);
- absence (in the analysed period) of city bike rental services;
- long journeys by public transport and frequent delays of buses and trolleybuses that reduce the quality of multimodal services (trips that use the railways) and the short length of bus lanes;
- failure to implement or insufficiently implement the transport policy assumptions, including the inefficient use of the policy's instruments.

Some of these hypotheses will be verified later in the monograph.

When looking for reasons that do not correspond to the goals of the share of sustainable mobility in the SUMP,[20] it is advisable to analyse the modal split of smaller areas, which may be districts and individual housing estates (in CTS surveys, so-called regions are determined using a specific methodology). It is important to note that data relating to units (or structures) smaller than those selected in the sampling procedure will be associated with a higher margin of error than initially assumed. For example, if the sample size for the city is calculated to keep the margin of error in estimating the share of trips within ±3%, the margin of error for smaller areas (such as districts) will inevitably be higher. Table 29 shows the model split breakdown for six selected districts of Gdynia.

The share of transport modes considered to be sustainable is strongly differentiated in individual districts and ranges from 11.8% (Pustki Cisowskie) to 58.6% (Chylonia). As a result, the share of cars in handling the transport needs of district residents is also diverse and ranges from 41.4% (Chylonia) to 88.2% (Pustki Cisowskie). Some of the differences in mobility presented are easy to explain and result, among other things, from the availability of individual public urban transport and the intensity of service, the measure of which may be the operational work in the district area or the number of residents. The impact of other factors explaining

[20] The SUMP for Gdynia for the period 2016–2025 assumed a 10% reduction in the share of cars in transport.

the variation in the share of individual travel modes can be identified from regression models.

Table 29. Modal split for selected districts of Gdynia in 2018

Travel mode	Share of types of travel					
	Babie Doły *n* = 16	Chwarzno--Wiczlino *n* = 86	Chylonia *n* = 185	Karwiny *n* = 85	Pustki Cisowskie *n* = 71	Śródmieście *n* = 109
Bus	25.0	25.8	15.2	18.2	8.2	21.4
Trolleybus	0.0	0.2	27.5	14.6	0.8	1.5
Train	0.0	3.9	13.0	0.8	2.8	15.3
Bike	0.0	1.1	2.9	1.6	0.0	0.0
Car	75.0	68.9	41.4	64.8	88.2	61.8

Source: Own work.

From the perspective of the public urban transport operator, comparing the modal split across different districts should serve as a foundation for identifying the factors that influence the distribution of transport modes in trips, and understanding how these factors affect the choice of transport options used for travel.

Interesting studies of factors affecting the use of individual modes of transport were based on the dataset from the study "Quality of life of Lodz residents" (Rokicka 2013). The measurement was carried out on a representative sample of 1000 Lodz residents 2012. The subject of the study included issues of lifestyle, residents' habits, economic and health issues, matters related to safety, social relations and transport. The share of residents declaring daily or almost daily use of public transport was 39.2%, compared to 31.4% for private transport. The analysis of the determinant of transport behaviour was based on a logit regression model, where the probability of p_i for dependent variables took the form:

$$p_i = \Lambda(x_i'\beta) = \frac{e^{x_i'\beta}}{1+e^{x_i'\beta}} \quad (3)$$

The results of the analysis showed (Wójcik 2019) – that the main synthetic variable affecting the choice of transport mode is the socio-demographic characteristics of the residents. Age has a non-linear (parabolic) association with the frequency of use of private transport: with age, the likelihood of regular use of private transport increases for the 35–44-year-old age group and decreases for residents 45 years and older. The highest probability was obtained for respondents aged 35–44. With each one-year increase in age, the likelihood of choosing public transport decreases by 0.004. Women use public transport on a daily basis more often than men (by 0.09) and use private passenger cars less often than men (by 0.21). Employment shows a positive correlation with the use of public transport (0.166). The same variable has three times less influence on the use of private transport. Married persons were less likely to choose to use a private car. However, this effect was only significant at a significance level of $\alpha = 0.1$ (*p-value* < 0.1). Researchers explain this fact by the use of the car to meet the needs of other family members in the household. Being a student or pupil significantly influenced the likelihood of regularly using public transport. The effect of this variable was 0.256.

The impact of the level of income of residents was examined on the basis of a subjective assessment of the financial situation. Assessments of moderate or weak financial situations have been shown to positively influence the preference for more affordable transport modes. Having two or more cars obviously affects the intensity with which they are used in everyday travel. Interestingly, the first car in the household has the strongest impact. In the assessments of the quality of public transport services, only one variable proved to be relevant. People who positively assessed public transport had a greater likelihood of choosing this form of transport (0.125) than those who felt that the transport options were unsatisfactory. The impact of the distance between the city

centre and the respondent's place of residence was also shown. For every 1 km increase in the distance from the centre, the probability of regular use of public transport decreases by 0.013. This effect was not relevant for private transport, which is more flexible in terms of travel time and the choice of route (Wójcik 2019).

The organiser of public urban transport should take into account those factors on which the change has a real impact and which may be determined on the basis of research or publicly available statistics. Such factors can include, for example:

- average number of cars in the household;
- distance from the main sources of traffic, measured, for example, by the ratio of time of travel by public transport to the time of travel by car;
- assessment of the quality of public transport services;
- classifying one of the three most important attributes as one of the three best-performing;
- share of employed residents commuting to places of work and study;
- transfer frequency rate;
- accessibility (walking time to the stop);
- waiting time for a public transport vehicle.

The selected factors from comprehensive research on the preferences and transport behaviour of the Sopot residents (2024) were used to develop a logit model presenting their impact on the modal split in this city in commuting to places of work and study. Travel modes in this city have been grouped into two segments: sustainable (public transport, bicycles, pedestrian and PTD) and unsustainable (car).

In the first stage of the analysis, the distributions of quantitative variables were examined. To this end, basic descriptive statistics were calculated, along with the Shapiro–Wilk test for distribution normality. The results of the analysis are shown in Table 30.

Table 30. Descriptive statistics for selected variables used in the logistic regression model, along with the results of the normality test (n = 114) from comprehensive studies on the travel preferences and behaviours of Sopot residents (2024)

Variable	*M*	*Me*	*SD*	*Sk.*	*Kurt.*	*Min.*	*Max.*	*W*	*p*
Number of cars in the household	1.24	1.00	0.45	1.55	1.21	1.00	3.00	0.54	< **0.001**
Assessment of urban transport	4.03	4.00	0.72	–0.18	–0.63	2.00	5.00	0.82	< **0.001**
Standard of comfort	3.04	3.00	1.29	–0.11	–1.20	1.00	5.00	0.89	< **0.001**
Average journey time to destination:									
public urban transport	37.98	35.00	16.96	1.34	4.20	1.00	120.00	0.91	< **0.001**
car	19.57	20.00	9.88	0.98	1.72	1.00	60.00	0.93	< **0.001**

M – mean; *Me* – median; *SD* – standard deviation; *Sk.* – skewness; *Kurt.* – kurtosis; *Min.* – minimal value; *Max.* – maximum value; *W* – Shapiro-Wilk test; *p* – p-value for the Shapiro–Wilk test

Source: Own work.

The results of the Kolmogorov–Smirnov test are statistically significant, indicating a degree of asymmetry in the distributions tested. However, the assumption of normally distributed variables does not apply to logistic regression analysis. For this reason, the analysis was carried out taking into account its other assumptions, such as the lack of linearity (which was confirmed by the VIF ratio < 3).

For ten selected variables potentially affecting the means of carrying out urban travel, which were initially selected as part of the model, the analysis examined their impact on the likelihood of selecting sustainable travel modes. For this purpose, a logistic regression analysis was performed for the given type of transport. The analysis included variables: gender (coding 1 – women, 2 – men), age (divided into 3 groups: under 41 years of age as a reference level, age 41–60 years, and over the age of 61), the number of cars in the household, the status of the main car user (1 – yes, 0 – no), the assessment of public urban transport in Sopot, the standard of comfort and the simultaneous indication of the given attribute as the most important and the best- or worst-performing (1 – yes, 0 – no). The assessment of public urban transport and the standard of comfort were measured using the Likert scale, so after checking the assumptions, they were included in the model as quantitative variables. There were no problems with co-linearity. The results of the analysis are shown in Table 31.

Table 31. Results of a logistic regression analysis examining the probability of using sustainable transport, based on demographic variables related to car ownership, public transport evaluation, and travel preferences (n = 102), derived from a comprehensive study of the transport preferences and behaviours of Sopot residents (2024)

Variable	*B*	*SE*	*Wald*(1)	*p*	Odds ratio [95% *CI*]
Age: below 41	reference level				
Age: 41–60	0.39	0.67	0.33	0.567	1.47 [0.39) 5.49]
Age: 61 years and above	2.96	1.42	4.37	**0.037**	19.35 (2.96) 311.53
Sex	–1.26	0.67	3.52	0.061	0.28 (–1.26) 1.06
Number of cars in the household	–0.78	0.75	1.09	0.297	0.46 (–0.78) 1.98
Main car users	–3.27	0.87	14.26	< **0.001**	0.04 (–3.27) 0.21
Average journey time to destination by public urban transport	–0.04	0.03	1.99	0.159	0.96 (–0.04) 1.02
Average journey time to destination by car	0.03	0.04	0.40	0.528	1.03 (0.03) 1.11]
Assessment of public urban transport	0.61	0.46	1.79	0.181	1.85 [0.61 4.54]
Standard of comfort	0.10	0.25	0.15	0.697	1.10 [0.10 1.78]
Selected attribute as the best-performing	1.10	0.71	2.38	0.123	2.99 [1.10; 12.06]
Selected attribute as the worst-performing	0.28	0.60	0.23	0.634	1.33 [0.28; 4.27]
Constant	1.73	2.35	0.55	0.461	5.66
Overall model coefficients test	$\chi^2(11) = 43.78$; $p < 0.001$				
Hosmer–Lemeshow Test	$\chi^2(8) = 6.43$; $p = 0.599$				
Nagelkerke R-squared	0.501				

Dependent variable: Transport mode (1 – balanced; 0 – unbalanced);
B – unstandardised regression coefficient; SE – standard error; Wald – test of significance of a predictor in the model; p – significance level of the Wald test; 95% CI – 95% confidence interval for the odds ratio

Source: Own work.

The results of the analysis indicate the appropriate model fit to the data and the significance of the coefficients in the model based on both tests. The explained variance was 49%. The model correctly classified 83.3% of cases. Of the predictors included in the model, only two turned out to be statistically significant – the status of the main user of the car in the household and age over 61. The status of the primary car user is negatively correlated with the dependent variable, while age over 61 is positively correlated. When interpreting the odds ratio, it should be assumed that the chance of using sustainable transport is 96% lower if the person does not have the status of the main car user compared to a person with such status. The probability that persons over the age of 61 will benefit from sustainable transport is higher by 1,835% than for persons under 41. Other predictors did not provide for the likelihood of using sustainable transport during travel.

The results of the model indicate that driving behaviours to places of work and study are strongly determined by the respondent having the status of the main car user in the household. Other given variables, including in particular the time of commuting to the destination, turned out to be statistically insignificant. It seems that in Sopot, a city with relatively short distances of travel, differences in travel by car and sustainable transport are not relevant when choosing a transport mode. Also, the fact that a given attribute has been considered the most important and at the same time is the best- or the worst-performing, does not have an important significance for residents. In conclusion, Sopot residents are willing to make use of sustainable travel modes until they become the main car user in the household. Whereas the chance of such transport behaviour is 96% lower.

The segment for which the likelihood of using transport modes that create sustainable mobility is clearly increased is Sopot residents aged over 60. Since these individuals are of pre-retirement age, their influence on sustainable commuting is limited. The impact of this segment is likely greater when all travel is considered, given that it accounts for 30%

of the resident population; however, confirming this hypothesis would require the development of an additional model.

Marketing research on transport behaviour also provides insights into the relationship between travel times by public transport and by private car. As previously noted, travel time is one of the most important synthetic (composite) indicators influencing the choice of urban transport mode. Even without modelling or estimating the effects of individual variables, comparing travel times between public urban transport and private cars provides a basis for implementing specific transport policy measures. Such a comparison is often more convincing for decision makers than complex logit models or regression analysis. Table 32 compares the commute times to places of work and study by public transport and by car from selected cities and municipalities of the Gdańsk agglomeration.

Table 32. Comparison of average commuting times to work and places of study in selected cities and municipalities of the Gdańsk agglomeration

Item	Gdynia 2018 $n_p = 934$ $n_n = 141$	Sopot 2018 $n_p = 398$ $n_n = 63$	Szemud* 2019 $n_p = 429$ $n_n = 78$	Rumia 2022 $n_p = 384$ $n_n = 61$	Kosakowo* 2023 $n_p = 489$ $n_n = 70$
Average journey time to place of education by car [min]	21	22	26	18	23
Average journey time to place of education by public transport [min]	40	36	61	36	52
Average journey time to place of education by car [min]	23	20	27	21	29
Average journey time to place of education by public transport [min]	39	26	55	34	60

n_p and n_n – number of respondents commuting to work and their place of education

* rural commune

Source: Own work.

The average driving time to the place of work by car compared to public urban travel is shorter by 50 to 57%. Private cars provide relatively greater benefits (shorter travel time to work) for rural residents. The average travel to a place of education by car is 20 to 50% shorter than by public transport. Cars provide relatively greater benefits connected with a reduction in travel time to rural residents than to urban residents. These benefits are at their lowest levels in towns/small cities (Sopot, Rumia).

Surprising results were obtained by analysing the change in the perceived travel time in Gdynia over a period of ten years, comparing the data from the 2008 and 2018 studies. In the opinion of respondents, the average travel time by car to work has not changed, and the average travel time by public transport has been reduced from 41 to 40 minutes (by 2.4%). In relation to travel to a place of education, the travel time by car has increased from 22 to 23 min (by 4.5%), and by public transport decreased from 40 to 30 min (by 25%). The marketing research data for public transport was compared with the actual driving times of public transport vehicles. The driving times of buses and trolleybuses provided in timetables are verified annually and take into changes in average traffic conditions. Since driving times in timetables reflect the average traffic conditions in a given period (they only partially take into account random traffic events, i.e. accidents, emergencies, planned road works and others), Table 33 also shows a change in the share of services delayed by up to 3 minutes (with a relatively low level of inconvenience for passengers), and 4 or more minutes (high level of inconvenience).

Table 33. Changes in the perceived travel time by public transport to a place of work or study, scheduled driving times and the share of delayed public transport services in Gdynia in 2008 and 2018

Item	2008/2018
Change in perception of average time of commuting to a place of work by public transport*	–2.4% (–1 min)
Change in perception of average time of commuting to a place of education by public transport*	–2.5% (–1 min)
Average change in travel times in bus and trolleybus timetables	4.5% (+2 min)
Change in the share of services delayed by up to 3 min*	+2.8 percentage points
Change in the share of services delayed by more than 3 min*	+2.8 percentage points
Share of rail in trips	–1.7%

*concerns only buses and trolleybuses

Source: Own work.

Assuming that the perceived changes in driving times by buses and trolleybuses are not statistically significant, it is notable that, during the period considered, the driving times of public transport vehicles, calculated empirically, increased by an average of 4.5%. Despite the extension of driving times, the share of services delayed up to 3 minutes increased from 24.65 to 27.50% between 2008 and 2018, while services that caused a higher level of inconvenience (delay of 4 minutes or more) increased from 20.37 to 23.17%. The analysed phenomenon of travel time perception can be explained as follows:

- passengers only begin to subjectively perceive a change in travel time once a certain threshold of actual travel time has been exceeded;
- the total travel time, comprising the time to walk to the stop, waiting time, in-vehicle time, any walking required during transfers, and the final walk to the destination, was analysed. A change in any

of these stages may influence the overall perception of the journey, either positively or negatively;
- although the bus lanes introduced in the analysed period have not significantly changed vehicle driving times (e.g., bus passes on some sections of the route to one Gdynia street reduced the actual journey time of buses by 3.5 minutes), the results of studies of the subjective assessment of driving times on this section showed that passengers tend to overestimate the time savings obtained by bus route sections (in the given example estimations amount to twice the actual figures on average) (Karkut 219).

The importance of shorter travel time as a factor in the choice of transport mode is indicated by the results of the study of the reasons for the choice to complete urban trips by car (Figure 14). The shorter travel time by car was classified as the second most significant among the reasons for the use of this transport mode. The two most important reasons for transporting children by car are convenience and safety. One reason for travelling by car of 5.1% of residents is to transport a child/children to school and other activities. Almost 50% of Gdynia residents stated that no facilities (e.g., free rides for children and parents, special transport routes exclusively for children) would encourage them to transport their children by a transport mode other than private car.

As in the case of public urban transport services, the convenience of travelling by car is a complex attribute. The author's own research, conducted through an in-depth group interview with students, revealed that this factor comprises the following elements:
- directness of travel between origin and destination;
- shorter travel time (appears as a separate factor in ranking studies);
- guaranteed availability of a seat throughout the journey;
- convenient luggage transport (included as a separate factor in ranking studies);
- adapting the travel conditions to the commuter's needs in terms of temperature and mood – listening to music at a volume of the commuter's choosing.

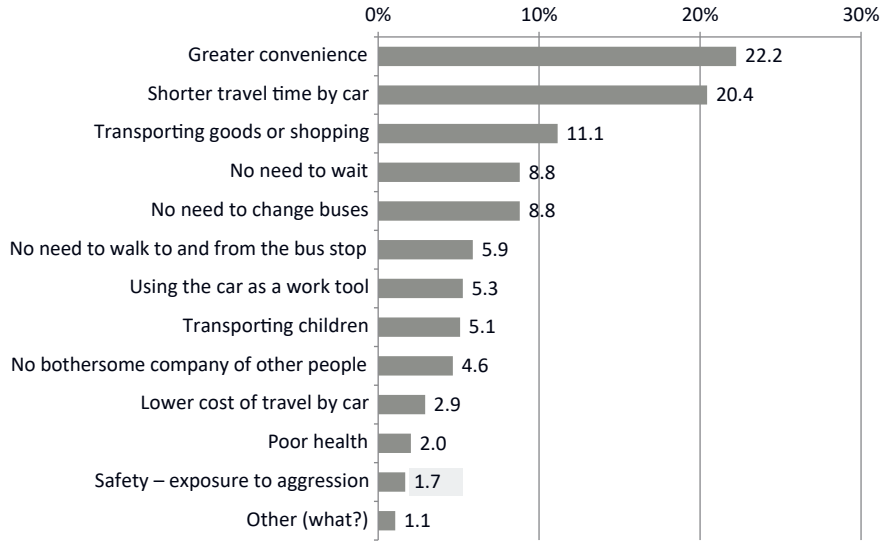

Figure 14. Reasons for travelling by car in Gdynia in 2018 (n = 834)

Source: ("Preferencje i zachowania komunikacyjne mieszkańców Gdyni w 2018 r." 2019).

Other comfort factors include:

- chance to smoke;
- possibility of choosing the route and stop-off locations during the journey;
- exercising control over the journey's progress.

From the point of view of marketing research in public urban transport, the results of travel time studies in Gdynia lead to the following conclusions:

1. The duration of the most important mandatory journeys (to place of work and study) by public transport is 20–60% longer, depending on the type and distance of travel;
2. Differences in travel times by public transport and car determine the importance of this factor in choosing this transport mode;
3. Extended travel by public urban transport is subject to the subjective assessment of passengers who tend to understate it in relation to real travel time;

4. Bus lanes are seen by public transport passengers as an effective tool for reducing travel time. When they are in operation, passengers tend to base their expectations on the actual travel time.

From a scientific point of view, the conclusions presented require further analysis and modelling of variables. From the point of view of decision-makers, however, they may be sufficient to consider allocating bus lanes on specific sections of the roads. Such decisions should be based on the analysis of traffic and the capacity utilisation of public urban transport vehicles. It is assumed that there is a justification for the allocation of lanes on triple carriageways, where the number of buses in one direction per hour is at least 25 (Sambor 1999).

There are discussions between specialists in the formation of urban transport systems regarding preferences in the layout of the network of direct connections and transfers. Leaving this issue aside, it should be noted that the effective use of connections with transfers of relatively higher frequencies compared to direct connections must take into account the urban characteristics of the city or agglomeration and the spatial layout of the transport network, the availability and convenience of transfers to fast public transport modes (metro, urban rail), tariff and ticket integration, and the preferences of residents in this regard. Before increasing the share of transfer-based connections, it is essential to identify the main inconveniences associated with changing modes of transport, as their significance may vary from city to city (Figure 15).

The identification of the inconvenience of transfers in individual areas (districts) indicates to the organiser the potential directions of actions that should be taken in order to improve the quality of travel. These might be:

- improving coordination of timetables;
- allocation of dedicated bus lanes on approaches to public transport interchanges;
- ticket tariff integration;
- creating stop clusters for specific routes;
- building bus shelters.

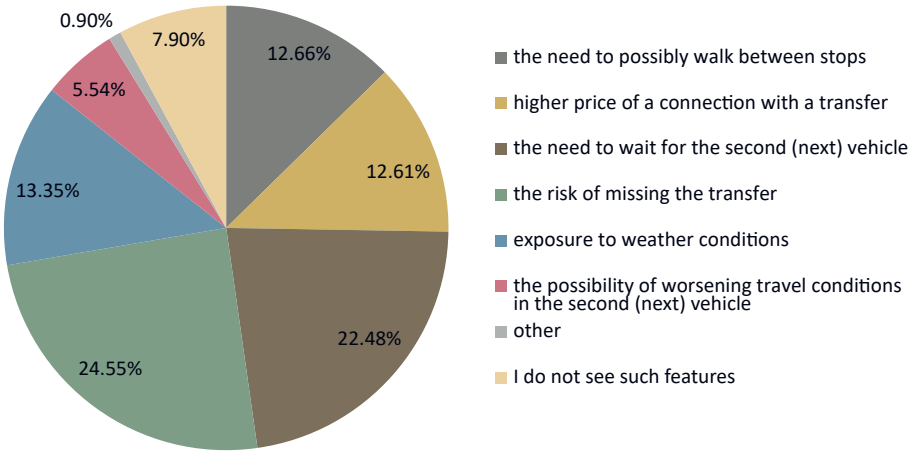

Figure 15. The most inconvenient characteristics of transfers in Gdynia in 2018

Source: ("Preferencje i zachowania komunikacyjne mieszkańców Gdyni w 2018 r." 2019).

6.3. Change of transport preferences of residents and passengers

The basic scope of the study of the transport preferences of residents includes the identification and ranking of attributes of public urban transport services.

The interrelationship between the importance of the attribute and the level of satisfaction with its performance has been repeatedly examined in the literature (Cats et al. 2015; De Oña, De Oña 2014; Oliver 1997). However, the interaction between satisfaction, the level of the offer, and the significance of the attributes is not fully understood. In designing the service offer, it is crucial to understand: Does any improvement in the quality of services (individual attributes) improve satisfaction? What attributes should policy-makers focus on? (Börjesson, Rubensson 2019).

Table 34 shows the ranking of public transport attributes in Gdynia over the period of twenty years 1998–2018.

Table 34. Prioritisation of transport demands (attributes of public urban transport services) in the light of the results of marketing research on Gdynia residents in the years 1998–2018

Attribute	Ranking place of the attribute in further research								
	1998 *n* = 1952	2000 *n* = 2001	2002 *n* = 1982	2006 *n* = 1887	2008 *n* = 1944	2010 *n* = 1975	2013 *n* = 2000	2015 *n* = 2000	2018 *n* = 1837
Directness	4	4	4	1	1	1	1	1	1
Frequency	3	3	3	3	4	4	3	3	3
Availability	2	2	1	4	3	3	4	4	4
Information	10	10	10	10	10	10	10	10	10
Cost	5	5	5	5	5	5	5	5	5
Reliability	8	7	7	8	6	6	6	6	7
Speed	7	7	8	7	7	7	7	7	6
Punctuality	1	1	2	2	2	2	2	2	2
Rhythmicity	9	9	9	9	9	9	9	9	9
Convenience	6	6	6	6	8	8	8	8	8

Source: (Grzelec, Hebel, Wyszomirski 2020).

Statistical analyses of the data concerning the frequency of indications for a given attribute (conducted using IBM SPSS Statistics, version 29) were carried out with reference to basic descriptive statistics (Spearman's *rho* correlation analysis). The common threshold of $\alpha = 0.05$ was adopted as the level of statistical significance.

6.3.1. Basic descriptive statistics of the measured quantitative variables, along with a test of distribution normality

The distributions of the quantitative variables were examined. To this end, basic descriptive statistics were calculated, along with the Shapiro–Wilk test for distribution normality. The results of the analysis are shown in Table 5.1 of the Appendix. The results of the Shapiro–Wilk test were mostly statistically non-significant, indicating that the distributions of the variables were predominantly similar to a normal distribution. However, in several instances, kurtosis and skewness values exceeded |2|, suggesting potential problems with outliers and asymmetrical distributions (George, Mallery 2021). Given the sample from the five periods and the previous findings of the distribution analysis, a non-parametric test was used in the target analysis.

6.3.2. Analysis of the relationship of the study period with the number of indications of an attribute as the most important

In order to check whether there is a statistically significant relationship between the study year and the number of indications for a given attribute as the most important, a correlation analysis using Spearman's rho was performed. The results of the analysis are shown in Table 35.

The results of the analysis showed that there is a statistically significant correlation between the year and the accessibility attribute. The recorded correlation, based on Spearman's rho, is negative and very strong. It follows that the validity of the accessibility attribute decreased over time. There was also a perfect positive correlation (1.00) between the period and the reliability attribute. The positive value of the correlation coefficient indicates that from year to year, the value of the importance of reliability as an attribute is gradually increasing. There was no significant correlation between the change in the meaning of other attributes and subsequent years (change of their meaning over time).

Table 35. Results of the analysis of the correlation of Spearman's *rho* attributes of public urban transport in Gdynia during the years 2008–2018 for a given period (year), with the number of indications of a given attribute as the most important

Attributes	The Spearman correlation value between the number of indications for a given attribute as the most important and a given year
Directness	–0.30
Frequency	0.20
Availability	**–0.90***
Reliability	**1.00**
Low cost	0.20
Speed	0.10
Punctuality	–0.60
Rhythmicity	0.36

* $p < 0.05$

Source: Own work.

6.3.3. The correlation between the number of attribute indications as the most important and its implementation

An analysis was conducted to determine whether there is an association between the perceived importance of the attribute and its evaluated performance. The analyses included indications of the attribute as the worst and best-performing. The analyses were based on the analysis of the correlation of Spearman's *rho* (Table 36).

Table 36. Results of the analysis of the Spearman's *rho* correlation between the number of attribute indications as the most important and the evaluation of its implementation for the attributes of public urban transport in Gdynia from 2008–2018

Variable	Number of indications as the most important attribute							
	Directness	**Frequency**	**Availability**	**Reliability**	**Low cost**	**Speed**	**Punctuality**	**Rhythmicity**
Worst-performing attribute								
Directness	0.50	0.10	0.20	–0.10	–0.50	–0.70	0.30	–0.82
Frequency	0.60	0.40	–0.30	0.10	**–0.90***	–0.20	0.50	–0.87
Availability	0.00	0.20	–0.60	0.80	0.00	–0.40	–0.40	–0.10
Reliability	0.20	0.00	–0.10	0.30	–0.30	–0.60	–0.10	–0.56
Low cost	0.10	0.60	–0.50	0.60	0.60	–0.30	–0.20	0.56
Speed	–0.50	–0.60	–0.20	0.10	–0.50	0.70	–0.30	–0.21
Punctuality	–0.70	–0.70	–0.10	0.00	–0.20	**0.90***	–0.40	0.15
Rhythmicity	–0.50	–0.60	–0.20	0.10	–0.50	0.70	–0.30	–0.21
Information	**–0.90***	**–0.90***	0.30	0.00	0.60	0.30	–0.80	0.56
Comfort	0.70	0.50	0.40	–0.70	–0.30	–0.10	**0.90***	–0.31

Table 36 (cont.)

Variable	Number of indications as the most important attribute							
	Directness	Frequency	Availability	Reliability	Low cost	Speed	Punctuality	Rhythmicity
Best-performing attribute								
Directness	0.00	–0.30	**0.90***	–0.70	0.50	–0.40	0.10	0.15
Frequency	0.70	0.70	0.10	0.00	0.20	**–0.90***	0.40	–0.15
Availability	0.70	0.70	0.10	0.00	0.20	**–0.90***	0.40	–0.15
Reliability	–0.70	–0.50	–0.40	0.70	0.30	0.10	**–0.90***	0.31
Low cost	–0.30	–0.70	0.60	–0.70	–0.30	0.50	0.10	–0.21
Speed	–0.21	0.31	**–0.97****	**0.97****	0.05	0.21	–0.46	0.29
Punctuality	–0.30	0.30	–0.60	0.70	0.70	0.10	–0.50	0.82
Rhythmicity	–0.40	–0.60	0.80	–0.60	0.60	0.00	–0.20	0.41
Information	0.56	0.67	–0.05	0.21	0.31	–0.87	0.21	–0.03
Comfort	–0.10	–0.40	0.20	0.10	–0.10	–0.50	–0.30	–0.41

* $p < 0.05$; ** $p < 0.01$

Source: Own work.

The analysis showed that there is a statistically significant negative correlation between the number of indications of the directness and frequency attributes as the most important, and the assessment of the information attribute as the worst-performing. The more respondents indicated directness and frequency as the most important attributes, the less they indicated the information attribute as the worst-performing. In addition, a negative correlation was observed between the low cost and frequency attributes, meaning that the more frequently the demand for low cost was indicated, the less often frequency was indicated as the worst-performing attribute. Given the size of this particular segment, it can be concluded that this association affects about 10% of residents.

In addition, there was a positive correlation between the assessment of the importance of the speed attribute and the worst-performing attribute, punctuality: the more important the speed attribute was for residents, the worse the indicated result for punctuality.

A positive correlation was also observed between the assessment of punctuality as the most important attribute and the indications of comfort as the least effectively implemented attribute. It follows that the more important punctuality was to the residents, the more comfort was indicated as the worst-performing attribute.

At the same time, statistically significant relationships were found between the evaluation of the attribute of availability as the most important, and the identification of the best-performing attributes of directness and speed. The first correlation is positive, and the second is negative. It can be assumed, therefore, that the more often the directness attribute was indicated as the most important attribute, the more often it was indicated as the best-performing. In turn, the increase in the number of indications of the accessibility attribute as the most important was accompanied by a decrease in the number of indications of speed as the best-performing attribute.

The indication of the reliability attribute as the most important was associated with indications of speed as the best-performing attribute. The nature of this correlation was positive, which means that the more

respondents indicated reliability as the most important attribute, the more speed was indicated as the best-performing attribute.

In addition, the number of indications of speed as the most important attribute was negatively associated with the number of indications of frequency and availability. The greater the number of indications of speed as the most important attribute, the fewer the number of indications observed for frequency and availability.

The last statistically strong correlation was the number of indications for punctuality as the most important attribute, and reliability as the best-performing attribute (negative correlation). The more respondents indicated punctuality as the most important attribute, the less they indicated reliability as the best-performing attribute.

The strength of all the aforementioned associations fell within the range of very-strong correlations ($r_S \geq 0.9$). The analysis of the correlation between the importance of the attribute and its evaluations does not allow for an unambiguous formulation of associations, indicating the need to take specific actions. Based on the analysis, it is not possible to confirm hypotheses, such as the one suggesting an increase in the importance of an attribute identified as the worst-performing. Such correlations may be local (e.g., within individual districts where the low assessment of services may increase the importance of a given attribute. Within the scale of the entire city, such local associations may cancel each other out).

6.3.4. The correlation between the number of indications of attributes as the best- and worst-performing

The correlation between the number of indications of the best-performing attributes and the number of indications of the worst-performing attributes was tested using Spearman's *rho*. The results are presented in Table 37.

Table 37. Results of the Spearman's *rho* correlation analysis of the number of indications of an attribute as the worst-performing and the best-performing for the attributes of public urban transport in Gdynia during the years 2008–2018

	Variable	Number of indications of a given attribute as the worst-performing									
		1.	2.	3.	4.	5.	6.	7.	8.	flat 9.	10
Number of indications of a given attribute as the best-performing	1. Directness	0.00	–0.60	–0.50	–0.20	–0.10	–0.50	–0.30	–0.50	0.40	0.30
	2. Frequency	0.40	0.10	0.30	0.30	0.60	**–0.90***	**–1.00**	**–0.90***	–0.50	0.30
	3. Availability	0.40	0.10	0.30	0.30	0.60	**–0.90***	**–1.00**	**–0.90***	–0.50	0.30
	4. Reliability	0.10	–0.10	0.70	0.50	0.10	0.40	0.30	0.40	0.60	–1.00
	5. Low cost	–0.10	–0.10	–0.70	–0.30	**–0.90***	0.60	0.70	0.60	0.40	0.20
	6. Speed	–0.15	0.21	0.72	0.21	0.56	0.15	0.05	0.15	–0.15	–0.56
	7. Punctuality	–0.60	–0.50	0.30	–0.30	**0.90***	–0.40	–0.20	–0.40	0.10	–0.30
	8. Rhythmicity	–0.30	–0.80	–0.60	–0.40	–0.20	–0.20	0.10	–0.20	0.70	0.10
	flat 9. Information	0.36	0.05	0.46	0.36	0.72	–0.87	**–0.97****	–0.87	–0.41	0.10
	10. Comfort	0.80	0.30	0.60	**0.90***	–0.30	0.20	–0.10	0.20	0.30	–0.60

* $p < 0.05$; ** $p < 0.01$

Source: Own work.

The analyses showed a correlation between the number of indications of the reliability attribute as the worst-performing and the number of indications of the comfort attribute as the best-performing. The positive direction of the correlation indicates that with an increase in the number of indications of reliability as the worst-performing attribute, the number of indications for comfort as the best-performing attribute also increases. Although statistically significant, this correlation is difficult to explain unequivocally. Low reliability assessments occur in low-frequency service areas (districts) and/or a large number of trips with transfers. In such cases, a missed connection or delay results in a low service quality assessment. These two features suggest that the observed correlation is likely driven by responses from residents of peripheral districts, where public transport accounts for a smaller proportion of overall travel. Consequently, these individuals may experience relatively more frequent opportunities to occupy a seat.

Subsequently, there were correlations between the number of indications of the low cost attribute as the worst-performing and the number of indications of the low cost attribute as the best-performing (negative correlation), as well as the number of indications of punctuality as the best-performing (positive correlation): the more low cost was indicated as the worst-performing attribute, the less it was regarded as the best-performing attribute, which is an obvious correlation from a logical point of view. At the same time, the more often the low cost attribute was indicated as the worst-performing, the more punctuality was regarded as the best-performing. The increase in the number of indications for low cost as the worst-performing attribute is accompanied by an increase in the number of indications of two other attributes regarded as the best-performing (and the most important in the ranking), i.e. availability and frequency, although the strength of this correlation is much weaker. This may prove that residents negatively assessing ticket prices would be willing to accept, to some extent, a deterioration in the quality of services in exchange for lower ticket prices. Other conclusions have already been made by experts at the World Bank (Bank World 2002).

The increase in negative assessments of speed is accompanied by a reduction in positive assessments of frequency and availability. This means that congestion lowers the assessment of the quality of services also in the context of these two attributes. The increase in the negative assessment of punctuality and rhythmicity assessments is also accompanied by a reduction in assessment of the quality of services in terms of frequency and availability. This correlation between the performance of attributes indicates that the increase in the speed and punctuality of public urban transport vehicles, e.g., through the construction of bus lanes, may be accompanied by an improvement in assessments in terms of frequency of services and availability, despite a lack of actual changes in this area.

In addition, a significant correlation between the number of indications of punctuality as the worst-performing attribute and information as the best-performing attribute was shown, with the negative direction of the correlation meaning that with an increase in indications of the punctuality attribute as the worst-performing, the number of indications of information as the best-performing decreases. This can be explained by the fact that as a result of the deterioration of punctuality, some residents consider information about services, especially timetables, to be unreliable.

The study of the influence of urban transport attributes in Gdynia on the quality of services was supplemented by analyses of the association between the ranking of attributes and their level over time.

6.3.5. Analysis of the correlation of rankings in different years

The aim of the analysis was to identify changes in correlation between attributes assessed as the most important, best-performing and worst-performing in different years. The correlation between the rankings for the following years, including the most important and the best-performing, and between the most important and the worst-performing, was calculated. The analysis

used Pearson's correlation coefficient and Spearman's rank correlation, defined by the following formulas:

Pearson's correlation coefficient – examines the linear relationship between variables and is shown in formula (4).

$$r = \frac{\sum_{i=1}^{n}(X_i - \overline{X})(Y_i - \overline{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \overline{X})^2} \times \sqrt{\sum_{i=1}^{n}(Y_i - \overline{Y})^2}} \tag{4}$$

where:

- X_i *and* Y_i are the observed values of the variables;
- $\overline{X}$ *and* $\overline{Y}$ are the arrhythmic means of variables *X and Y*;
- n is the number of observations.

The coefficient r takes values from –1 to 1:

r = 1: perfect positive correlation (an increase in one variable causes an increase in the other),

r = −1: perfect negative correlation (an increase in one variable causes a decrease in the other),

r = 0: no correlation (the variables are linearly independent).

Spearman's rank correlation is shown in formula (5):

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)} \tag{5}$$

where:

- d_i is the difference between the ranks of corresponding observations (attributes) in the two sets;
- n is the number of observations (attributes).

The results of the analysis are shown in Tables 38 and 39.

Table 38. Pearson correlation values between the rankings of attributes and their assessments of public urban transport in Gdynia during the years 2008–2018

Ord. No.	Year	Importance_vs_Best	Importance_vs_Worst
1	2008	0.867	0.366
2	2010	0.900	0.536
3	2013	0.848	0.321
4	2015	0.809	0.710
5	2018	0.547	0.331

Source: Own work.

Table 39. The values of Spearman's rank correlation of the attributes ranking and their assessment of the attributes of public urban transport in Gdynia for the years 2008–2018

Ord. No.	Year	Importance_vs_Best	Importance_vs_Worst
1	2008	0.212	0.454
2	2010	0.333	0.466
3	2013	0.539	0.321
4	2015	0.455	0.695
5	2018	0.515	0.382

Source: Own work.

The results of the Pearson correlation analysis indicate that the correlation values between the attribute rank and its worst assessment are moderate (from 0.320 to 0.710 depending on the year). The highest correlation was in 2015 (0.710). This result does not again confirm the hypothesis of a strong relationship between the importance of the attribute and its non-fulfilment (the worse the service is rated in terms of a given attribute, the higher its rank). The correlation between the ranking of attributes

and their highest rating in individual years is significantly stronger (from 0.547 to 0.900). Notable is the declining correlation between the rank of attributes and the best-fulfilled attributes, which was at its lowest in 2018. This suggests a significant reduction in the quality of services between 2015 and 2018.

The correlation of the rank confirms the results of Pearson's correlation coefficient and indicates a relatively weak correlation of the significance of a given attribute and how poorly it performs as assessed by residents (0.321–0.695). It also shows weaker correlations between the significance of the attribute and the assessment of residents as the worst-performing.

The differences in the rankings are due to the fact that Pearson's correlation coefficient measures the linear relationship between the two variables, assuming that these variables are continuous and have a normal distribution. Pearson's correlation coefficient achieves high values if the variables change in a proportional way (i.e. as one variable grows, the other also grows predictably). Spearman's rank correlation measures the monotonic[21] correlation between two variables, whether it is linear or non-linear. This analysis assesses whether two variables are growing or decreasing together without examining their linearity. Spearman's rank correlation is based on variable ranks, which means that it only examines the relationship between the ranks and not the specific values of variables (Wiśniewski 2014). The results of Spearman's analysis suggest a monotonic correlation, but the correlation is weaker and more irregular across the individual years. The values of Spearman's rank correlation are smaller because it has less sensitivity to non-linear correlations. Significance tests for both correlations (Student's t-test) showed that in the years 2008, 2013 and 2018, there are no statistically significant correlations (both Pearson and Spearman) between the ranking and the lowest assessment of attribute performance. The lowest-rated attributes were implemented in a way that was less consistent with their importance in the ranking.

[21] The monotonic correlation occurs when with the increase of one variable a second variable also increases (or when with the decrease of one variable a second variable also decreases). The correlation may or may not be linear.

6.3.6. Changes in average trends for attributes in the groups of the best- and worst-performing

A comparison of the volatility of the assessment of the five most important attributes and the overall assessment of the quality of public urban transport services in Gdynia in the years 2008–2018 are presented in Figure 16A–F.

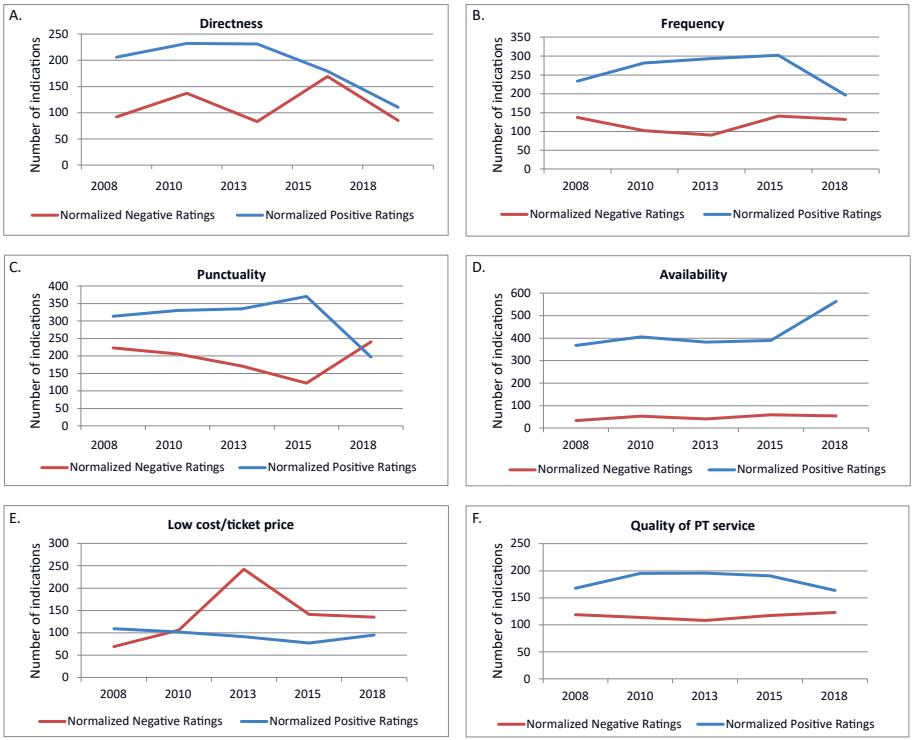

Figure 16A–F. Volatility of the assessment of the five most important attributes: directness (A), frequency (B), punctuality (C), availability (D), Low cost / ticket price (E) and the total assessment of the quality of public urban transport services (F) in Gdynia in the years 2008–2018

Source: Own work.

The greater the range between the number of indications for an attribute as the best- and worst-performing, the higher the assessment of the quality of services in relation to this attribute.[22] The persistence of a large range between positive and negative assessments of attributes throughout the entire analysed period indicates the stability of the assessment of a given attribute.

Up until 2013, the directness attribute was characterised by a relatively high difference between the number of positive and negative assessments. Since 2013, the number of positive assessments of this attribute has decreased rapidly, and the number of negative assessments has increased. In 2018, the number of negative and positive assessments was similar. Since 2015, the range of indications has also decreased in relation to the demand for frequency, reaching its lowest point in 2018. The assessments of the demand for frequency and punctuality since 2015 are also characterised by a decrease in positive assessments and an increase in the number of negative assessments, with the number of negative punctuality assessments being greater than positive in 2018. In the years 2008–2015, stability was observed in the assessment of the demand for availability. An increase was noted in 2018. Importantly, the relatively small percentage of negative and large percentage of positive assessments are confirmed in the high level of acceptance of the time to taken to reach a stop (from 94 to 97% of residents accept the time taken to reach a public urban transport stop). The assessment of the demand for low cost is subject to periodic fluctuations resulting from ticket price increases. Passengers then assess the new ticket price in relation to the unaltered quality of service and see it as too high (Hensher, Rose, Greene 2005). The negative assessment of the demand for low cost in 2013 is a reflection of a double price increase in 2011 and 2012. The practice to date in Gdynia in this area took into account

[22] The analysis was also carried out for relative values (the percentage of indications that take into account the different number of samples in individual years), but differences in the number of samples did not change the shape of the curves and the range between them.

only budgetary conditions and, in some cases, price elasticity. When determining the level of ticket prices, the relationship between the price of a ticket and the price of a litre of fuel and the level of household income was not considered. It is difficult to understand the policy of increasing ticket prices in Gdynia as an action which takes into account the goals of sustainable mobility. However, it is notable that the demand for low cost is only fifth in the ranking. The last graph also presents a standardised change in the synthetic assessment of the quality of public transport in Gdynia in the years 2008–2018. The standardised assessment was established by calculating its weight for a given year – the percentage of indications for a given demand as the most important. The weight was multiplied by the number of times the demand was indicated as either the best or the worst. The graph shows that since 2013, the number of negative service quality assessments has increased, and since 2015, the number of positive assessments has decreased.

The presented trend confirms the general assessments of public urban transport services in Gdynia in the years 2008–2018 (on the scale of grades used at Polish universities from 2 – the worst, to 5 – the best), although the spread of changes of these assessments since 2013 is minimal. See Figure 17.

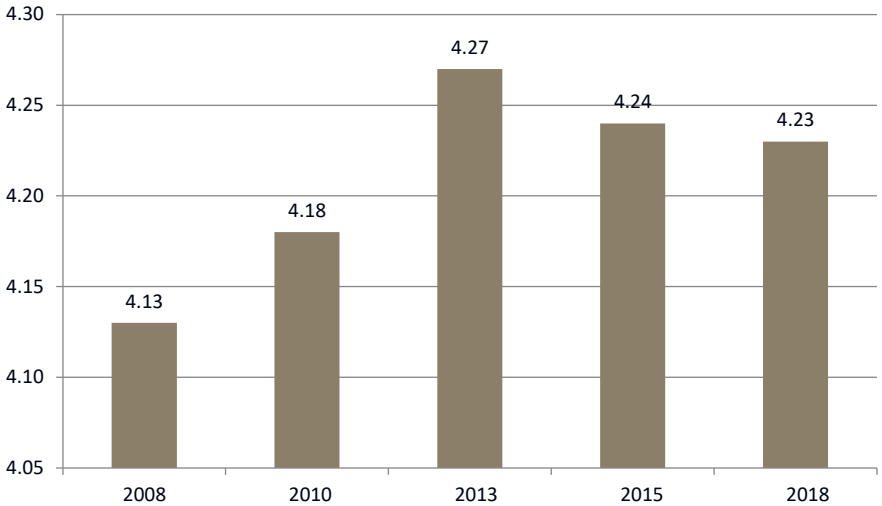

Figure 17. Average assessment of public urban transport in Gdynia 2008–2018
Using the scale of grades used at Polish universities (from 2 – the worst, to 5 – the best)
Source: Own work.

6.3.7. Principal Component Analysis – PCA

PCA shows the distribution of attributes across two principal components. Assigning attributes to these components allows for the identification of groups of attributes that share a similar pattern of change in the ranking. PCA Components and Explained Variance – shows the percentage of variance explained by each principal component. Higher values indicate that the component better explains the variability in the data. PCA Transformed Data for Attributes – presents attributes expressed as combinations of the principal components, allowing for the determination of how attributes cluster around specific components. By reducing the dimensionality of the data, PCA highlights which principal components dominate the description of variability in the ranking data (which attribute combinations have the greatest influence on the results) and which

attributes are strongly related to one another, influencing the overall assessment of performance.

Each point corresponds to the attribute, and the distances between points indicate similarities in the importance and performance of the attributes. Attributes close to each other are strongly linked in terms of performance and importance.

The chart of attributes in the coordinate system (Figure 18) of the first two components (PC1/PC2) indicates that:

- the PC1 component explains 67.69% of data variability, on which it has a dominant effect;
- PC2 explains 28.35% of data variability.

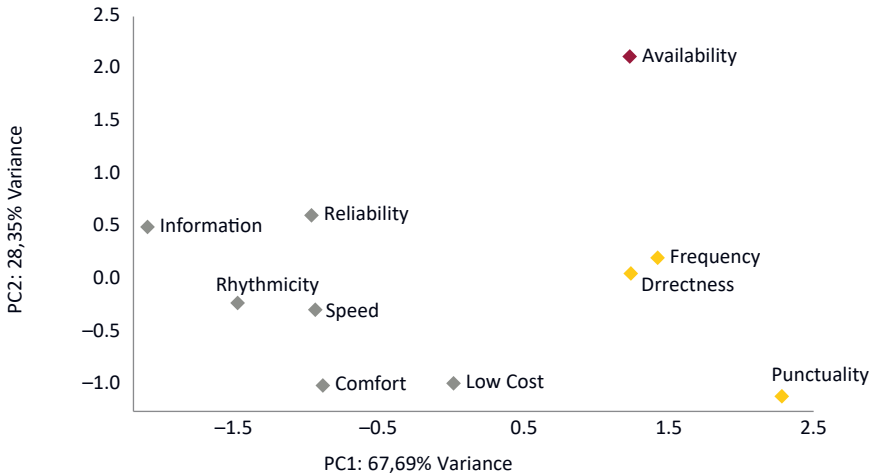

Figure 18. The presented trend confirms the general assessments of public urban transport services in Gdynia in the years 2008–2018

Source: Own work.

This means that most of the variability in the data can be explained by a single dominant pattern, which reduces the data structure to several principal components that typically account for the variability in attribute rankings over time. Attributes related to the PC1 component (punctuality, frequency and availability) have the greatest impact on the quality assessment.

The Shapiro-Wilk test indicated that the hypothesis of normal distribution is true for both components. In turn, the Pearson correlation indicated a strong correlation between component PC1 and the average importance of attributes, and a very weak association for component PC2.

Conclusions from the study of the behaviour and preferences of residents

The presented results of marketing research can be effectively used to monitor the results of sustainable mobility policy in cities and agglomerations. The SUMP scenario for Gdynia, assuming the achievement of the goals of sustainable mobility maintains the assumption that, inter alia, "the mobility of Gdynia, expressed in the average number of trips per day, will increase by 5% (from 1.65 journeys in 2015 to 1.73 journeys in 2025), and the share of a passenger car in the distribution of urban travel will decrease by 10% (from the current 52%, walking trips, to 42%) (Wołek 2016). As soon as the monograph was submitted to the Publishing House, PTB made available the results of marketing research on marketing preferences and transport behaviour of the Gdynia residents in 2024. The share of cars in urban travel in Gdynia in 2024 (without walking trips) was 57.5%, which confirmed the conclusion that the objectives set out in the SUMP had not been achieved in this city.

Factors that are intended to support the implementation of the scenario are:

- the change of behaviour and lifestyle of some residents of the city;
- an increase in fuel prices and other costs related to owning and using a car;
- the construction of bicycle infrastructure and promotion of bicycle transport, especially in trips up to 5 km (the majority of trips in the city);
- a further increase in the attractiveness of public transport, in particular the complete integration of fares and ticketing within the metropolitan area;
- increased attractiveness of pedestrian zones;
- changes in traffic organisation to improve safety.

The results of comprehensive marketing research on the transport preferences and behaviour of residents during a period of ten years (2008–2018) indicate that the number of segments of residents is changing, therefore determining transport behaviour. This applies to the following groups of residents:

- 16–20 and 21–30 year olds, which in 2018 resulted in a reduction in the share of people entitled to reduced and free travel, and in subsequent years has a negative impact on the number of people in employment (regardless of unemployment rates), which in turn affects the share of people travelling on full-fare tickets on public urban transport;
- 60+, which translates into an increase in people entitled to discounts and free travel;
- employed persons whose share has increased; however, given the volatility of these changes in connection with the economic situation, they should be monitored using demographic and unemployment indicators;
- people from households that own a car, whose share increased by 11 percentage points;
- main car users in the households, whose share increased by 13.5 percentage points.

Changes in the different segments signal changes in transport behaviour, including modal splits, which should be considered the most important indicator of the results of sustainable mobility activities.

In 2008–2019, the mobility of Gdynia residents increased by 9.5% of the number of trips per day. The assumptions adopted in the SUMP on the projected increase in mobility by 10% follow the trend observed in previous years, although it seems that the increase in the number of trips in the period 2016–2025 was planned with a certain margin.

The study of the structure of travel motivations did not show statistically significant changes in almost all travel destinations analysed. Significant changes have occurred in the share of individual transport modes. The share of cars increased by 8 percentage points in the years

2008–2018, and in the years 2015–2018 there was a slight reduction in this share by 2.3 percentage points, which should be treated with extreme caution due to the accepted permissible estimation error, as well as restrictions during the pandemic – a significant factor interfering with the decrease in the share of cars from 2020 to 2023.

The survey of the behaviour and preferences of transport residents, implemented during the period in which pandemic restrictions were in place in the metropolis of Gdańsk, did not indicate significant changes in the modal split; however, significantly, this is due to a 40% decrease in the number of trips by public urban transport. Based on declarations of residents, it was found that after the pandemic period, the share of public transport may have decreased by 15 percentage points, and the share of cars may have increased by 9 percentage points. Given the specific period of submission of these declarations, determined by the fear of the consequences of contracting the virus, and the fact that declarations always differ to a certain extent from actual consumer behaviour, this data should be treated with caution (Grzelec et al. 2023). Nevertheless, it is notable that in the largest city of the metropolis, Gdańsk, the share of cars in urban travel in the years 2016–2022 increased by over 4.5 percentage points. In districts bordering Gdynia, where full surveys of demand for public urban transport are carried out, the number of passengers per vehicle-kilometre in 2024 compared to the number of passengers in 2019 (before the pandemic) was still 3 to 12% lower, depending on the district. It should be expected, therefore, that in Gdynia the indicators planned in the SUMP will not be achieved. This may eventually be shown in the studies carried out at the end of 2024.

The main reasons for the expected increase in the share of cars in trips in Gdynia may be those identified between 2008 and 2018. These include:

- shorter travel time by car (twice as long compared to public transport);
- more convenient travel;

– deteriorating quality of public urban transport services in Gdynia since 2015, including in the context of the most important attributes: frequency, directness and punctuality.

7. Conditions for the implementation and use of marketing research results in operational activities and strategic sustainable mobility

Experience in the implementation of marketing research in the context of the adopted goals of sustainable mobility led the author of this monograph to develop the last sub-chapter as a starting point for a discussion on the conditions of research implementation and the scope and method of its use in achieving the objectives contained in the SUMP, including a critical assessment of the activities implemented in this area.

Sustainable mobility is part of sustainable development policy. The goals presented in most SUMPs can be considered ambitious, in line with the main assumptions of various policies aimed primarily at:

- improving quality of life;
- minimising the use of natural resources;
- minimising the negative impact of human activity, including economic activity on the environment;
- protecting human and animal life and health, and their natural surroundings;
- neutralisation of emissions and waste related to economic and social development, including human spatial activity;
- use in the implementation of the sustainable development goals of modern technologies, including primarily information technology.

In many publications on sustainable development policy, additional goals are also identified, such as inclusiveness, understood as counteracting the formation of closed social groups and combating discrimination, the creation of a global partnership, and the pursuit of world

peace. The implementation of these recent goals, although ethically correct, socially and civilly desirable, and despite dominating in recent years in publications, the media and political debates, faces certain barriers. Some inclusivity goals have expanded to encompass ethically and culturally questionable issues, and too often, their implementation is being enforced in ways that deviate from traditional Western practices. The course of globalisation processes also shows that optimistic visions of the end of history, in the context of armed conflicts, including in Ukraine and the Middle East, the dynamic economic and military development of China, the continuing protectionist practices, the increase in developmental differences between the USA and China on the one hand and the European Union, on the other hand, the increasing differences between the poorest and the richest countries, the pauperisation of the middle class in Western countries, and the clear increase in the wealth accumulation dynamics of the top 1% of the richest people, have not materialised.

It seems that too broad a treatment of sustainable development processes and, consequently, the dispersion of activities (and therefore expenditures) may lead to similar results that were characteristic of the bloc of Soviet-influenced countries, where the primacy of investment actions (largely of low efficiency, subordinated to ideological assumptions, and not meeting needs through increased consumption), led in the 20th century to the pauperisation of the inhabitants of the USSR and Eastern Europe and China, with significant degradation of the natural environment and the plundering exploitation of the raw materials. The 21st-century management model, which is implemented by proponents of the green economic transformation, and whose main assumption is supposedly degrowth, in terms of stifling consumption resembles the actions of supporters of a centrally planned and directive-distributive economy. Chaotic economic policy and the low efficiency of some activities, concerning undoubtedly desirable changes in the implementation of economic processes, are conducive to the depreciation of rigorous scientific debate that has intensified in recent years. These phenomena

also occur, although to a lesser extent, in the policy of sustainable mobility within cities.

Sustainable urban mobility has become the rule in the shaping of urban space. The rules for sustainable mobility continue to transform towards the most effective solutions, combining the need for mobility with environmental protection and the comfort of life in cities. Some researchers advocate the implementation of radical degrowth activities aimed at reframing human needs and ways to meet them by abandoning the paradigm of development by ensuring continued economic growth. These views, like other concepts (e.g., shareholder capitalism) have been transformed into ideological assumptions and are being put into practice in this form.

In pursuit of sustainable mobility, monitoring of the degree of achievement of individual goals set out in the SUMP is assumed. Urbanek (2019) reviewed the measures presented in the subject's literature. "These indicators evolve in line with advances in knowledge, the increasing complexity and diversity of economic processes, as well as the technical and practical possibilities of measurement and of data processing itself. Equally significant are the possibilities for automating certain measurements offered by information systems, which are in practice present in all major entities and encompass the entirety of the processes they carry out" (Urbanek 2019: 76). The catalogue of indicators and the scope of their application demonstrate that sustainable mobility is a multifaceted issue. On the other hand, there is concern that in the abundance of diverse measurements of all possible phenomena shaping the image of a city's sustainable development, including of course sustainable mobility, the most important aspects, namely modal split and modal shift, may be overlooked. It is the opinion of the author of this monograph that these are two key issues, which determine whether in relation to a given city, it is possible to speak of either achieving or not achieving the goals of sustainable mobility. Simply stated, only through the growth of the share of sustainable transport modes, namely public urban transport, bicycles, walking, PLEV, and in some cases car sharing, can we speak of achieving the goals of sustainable mobility. Other measures have a supplementary role, as they

may indicate the depth and durability of changes in transport behaviours and preferences consistent with the objectives of sustainable mobility.

For example, the Index of Sustainable Urban Mobility, developed, evaluated and verified in economic practice in Brazilian cities, consists of several indicators which are each assigned a specific weight. In relation to urban transport, the indicators include, *inter alia*: the length of the public transport network, service frequency, punctuality, average speed, average fleet age, diversity of transport modes, transfer hubs, pricing policy, contracts and tenders, public subsidies, and entitlements to reduced or free fares. The advantage of such extensive indicators is the possibility of making comparisons between cities and designing models that show the impact of particular variables on the modal split. However, there is a risk of uncritical transfer of solutions from cities with a different urban, transport, demographic, locational, and economic profile, etc., to other cities, as a result of which the main goals of sustainable mobility may not be achieved.

In relation to Polish cities, one of these issues was analysed in detail by Wolański, who demonstrated that public intervention in mobility in most large cities had not produced the expected results. The author gives examples of simultaneously undertaken investments with diametrically opposed objectives, such as the purchase of new rolling stock for public transport and the expansion of road capacity. Another example of actions of relatively low rationality from the perspective of sustainable mobility goals is the focus on replacing combustion-engine fleets with electric ones. Wolański (2022: 233) argues that, "based on a cost–benefit analysis of the efficiency of electrification, the electrification of bus transport in Poland is fundamentally ineffective due to the country's unfavourable energy mix and the relatively low average mileage of buses." EU projects encouraged the implementation of capital expenditure, which for two decades held priority in the eyes of decision-makers. Moreover, they aligned well with the spectacular initiatives of local authorities framed within the goals of sustainable mobility. Yet, as the author shows by presenting an alternative scenario, if part of the funds had been allocated

not to capital investments but to increasing the supply and improving the quality of public transport services, "the efficiency of intervention would have been much higher." The conclusions presented regarding the ineffectiveness or low effectiveness of public intervention in Polish cities confirm the thesis that a focus by decision-makers on partial goals, such as fleet electrification, emission reduction, or expenditure on public transport, including rolling stock, does not necessarily lead to sustainable urban transport. This has also been demonstrated by the results of marketing research carried out in Gdynia.

The actual transport behaviours of residents often do not reflect their declared pro-environmental attitudes. Studies indicate that the relatively high position of environmental concern in the ranking of determinants of consumer behaviour often results from a desire to portray oneself as environmentally responsible, rather than from genuine pro-environmental choices (Auger, Devinney 2007), including the choice of transport mode. In this context, the purchase and operation of electric vehicles in urban public transport should primarily be regarded as an expression of efforts to improve the quality of urban life. However, electromobility does not have a decisive impact on changing transport behaviours. Strong evidence for this can be found in rankings of transport preferences from various cities, including Gdynia. The most important attributes of urban public transport services remain those related to travel time.

Economic and financial analyses of public urban transport services make it possible to assess the impact of rolling stock investments on the economic and financial efficiency of this transport. Higher purchase prices of electric buses increase depreciation costs, which in turn result in higher fares. In cases where cost–benefit analyses show that investments in new electric rolling stock are unjustified in most cities, consideration should instead be given to a fleet replacement policy based on diesel buses meeting the highest emission standards.[23] Based

[23] It should be emphasised that the lack of justification for operating electric buses, as indicated by cost–benefit analysis, does not imply that the electrification of the fleet should be abandoned. In addition to the findings of cost–benefit analyses, other

on the results of economic and financial efficiency studies of individual routes and tasks, it is possible to simulate the savings obtained by withdrawing electric buses from operation on specific routes. The financial resources thus obtained can then be allocated to improving the quality of services in relation to the most important, and at the same time, the most poorly rated, attributes.

The implementation of local government policies through public urban transport services leads some decision-makers to exercise direct control in service management. They propose increasing service provision by introducing or shortening certain direct routes and by raising service frequency. The justification for implementing these proposals is most often a list of residents who have signed the relevant petition. The organiser of public urban transport should verify this vox populi against the findings of existing marketing research, and commission such research to be conducted if necessary. As experience shows, such petitions are also signed by individuals who have no interest in using public urban transport, but who support the initiative out of neighbourly courtesy. On the other hand, the results of marketing research can serve as an effective tool for implementing transport policy in line with residents' expectations, provided that its legitimacy has first been confirmed by economic and financial analyses. An example of marketing research findings concerning the city's transport policy is shown in Figure 19.

assessments, such as dynamic generation cost (DGC) analysis, point to local justification for the operation of electric vehicles in public urban transport (Grzelec, Okrój 2016).

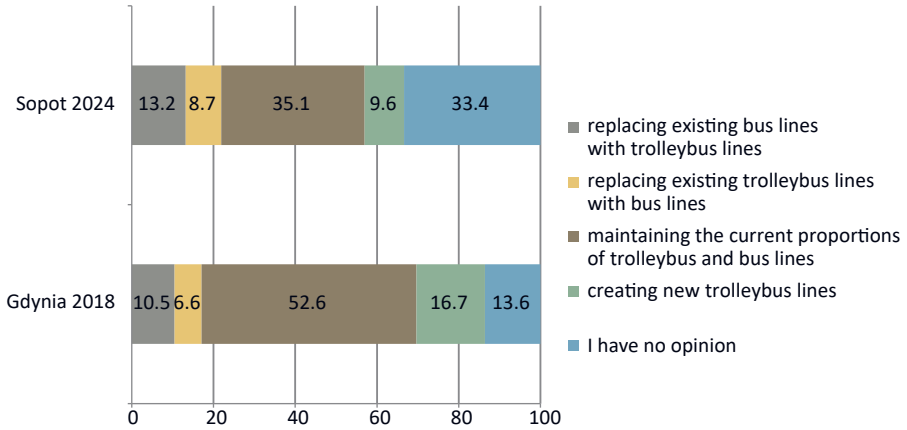

Figure 19. Opinion of Gdynia and Sopot residents on the role of trolleybuses in transport services in these cities

Source: Own work.

The majority of Gdynia residents and Sopot (79.8% in Gdynia and 57.9% in Sopot) are at least in favour of maintaining the current proportions of trolleybuses serving these cities (in both cities, the share of trolleybuses in service is about 32%). This majority includes between 10.5 and 13.2% of residents who want to replace bus routes with trolleybus routes, and 9.6–16% who want to create new trolleybus routes. Evidence that *en masse* residents are not enthusiastic supporters of the electrification of public urban transport can be seen in the case of the residents of a newly built housing estate in Gdynia. In response to the demands of its residents, PTB planned to introduce a trolleybus route to serve the housing estate. The move was protested against by the residents who opposed the construction of the overhead network along the streets of the estate for aesthetic reasons. In this case, a bus with an internal combustion engine was introduced into operation (the city did not have electric buses at the time), which, after a few years, was replaced by trolleybuses with an additional battery drive.

The implementation of some solutions shaping the parameters of the transport offer is attempted by way of experimentation. The solutions

concern the study of the impact of changes in the supply of services on demand, in terms of factors such as altering routes, frequency of vehicle operation, introduction of free public urban transport, and the allocation of bus lanes. Experimental allocation of a bus lane was carried out in 2024 in Gdansk on one of the city's main streets. A bus lane was created on a three-lane section of the road. After a period of analysing changes in the journey times of buses, the bus lane was made permanent. Regardless of the time savings and the increase in the number of passengers, it is notable that on this section of road the number of buses operated is three times lower than the limit value justifying the introduction of bus lanes on three-lane roads. When making the decision, it was not considered that the "profitability threshold" for such changes in road traffic should take into account all users using a given section of road (including private cars), their time start, emissions and noise pollution. The arbitrary shifting of this threshold frames these decisions as political acts that are not adequately supported by scientific or empirical evidence.

A frequently overlooked factor in achieving the goals of sustainable mobility based on the results of marketing research is the role of the public urban transport organiser. The role of the organisational culture of transport organisers and its impact on their ability to concentrate activities on customers was highlighted by researchers such (Deshpande, Webster 1989; Walker, Ruekert 1987; Weitz, Sujan, Sujan 1986). Deshpande and Webster defined organisational culture as "a pattern of shared values and beliefs that helps individuals understand how the organisation functions, and thus provides them with norms for behaviour within the organisation." This means that organisational culture is linked to the causality that members attribute to how the organisation operates (Deshpande, Webster 1989). In many Western European countries public transport functions organisers operate as local city entities, in which there are two clearly separated levels of governance: political and managerial. The managerial level is responsible for the marketing management of public urban transport services. The way in which these entities are organised and the scope of their independence enable them to effectively

shape the individual elements of these transport services. In Poland, despite the adoption of effective organisational solutions consisting of the separation of the public transport board and the operators, organisers operate within an inefficient organisational structure that is highly susceptible to direct control of decision-makers. The managers of public transport boards in Poland are not treated as managers but as officials, and the organisational form of municipal budgetary units limits the ability to develop an organisational culture suited to marketing-oriented management. Only a few public transport boards in Poland conduct marketing research, and even fewer conduct comprehensive research and use the results to shape their service offer (Mendryk 2013). As a consequence, some of the implemented solutions in the field of sustainable mobility in Polish cities are perceived as political and ideological activities, especially when leading to a reduction in the fulfilment of residents' mobility needs. This issue is further compounded by the problem of restricting competition in the provision of transport services, which is political and social in nature. In Poland, bus services have been completely privatised in one city only, and the public urban transport market is dominated by monopolistic or dominant communal operators. The prices of their services are not verified by the market, given the possibility of employing them as "in-house" operators. As a result, cities experience difficulties in developing a transport offer that is adapted to the preferences and transport behaviour of their residents.

Sustainable mobility falls within the sphere of political activity and the regulation of economic and social phenomena. The selection of sustainable mobility goals is based on the diagnosis, analysis and prediction of specific phenomena. An example of this is transport models. If the measurements for transport models have been carried out in a manner consistent with the requirements of comprehensive traffic surveys, and the analyses carried out reliably using specialised programmes, then predictive accuracy may be high. Nevertheless, analysts must be aware of the limitations of models, primarily resulting from the limited reliability and verifiability of measurements and the uncertainty connected with

the mathematical modelling of human behaviour, including transport behaviour. “By knowing the mechanisms of the model’s operation, its sensitivity, specificity and accuracy, you can find rational arguments for the results obtained. It also helps to know the results of research on traffic changes, both at home and abroad. This makes it possible to counter the claim that something is possible or impossible. However, it should be remembered that any discussion of the results of the model can lead to its improvements and the modification or elimination of errors” (Jastrzębski 2014: 164). Oskarbski points out the accuracy and reliability of data from the traffic management systems databases (ITS): “The conducted scientific research confirms that the data obtained from ITS services can be successfully used to develop and verify transport system models and calibrate them to local conditions. Thanks to the wide range of data collected on a continual basis, it is possible to update and develop models and create new ones. The structure of databases in traffic management systems and the available data formats, their large volume, and the level of aggregation often require additional processing to adapt the datasets for research purposes. Attention should be paid to the reliability and accuracy of the information obtained, which requires preliminary verification before being used in modelling” (Oskarbski 2020: 18).

In public urban transport marketing research, there are similar methodological conditions, some of which are presented in Chapter 4.

The implementation of marketing research in public urban transport is subject to various conditions, among which can be distinguished:

- problems related to the organisation and implementation of research;
- conditions for data reduction, processing and analysis;
- determinants of the use of research results in achieving the goals of sustainable mobility;
- other conditions, resulting from the characteristics of a given country, city, or the public urban transport system of organisation.

One of the most common organisational problems of marketing research is access to sources of marketing information about the market

and demand. The computerization of economic and social processes creates new opportunities for obtaining metadata from databases related to human activity. These include databases of mobile device operators, search engines (e.g., Google), data collected by fare collection systems in public urban transport vehicles, travel planners, surveillance cameras, and smart city information systems. Each of these sources must be evaluated using a standardised framework for assessing marketing information sources. The data must be evaluated for:

- accuracy;
- reliability;
- credibility;
- consistency;
- completeness;
- possibility to use the data legally.

The IT databases provide data of varying degrees of accuracy. Measurements using data from mobile device operators to model demand in public transport are already being carried out. The main advantage of these data sets is that they contain data about the journeys of very many units, however it should be remembered that the data is held by several different operators. The data collected should be anonymised in advance. The collection and anonymisation of data is a very time-consuming process and is subject to strict legal requirements (General Data Protection Regulation – GDPR). The databases of operators consist of two elements: "Charging Data Record," which contains data on active subscribers and "Signalling Data Sources," which contains information on data between the mobile device and the mobile network station (Vidovic et al. 2022). Operators make such data available, but for a fee and in connection with a specific research and analytical purpose. When using this type of metadata, its weaknesses should be taken into account. These include the inaccuracy of the subscriber's location measurement, interruptions in data transmissions, and the need to make use of data from different operators, which results in increased costs of obtaining the data. A specific problem may be different data recording formats.

One of the most important problems regarding data acquisition and the organisation of research conducted using traditional methods (e.g., interviews in households) is the control of the quantity and quality of measurements. Many years of experience of the author and the team with which he cooperates in the implementation of marketing research in public urban transport highlight the following sensitive areas of research, where measurement results must be carefully verified in terms of:

- their number, including the completeness of all measurements;
- their quality, including the accuracy of measurements.

Most entities outsource marketing research to specialised marketing research units. The public transport organiser or the operator can carry out independent research that does not require the involvement of specialised workers and equipment. Research carried out independently should be subject to random checks on its implementation. Research performed by specialised entities should be controlled by the client, regardless of the reputation of the research agency performing the marketing research, in accordance with the principle: 'trust, but check.' Reputable marketing research agencies have their own control procedures and remuneration systems, rewarding the best and most efficient employees and a penalty system in the event of their failure to perform their obligations. Nevertheless, regardless of the motivational systems of research agencies, the author's thirty years of experience allows for the identification of the following negative experiences that may affect the credibility and reliability of results:

- failure to conduct the survey;
- failure to complete the survey;
- failure to conduct the survey and the partial or complete falsification of the survey's results;
- conducting the survey on a person from outside the random sample or who does not meet the established criteria;
- supplementing missing measurements in a way which is not in accordance with the research methodology;
- supplementing missing measurements at the data reduction stage;

- errors in the analysis and description of processed data resulting from a lack of understanding of the specific nature of how public urban transport operates.

There may be various reasons for the failure to conduct the survey with the respondent: the respondent's disagreement to take part in the survey, the absence of the respondent at the location where the interview is to be conducted, or the respondent's place of residence differs from that listed in the population list. Where there is no possibility to conduct an interview (e.g., through a second visit to the household), it is necessary to have a backup list from which a reserve respondent (worker, student, etc., depending on the purpose and place of implementation of the study) who lives close to the place of residence of the primary respondent and shares the same main characteristics, which can be identified based on the information in the list, i.e. gender and age, can be selected. The use of the respondents' reserve list should be treated as a last resort, because the characteristics of the respondents from the main and reserve list regarding transport behaviour and, consequently, also preferences, may differ significantly. This is because residents available from the reserve list (i.e. those at home) tend to be less professionally active and lead a different, less active lifestyle compared to those who are less readily available.

As a result, already at the measurement stage, the sample tends to include respondents who use a private car less frequently or do not use one at all, despite car ownership being a factor that enables higher mobility. Consequently, the share of private car trips in the modal split may be underestimated. The more respondents from reserve lists are surveyed, the greater the potential measurement error, leading to an underestimation of the share of private car users. A similar situation occurs in the random route method, which assumes that an interview is conducted with the next available respondent along the designated route if the initially selected person cannot be reached. The "seek until you find" principle may likewise result in a reduced share of private car users in the sample compared to the whole population.

The failure to complete the survey in its entirety is most often due to an inability or unwillingness to provide a real and definitive answer to some questions. People who always use a private car are not able to answer some questions about the services offered by public urban transport, especially regarding its assessment. For this reason, when designing a questionnaire (or another measuring instrument), it should always be tested on a sample through a pilot study, and in certain cases, filtering questions should be used. Refusal to answer certain questions typically relates to sensitive topics, such as income. Since income data is one of the most important variable models of transport behaviour and preferences, appropriate measurement scales should be tested in questions concerning income, choosing those that provide the most information and result in the fewest refusals.

The inability to conduct an interview or its incompletion often results in the need to repeat the survey, which prompts some interviewers to falsify the data. The measurement error resulting from falsification of data affects the credibility and reliability of the results. Such errors are detectable by experienced researchers who are aware, for example, of the specificity of the public transport network. Surveyors falsifying data often make logical errors, e.g., by answering individual questions with responses on transport behaviour, which is not possible in practice. During research carried out under the direction of the author in 2024, an interviewer falsified the results of the study, consistently repeating his transport preferences and assessment of public urban transport services in the questionnaire. An audit of the study showed that the interviews were not carried out on the ground. A safeguard against data falsification is a random spot check, involving the respondent confirming that the survey has been fully completed. This also allows for the evaluation of the work, behaviour, and competences of the interviewer. Marketing research agencies use mobile devices equipped with an application for research, which only launches a questionnaire after reaching the geographical coordinates corresponding to the place of interview. This does not completely protect against the possibility of falsification

of data in a situation where the interviewer is unable to conduct the survey with the respondent (e.g., the interviewer may falsify the response in the staircase of an apartment building). Therefore, regardless of the use of modern measuring devices, the control confirming the measurement is indicated.

The inability to conduct the survey with a given respondent leads some interviewers to interview another person available at home and assign their behaviour and transport preferences to the person selected for the study. This type of misconduct also indicates the need to ensure research is carried out correctly.

When marketing research agencies are responsible for the entire research process (including organisation, implementation, data reduction, processing, analysis, and reporting), there may be a tendency to fill in missing data during the data reduction and processing stages. Some data can be supplemented without compromising the quality of the test results. These are usually obvious mistakes that can be rectified following consultation with the interviewer. Other errors require part of the survey to be repeated.

When commissioning the research to marketing research agencies, the research aim, hypotheses and scope should be agreed. This allows for errors resulting from a lack of understanding on the part of the agency's employees of the specificity of the public urban transport market, especially the behaviour and transport preferences of residents, to be avoided.

Within the next decade, some analytical and calculation operations are likely to be performed using Artificial Intelligence (AI). Work is already underway on its use in the arrangement of timetables and work schedules for drivers. The International Union for Public Transport notes in its report that (UITP 2018):

- AI systems are based on data;
- due to its nature as a 'living' application that learns from user input, all public transport stakeholders have a role to play in the implementation of AI, including passengers;

- stakeholders should engage in a partnership to build synergies and create highly qualified, multidisciplinary teams;
- service managers should initiate changes to foster a culture of innovation and adopt a 'fail fast, learn faster' approach;
- organisations should learn to "safely fail" because AI requires a trial-and-error approach.

In response to the UITP's conclusions, the author of this monograph performed an experiment as part of the analysis of the data contained in Chapter 6. After performing the analyses and consulting the results with the statistics, the performance of four analyses was assigned to AI, in order to check the consistency of the results. Divergent results were obtained were obtained in three cases, which required the data to be re-input and the task to be performed by AI to be restated. The discrepancies remained unchanged following a further two attempts. Subsequent attempts were also unsuccessful, obtaining the same or at least comparable results. During further attempts, it could be inferred that during the learning process AI is inclined to accept various suggestions in order to satisfy the user with a certain result. However, this observation should not be regarded as scientific, as it may result from the author's in-ability to specify the task in a way that is understood by AI.

Conclusions

The considerations presented in the monograph lead to the following conclusions proving the research hypothesis that the adaptation of the quantity and quality of public urban transport services to the diverse preferences and expectations of residents regarding the quality of services and complex transport behaviours requires public urban transport organisers to conduct marketing research:

1. Sustainable mobility cannot be only a public-funded policy project, which disregards the market as a means of assessing the benefits, costs, and risks to socio-economic development.
2. The sustainable mobility goals of individual cities vary in their details.
3. Urban mobility can become sustainable if people travel more efficiently, travel differently, and/or travel less (the latter, however, will require appropriate changes in spatial planning). The appropriate path to a more sustainable mobility, at the current stage of urban development, is to encourage modal shift by increasing the share of public transport in urban travel (Phase II of Poland's Green Public Transport Programme (ZTP / UPT 2.0).
4. Modal shift will take place provided that public urban transport is widely available and the quantity and quality of its services meet the expectations of residents.
5. Restrictions on the freedom to use private cars in cities, or even restrictions on users of these vehicles, may prove to be counter-effective in the long run, if these actions are not preceded by a decisive improvement in the quality of public urban transport services.

6. Obstacles to the spread of sustainable forms of mobility are individual beliefs and mobility culture, as well as individual consumer decisions on mobility determined by economic factors.
7. A populist interpretation of the goals of sustainable mobility and subordinating them to other political objectives leads to the inefficient use of funds.
8. The appropriate course of action is to base sustainable mobility activities on public urban transport services, which should adopt a marketing-led management approach based on the results of marketing research.
9. The results of marketing research on demand and its structure should be the basis for making rational decisions on the launch of services with specific parameters. The reliance of decision-makers solely on political and ideological considerations may lead to the incurrence of social costs.
10. Only a high level of satisfaction with the quantity and quality of services offered can be an indicator of the ability of this mode of transport to satisfy an increasing number of transport requirements and improve its share in urban transport.
11. The increase in the competitiveness of public urban transport in relation to private cars also requires increasing the quantity and improving the quality of services in a way that positively effects the level of satisfaction of residents.
12. The main subject of marketing research in public urban transport is the demand, behaviour and transport preferences of residents.
13. The results of marketing research on public urban transport services provide the basis for making changes to the attributes and costs of services in accordance with the expectations and preferences of residents.
14. The results of marketing research can be an effective tool for the marketing management of public urban transport when adapting the attributes of the service to sustainable mobility.

15. Marketing research is an effective method in the verification of the effectiveness of public authority activities in achieving the goals of sustainable mobility.
16. After the monograph had been submitted for publication, the author obtained, the results of a 2024 marketing survey on the transport preferences and behaviours of Gdynia residents.

These results confirmed the conclusions presented in Chapter 6. A comparison of the 2018 and 2024 survey results, without detailed statistical analyses, indicates that:

- the share of respondents declaring that they mostly travel by public transport decreased by 4.4 percentage points, while the share of those declaring that they travel equally often by private car and public transport increased by 3.4 percentage points;
- the proportion of respondents declaring that they always or mostly use a private car changed only slightly (by approximately 1 percentage point);
- declared travel behaviours were verified using a one-day travel diary method to determine the modal split: the share of residents travelling by public transport decreased by 2.5 percentage points, while the share of those travelling by private car increased by 1 percentage point. Thus, the objectives set in the SUMP were not achieved;
- the main reasons for using a private car by inhabitants of Gdynia remain, in order of importance: greater comfort, shorter travel time, and the need to transport goods or shopping;
- parking fees have become a more important reason for choosing public transport than parking difficulties. The importance of car use by a second person in the household has also increased;
- the most important attributes of public transport services continue to be directness and accessibility, with their relative importance increasing, while the significance of service frequency and punctuality has decreased;
- the evaluation of Gdynia's urban public transport system (on a scale from 2 to 5) declined slightly – from 4.23 in 2018 to 4.19 in 2024.

Appendix 1

Table 1.1. Operational and Economic Parameters of Bus Route no. 85 in Rumia for the direction: Rumia Partyzantów to Rumia Szmelta in 2023

Route	Relation	Time	Total no. of passengers	Turnover	Revenue per passenger	Max. no. of passengers	No. of passengers
85	Rumia Partyzantów – Rumia Szmelta	4:32	14	28.73 PLN	2.05 PLN	Żeromskiego (request stop)	14
85	Rumia Partyzantów – Rumia Szmelta	4:50	14	28.73 PLN	2.05 PLN	Żeromskiego (request stop)	13
85	Rumia Partyzantów – Rumia Szmelta	5:11	15	21.80 PLN	1.45 PLN	Żeromskiego (request stop)	14
85	Rumia Partyzantów – Rumia Szmelta	5:35	19	27.62 PLN	1.45 PLN	Żeromskiego (request stop)	17
85	Rumia Partyzantów – Rumia Szmelta	6:01	23	19.42 PLN	0.84 PLN	Żeromskiego (request stop)	23
85	Rumia Partyzantów – Rumia Szmelta	6:30	36	30.40 PLN	0.84 PLN	Starowiejska – Poczta	18
85	Rumia Partyzantów – Rumia Szmelta	7:01	36	30.40 PLN	0.84 PLN	Reja (request stop)	23
85	Rumia Partyzantów – Rumia Szmelta	7:13	30	28.76 PLN	0.96 PLN	Żeromskiego (request stop)	20
85	Rumia Partyzantów – Rumia Szmelta	7:25	33	31.64 PLN	0.96 PLN	Żeromskiego (request stop)	19
85	Rumia Partyzantów – Rumia Szmelta	7:51	39	37.39 PLN	0.96 PLN	Reja (request stop)	**29**
85	Rumia Partyzantów – Rumia Szmelta	8:10	29	25.20 PLN	0.87 PLN	Żeromskiego (request stop)	17
85	Rumia Partyzantów – Rumia Szmelta	8:30	35	30.41 PLN	0.87 PLN	Ceynowy	24
85	Rumia Partyzantów – Rumia Szmelta	8:52	39	33.89 PLN	0.87 PLN	Żeromskiego (request stop)	27
85	Rumia Partyzantów – Rumia Szmelta	9:30	31	15.90 PLN	0.51 PLN	Żeromskiego (request stop)	18

Table 1.1 (cont.)

Route	Relation	Time	Total no. of passengers	Turnover	Revenue per passenger	Max. no. of passengers	No. of passengers
85	Rumia Partyzantów – Rumia Szmelta	9:56	25	12.82 PLN	0.51 PLN	Żeromskiego (request stop)	18
85	Rumia Partyzantów – Rumia Szmelta	10:31	32	39.74 PLN	1.24 PLN	Żeromskiego (request stop)	22
85	Rumia Partyzantów – Rumia Szmelta	11:02	35	43.47 PLN	1.24 PLN	Rumia Dworzec PKP	21
85	Rumia Partyzantów – Rumia Szmelta	11:32	27	11.16 PLN	0.41 PLN	Starowiejska – Poczta	17
85	Rumia Partyzantów – Rumia Szmelta	12:02	33	13.64 PLN	0.41 PLN	Ceynowy	21
85	Rumia Partyzantów – Rumia Szmelta	12:32	18	18.21 PLN	1.01 PLN	Żeromskiego (request stop)	13
85	Rumia Partyzantów – Rumia Szmelta	13:02	26	26.31 PLN	1.01 PLN	Żeromskiego (request stop)	17
85	Rumia Partyzantów – Rumia Szmelta	13:32	26	13.39 PLN	0.51 PLN	Rumia Dworzec PKP	19
85	Rumia Partyzantów – Rumia Szmelta	14:02	26	13.39 PLN	0.51 PLN	Ceynowy	16
85	Rumia Partyzantów – Rumia Szmelta	14:32	37	19.05 PLN	0.51 PLN	Rumia Dworzec PKP	25
85	Rumia Partyzantów – Rumia Szmelta	15:02	38	30.73 PLN	0.81 PLN	Żeromskiego (request stop)	18
85	Rumia Partyzantów – Rumia Szmelta	15:32	47	38.01 PLN	0.81 PLN	Rumia Dworzec PKP	27
85	Rumia Partyzantów – Rumia Szmelta	16:04	15	14.26 PLN	0.95 PLN	Reja (request stop)	10
85	Rumia Partyzantów – Rumia Szmelta	16:34	25	23.77 PLN	0.95 PLN	Rumia Dworzec PKP	13
85	Rumia Partyzantów – Rumia Szmelta	17:04	31	20.76 PLN	0.67 PLN	Rumia Dworzec PKP	20

Table 1.1 (cont.)

Route	Relation	Time	Total no. of passengers	Turnover	Revenue per passenger	Max. no. of passengers	No. of passengers
85	Rumia Partyzantów – Rumia Szmelta	17:34	22	14.74 PLN	0.67 PLN	Rumia Dworzec PKP	16
85	Rumia Partyzantów – Rumia Szmelta	18:06	17	15.40 PLN	0.91 PLN	Rumia Dworzec PKP	12
85	Rumia Partyzantów – Rumia Szmelta	18:33	16	14.50 PLN	0.91 PLN	Starowiejska – Poczta	7
85	Rumia Partyzantów – Rumia Szmelta	19:03	10	9.62 PLN	0.96 PLN	Okrzei	7
85	Rumia Partyzantów – Rumia Szmelta	19:52	9	8.66 PLN	0.96 PLN	Reja (request stop)	5
85	Rumia Partyzantów – Rumia Szmelta	20:21	6	3.30 PLN	0.55 PLN	Rumia Dworzec PKP	4
85	Rumia Partyzantów – Rumia Dworzec PKP	20:43	10	5.50 PLN	0.55 PLN	Reja (request stop)	10
85	Rumia Partyzantów – Rumia Szmelta	21:18	5	3.26 PLN	0.65 PLN	Okrzei	4
85	Rumia Partyzantów – Rumia Szmelta	22:21	2	2.85 PLN	1.42 PLN	Rumia Dworzec PKP	2

Source: Compiled by the author based on the (MZKZG 2023) in light of marketing research findings from spring 2023.

Appendix 2

Table 2.1. Spearman's and Pearson's test results for segments identified *a priori*

Ord. No.	Feature	Trend analysis	Statistic (correlation)	*p-value*	Significant ($p < 0.05$)
Age [in years]					
1	16–20	Spearman Trend Test	–0.900	0.037	True
2	16–20	Pearson Linear Trend Test	–0.907	0.333	True
3	21–30	Spearman Trend Test	–0.999	1.40E–24	True
4	21–30	Pearson Linear Trend Test	–0.973	0.005	True
5	41–50	Spearman Trend Test	–0.899	0.037	True
6	41–50	Pearson Linear Trend Test	–0.915	0.029	True
7	51–60	Spearman Trend Test	–0.999	1.40E–24	True
8	51–60	Pearson Linear Trend Test	–0.958	0.010	True
9	61–70	Spearman Trend Test	–0.899	0.037	True
10	61–70	Pearson Linear Trend Test	–0.924	0.024	True

Table 2.1 (cont.)

Ord. No.	Feature	Trend analysis	Statistic (correlation)	*p-value*	Significant ($p < 0.05$)
Socio-occupational status					
11	Students/pupils	Spearman Trend Test	–0.999	1.40E–24	True
12	Students/pupils	Pearson Linear Trend Test	–0.925	0.024	True
13	Working pensioners/ disability pensioners	Spearman Trend Test	–0.899	0.037	True
14	Working pensioners/ disability pensioners	Pearson Linear Trend Test	–0.891	0.042	True
Car ownership status					
15	Households with no car	Spearman Trend Test	–0.899	0.037	True
16	Main car users	Spearman Trend Test	–0.899	0.037	True
17	Main car users	Pearson Linear Trend Test	–0.918	0.037	True

Source: Own work.

Appendix 3

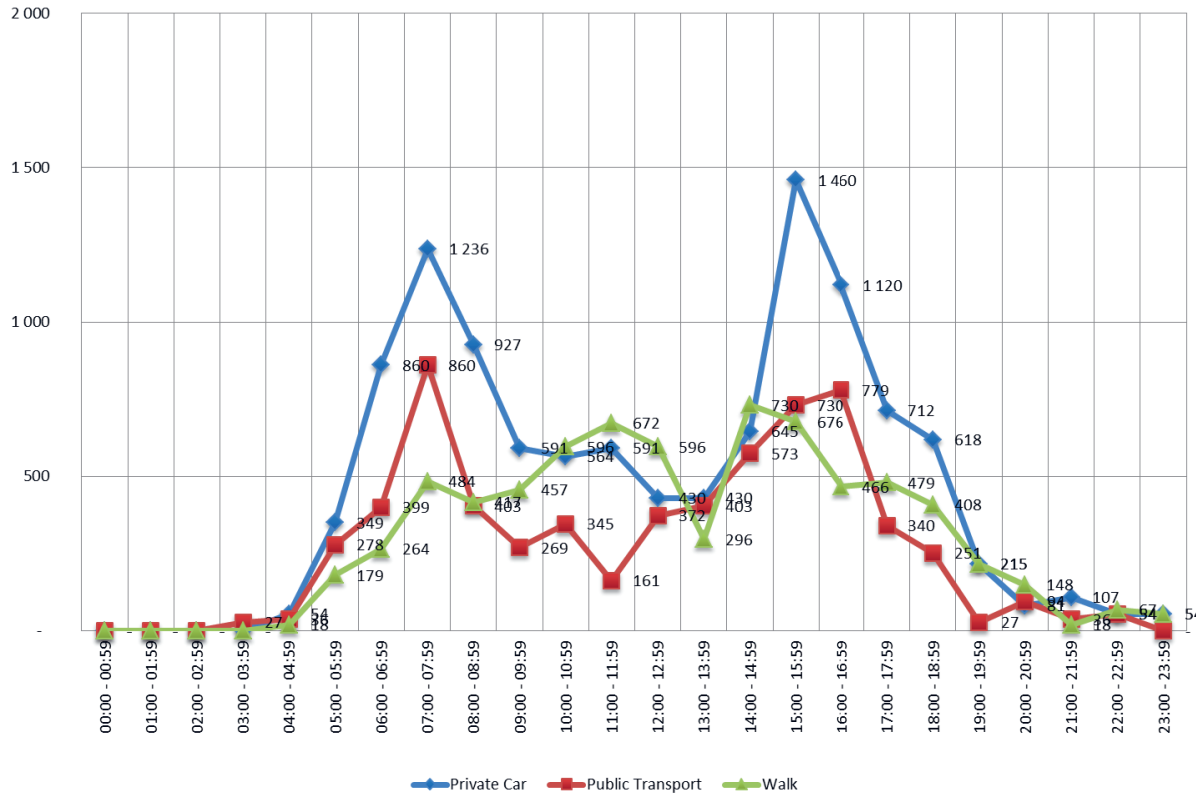

Figure 3.1. Daily variation in travel volume in Sopot in 2024 [*n* = 849]

Source: (“Preferencje i zachowania komunikacyjne mieszkańców Sopotu w 2024 r.” 2024).

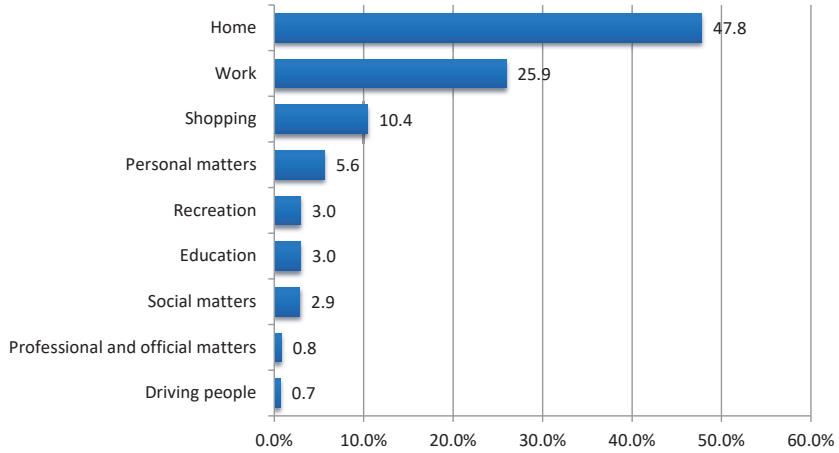

Figure 3.2. Structure of Sopot residents' travel motivations (destinations) in 2024 [*n* = 849]

Source: ("Preferencje i zachowania komunikacyjne mieszkańców Sopotu w 2024 r." 2024).

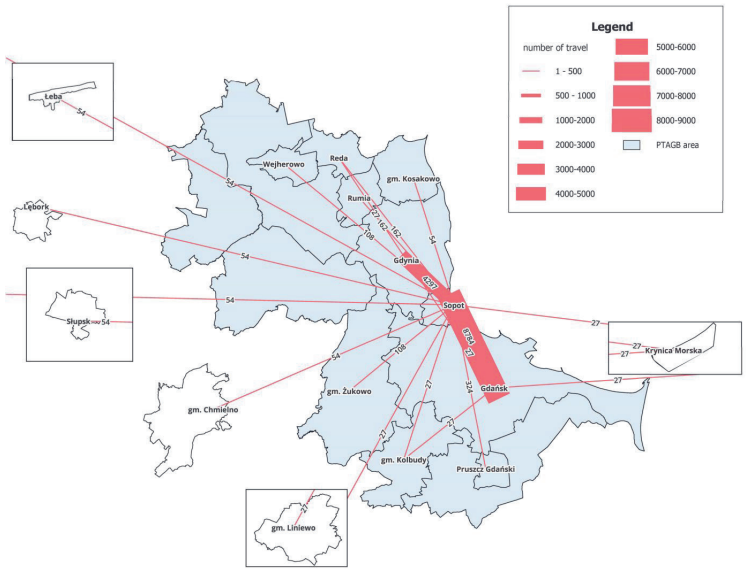

Figure3. Sopot Residents' travel patterns (travel matrix) on weekdays in 2024 [*n* = 849]

Source: ("Preferencje i zachowania komunikacyjne mieszkańców Sopotu w 2024 r." 202c

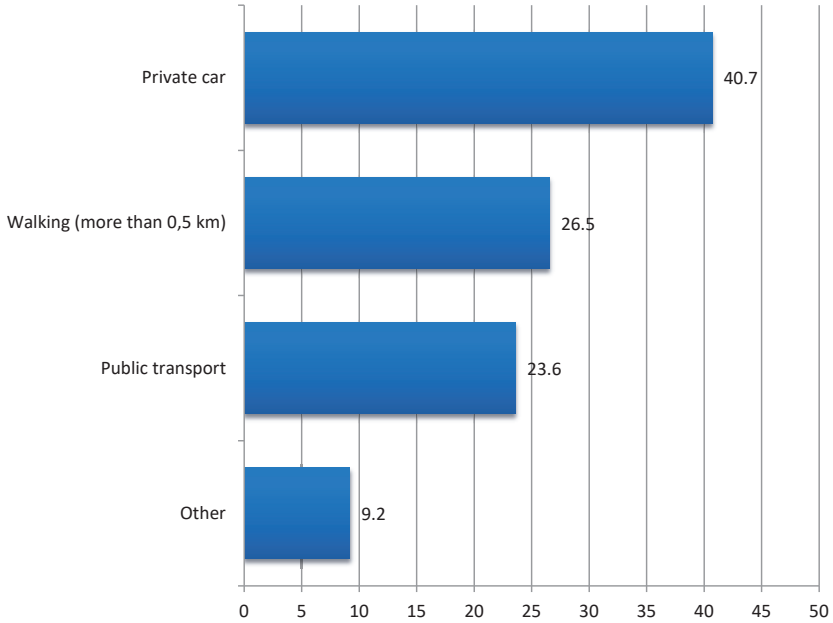

Figure 3.4. Travel patterns according to the mode of transport in Sopot in 2024 [n = 849]

Source: ("Preferencje i zachowania komunikacyjne mieszkańców Sopotu w 2024 r." 2024).

Appendix 4

Table 4.1. Analysis of the different purposes for travel of three groups of Gdynia residents (2018) – Chi-squared test

Destinations (travel motivations)	**Total**	**Travelling always or mostly by public urban transport**	**Travelling always or usually by private car**	***Chi-squared value***
Home	45.3	46.3	44.8	*0.0256*
Work	25.8	20.9	31.4	*2.1206*
Shopping	9.2	9.8	8.2	*0.1441*
Personal matters	8.2	9.4	6.4	*0.5700*
Recreation	3.2	3.5	3.7	*0.0365*
Education	**3.3**	**7**	**0.5**	*5.9055*
Social activities	1.9	2.1	1.4	*0.1444*
Other	3.1	1	3.6	*1.4831*

Source: Own work.

Appendix 5

Table 5.1. Basic descriptive statistics together with the Shapiro–Wilk test result

Dependent variable	*M*	*Me*	*SD*	*Sk.*	*Kurt.*	*Min.*	*Max.*	*W*	*p*
Number of indications as the most important attribute									
Directness	345.60	362.00	37.95	–2.19	4.83	278.00	366.00	0.63	**0.001**
Frequency	331.20	333.00	11.86	0.25	0.50	316.00	348.00	0.98	0.913
Availability	272.00	254.00	32.03	1.44	1.40	248.00	324.00	0.81	0.102
Reliability	139.40	140.00	24.20	–1.05	1.84	101.00	166.00	0.93	0.569
Low cost	175.40	180.00	26.42	–0.34	1.27	137.00	210.00	0.96	0.841
Speed	137.40	134.00	18.89	1.57	2.66	122.00	169.00	0.84	0.163
Punctuality	336.80	336.00	25.16	–0.93	0.75	298.00	362.00	0.92	0.544
Rhythmicity	59.00	61.00	4.69	–0.36	–2.91	54.00	64.00	0.84	0.154
Number of indications as the worst-performing attribute									
Directness	113.20	92.00	38.20	0.95	–1.14	83.00	169.00	0.83	0.145
Frequency	120.40	132.00	22.90	–0.67	–2.35	90.00	141.00	0.85	0.210
Availability	48.00	53.00	10.68	–0.70	–1.31	33.00	59.00	0.91	0.493
Reliability	55.20	56.00	7.63	–0.13	–0.41	45.00	65.00	1.00	0.995
Low cost	138.60	135.00	64.45	1.14	2.06	69.00	242.00	0.92	0.509
Speed	92.00	89.00	17.86	0.30	–1.89	72.00	115.00	0.95	0.752
Punctuality	192.40	206.00	46.91	–0.89	–0.04	122.00	240.00	0.94	0.669

Table 5.1 (cont.)

Dependent variable	*M*	*Me*	*SD*	*Sk.*	*Kurt.*	*Min.*	*Max.*	*W*	*p*
Rhythmicity	87.20	74.00	39.44	1.97	4.04	59.00	156.00	0.76	**0.033**
Information	47.40	46.00	7.27	0.73	–0.54	40.00	58.00	0.95	0.709
Comfort	127.00	111.00	43.93	2.15	4.72	99.00	205.00	0.67	**0.004**
Number of indications as the best-performing attribute									
Directness	191.60	206.00	50.52	–1.34	1.49	110.00	232.00	0.86	0.224
Frequency	261.60	282.00	45.18	–0.88	–1.09	196.00	302.00	0.88	0.326
Availability	309.20	330.00	65.97	–1.69	3.40	197.00	370.00	0.83	0.134
Reliability	421.40	390.00	80.34	2.07	4.43	367.00	563.00	0.71	**0.013**
Low cost	94.80	95.00	12.09	–0.58	0.42	77.00	109.00	0.98	0.927
Speed	91.20	100.00	28.17	–0.12	–2.39	62.00	125.00	0.88	0.291
Punctuality	43.20	42.00	13.63	0.60	–0.19	28.00	63.00	0.97	0.893
Rhythmicity	42.40	41.00	11.13	–0.12	0.38	27.00	57.00	0.99	0.969
Information	42.80	47.00	10.08	–0.41	–3.04	32.00	53.00	0.82	0.124
Comfort	26.00	27.00	7.62	–0.25	–1.38	16.00	35.00	0.98	0.907

M – mean; *Me* – median; *SD* – standard deviation; *Sk.* – skewness; *Kurt.* – kurtosis; Min. – minimal value; Max. – maximum value; *W* – Shapiro-Wilk test; *p* – *p*-value for the Shapiro-Wilk test

Source: Own work.

Appendix 6

Table 6.1. Result of the Principal Component Analysis (PCA) analysis

	Attribute	Best Evaluated Variable	Worst Evaluated Variable
1	Directness	**6.4**	**3.6**
2	Frequency	**5.1**	1.3
3	Availability	**10.8**	0.3
4	Reliability	**15.6**	0.1
5	Low cost	0.4	**10.2**
6	Speed	1.9	0.8
7	Punctuality	0.5	**5.4**
8	Rhythmicity	0.3	**3.8**
9	Sufficient information	0.3	0.1
10	Convenience	0.1	**4.8**

Source: Own work.

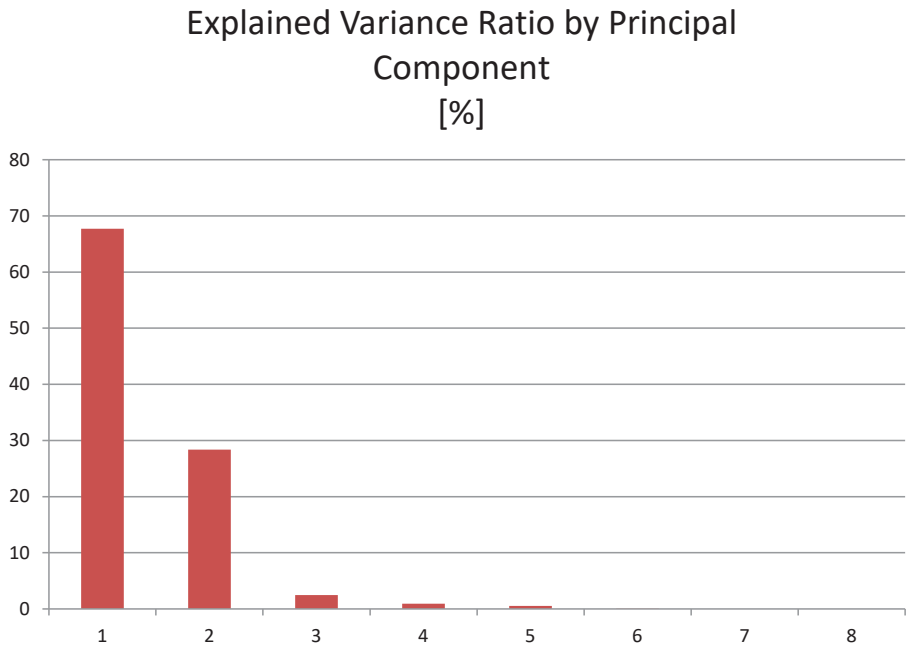

Figure 6.1. Percentage of variance explained by individual components PC1 and PC2

Source: Own work.

Appendix 7

Table 7.1. Cross Analysis Age_v3 * Mean of transport

Variable			Mean of transport		Total
			non-sustainable	sustainable	
Age_v3	Less 40	N	75	119	194
		% from Mean of transport	39,9%	44,7%	42,7%
	41–60	N	86	82	168
		% from Mean of transport	45,7%	30,8%	37,0%
	More 60	N	27	65	92
		% from Mean of transport	14,4%	24,4%	20,3%
Total		N	188	266	454
		% from Mean of transport	100,0%	100,0%	100,0%

Source: Own work.

Table 7.2. Cross Analysis: Gender * Mean of transport

Variable			Mean of transport		Total
			non-sustainable	sustainable	
Gender	Woman	N	78	158	236
		% from Mean of transport	41,5%	59,4%	52,0%
	Man	N	110	108	218
		% from Mean of transport	58,5%	40,6%	48,0%
Total		N	188	266	454
		% from Mean of transport	100,0%	100,0%	100,0%

Source: Own work.

Table 7.3. Cross analisys: Main car users * Mean of transport

Variable			Mean of transport		Total
			non-sustainable	sustainable	
Main car users	No	N	13	43	56
		% from Mean of transport	7,6%	53,8%	22,3%
	Yes	N	158	37	195
		% from Mean of transport	92,4%	46,3%	77,7%
Total		N	171	80	251
		% from Mean of transport	100,0%	100,0%	100,0%

Source: Own work.

Table 7.4. Cross Analysis: Public transport assessment * Mean of Transport

Variable			Mean of transport		Total
			non-sustainable	sustainable	
Public transport assessment	Insufficient	N	10	7	17
		% from Mean of transport	6,8%	2,8%	4,3%
	Sufficient	N	40	63	103
		% from Mean of transport	27,0%	25,3%	25,9%
	Good	N	72	138	210
		% from Mean of transport	48,6%	55,4%	52,9%
	Very good	N	26	41	67
		% from Mean of transport	17,6%	16,5%	16,9%
Total		N	148	249	397
		% from Mean of transport	100,0%	100,0%	100,0%

Source: Own work.

Table 7.5. Cross Analysis: Standard of comfort * Mean of Transport

Variable			Mean of transport		Total
			non-sustainable	sustainable	
Standard of comfort	I accept travel in crowded conditions	N	23	22	45
		% from Mean of transport	12,2%	8,3%	9,9%
	I expect standing place in non-difficult conditions	N	41	44	85
		% from Mean of transport	21,8%	16,5%	18,7%
	No opinion	N	66	34	100
		% from Mean of transport	35,1%	12,8%	22,0%
	I expect mostly a seat	N	37	108	145
		% from Mean of transport	19,7%	40,6%	31,9%
	I expect always a seat	N	21	58	79
		% from Mean of transport	11,2%	21,8%	17,4%
Total		N	188	266	454
		% from Mean of transport	100,0%	100,0%	100,0%

Source: Own work.

Table 7.6. Cross Analysis: The attribute selected as the best implemented * Mean of transport

Variable			Mean of transport		Total
			non-sustainable	sustainable	
The attribute selected as the best implemented	No	N	59	110	169
		% from Mean of transport	51,8%	49,1%	50,0%
	Yes	N	55	114	169
		% from Mean of transport	48,2%	50,9%	50,0%
Total		N	114	224	338
		% from Mean of transport	100,0%	100,0%	100,0%

Source: Own work.

Table 7.7. Cross Analysis: The attribute selected as the worst implemented * Mean of transport

Variable			Mean of transport		Total
			non-sustainable	sustainable	
The selected attribute as the worst implemented	No	N	60	108	168
		% from Mean of transport	47,6%	46,6%	46,9%
	Yes	N	66	124	190
		% from Mean of transport	52,4%	53,4%	53,1%
Total		N	126	232	358
		% from Mean of transport	100,0%	100,0%	100,0%

Source: Own work.

Table 7.8. Cross Analysis: Age * Main car user

Variable			Main car user		Total
			no	yes	
Age_v3	Less 40	N	40	**110**	150
		% from Mean of transport	50,0%	**35,9%**	38,9%
	41–60	N	30	143	173
		% from Mean of transport	37,5%	46,7%	44,8%
	More 60	N	10	53	63
		% from Mean of transport	12,5%	17,3%	16,3%
Total		N	80	306	386
		% from Mean of transport	100,0%	100,0%	100,0%

Source: Own work.

References

Literature

Abrate Graziano, Massimiliano Piacenza, Davide Vannoni. 2009. "The Impact of Integrated Tariff Systems on Public Transport Demand: Evidence from Italy." *Regional Science and Urban Economics* 39(2): 120–127. https://doi.org/https://doi.org/10.1016/j.regsciurbeco.2008.05.014.

Adams Karen, Ian Brace. 2006. *An Introduction to Market & Social Research: Planning & Using Research Tools & Techniques*. Kogan Page Series. London: Kogan Page. https://books.google.pl/books?id=JPERJsXMKuAC.

Ajzen Icek, Martin Fishbein. 2005. "The Influence of Attitudes on Behavior." In *The Handbook of Attitudes*. Eds. Dolores Albarracín, Blair T. Johnson, Mark P. Zanna. 187–236. New York: Psychology Press. https://doi.org/10.4324/9781410612823-13.

Akinyemi Eyitayo Olufunmilayo, Mark Zuidgeest. 2000. "Sustainable Development and Transportation: Past Experiences and Future Challenges." *World Transport Policy & Practice* 6(1): 31–39.

Alonso Andrea, Andrés Monzón, Rocío Cascajo. 2015. "Comparative Analysis of Passenger Transport Sustainability in European Cities." *Ecological Indicators* 48: 578–592.

Al-Salih Wissam Qassim, Domokos Esztergár-Kiss. 2021. "Linking Mode Choice with Travel Behavior by Using Logit Model Based on Utility Function." *Sustainability* 13(8): 17. https://doi.org/10.3390/su13084332.

"Analiza rynku komunikacji miejskiej w Lublinie. Zadanie 2." 2023. Lublin—Wrocław.

Anderson Richard, Benjamin Condry, Nicholas Findlay. 2013. "Measuring and Valuing Convenience and Service Quality: A Review of Global Practices and Challenges from the Public Transport Sector." Discussion Paper 16. London: Imperial College London: 44. http://www.internationaltransportforum.org/jtrc/DiscussionPapers/DP201316.pdf.

Asensio Javier, Anna Matas, José-Luis Raymond. 2003. "Redistributive Effects of Subsidies to Urban Public Transport in Spain." *Transport Reviews* 23(4): 433–452. https://doi.org/10.1080/01441647.2002.10823176.

Auger Pat, Timothy M. Devinney. 2007. "Do What Consumers Say Matter? The Misalignment of Preferences with Unconstrained Ethical Intentions." *Journal of Business Ethics* 76(4): 361–183. https://doi.org/10.1007/s10551-006-9287-y.

Balcombe Richard, Roger Mackett, Neil Paulley, John Preston, Jeremy Shires, Helena Titheridge, Mark Wardman, Peter White. 2006. "The Demand for Public Transport: The effects of fares, quality of service, income and car ownership." *Transport Policy* 13(4): 295–306. https://doi.org/10.1016/j.tranpol.2005.12.004.

Bamberg Sebastian, Marcel Hunecke, Anke Blöbaum. 2007. "Social Context, Personal Norms and the Use of Public Transportation: Two Field Studies." *Journal of Environmental Psychology* 27(3): 190–203. https://doi.org/https://doi.org/10.1016/j.jenvp.2007.04.001.

Bamberg Sebastian, Daniel Rölle, Christoph Weber. 2003. "Does Habitual Car Use Not Lead to More Resistance to Change of Travel Mode?" *Transportation* 30(1): 97–108. https://doi.org/10.1023/A:1021282523910.

Banister David. 2008. "The Sustainable Mobility Paradigm." *Transport Policy* 15(2): 73–80. https://doi.org/10.1016/J.TRANPOL.2007.10.005.

"Bank Danych Lokalnych." 2024. GUS. 2024. https://bdl.stat.gov.pl/BDL/dane/podgrup/temat.

Bank World. 2002. *Cities on the Move: A World Bank Urban Transport Strategy Review*. The World Bank.

Barbieri Diego Maria, Baowen Lou, Marco Passavanti, Cang Hui, Daniela Antunes Lessa, Brij Maharaj, Arunabha Banerjee. 2020. "A Survey Dataset to Evaluate the Changes in Mobility and Transportation Due to COVID-19 Travel Restrictions in Australia, Brazil, China, Ghana, India, Iran, Italy, Norway, South Africa, United States." *Data in Brief* 33 (December):106459. https://doi.org/10.1016/j.dib.2020.106459.

Baron Marcin, Adam Bartoszek, Rafał Blazy, Krzysztof Gasidło, Monika Janiszek, Andrzej Klasik, Tadeusz Markowski Katarzyna Mazur-Belzyt, Luk Palmen, Alina Pancewicz, Małgorzata Pięta-Kanurska, Jerzy Runge, Agata Twardoch, Krzysztof Wrana. 2019. "Rozdział 2: Praktyka kształtowania przestrzeni miejskich." In *Budowanie atrakcyjności przestrzeni miejskich*. Red. Tomasz Komornicki. 59–105. Warszawa: Polska Akademia Nauk. Komitet Przestrzennego Zagospodarowania Kraju. http://publikacje.pan.pl/Content/115938/PDF-MASTER/Rozdział2.pdf.

Bárta Martin. 2020. "Comparative Analysis of the Accessibility and Connectivity of Public Transport in the City Districts of Krakow." *Prace Komisji Geografii Komunikacji PTG* 23(3): 7–14. https://doi.org/10.4467/2543859xpkg.20.016.12784.

Bauer Johannes J. 2014. "Selection Errors of Random Route Samples." *Sociological Methods and Research* 43(3): 519–544. https://doi.org/10.1177/0049124114521150.

Beirão Gabriela, José António Sarsfield Cabral. 2007. "Understanding Attitudes towards Public Transport and Private Car: A Qualitative Study." *Transport Policy* 14(6): 478–489. https://doi.org/10.1016/j.tranpol.2007.04.009.

Bergman Noam, Tim Schwanen, Benjamin K. Sovacool. 2017. “Imagined People, Behaviour and Future Mobility: Insights from Visions of Electric Vehicles and Car Clubs in the United Kingdom.” *Transport Policy* 59: 165–173. https://doi.org/https://doi.org/10.1016/j.tranpol.2017.07.016.

Beshah Birhanu, Daniel Kitaw, Eshetie Berhan. 2013. “Performance Analysis on Public Bus Transport of the City of Addis Ababa.” *International Journal of Computer Information Systems and Industrial Management Applications* 5: 722–728. https://www.mirlabs.org/ijcisim/regular_papers_2013/Paper151.pdf.

Besser Lilah M., Andrew L. Dannenberg. 2005. “Walking to Public Transit: Steps to Help Meet Physical Activity Recommendations.” *American Journal of Preventive Medicine* 29(4): 273–280. https://doi.org/https://doi.org/10.1016/j.amepre.2005.06.010.

Beyazit Eda. 2011. “Evaluating Social Justice in Transport: Lessons to Be Learned from the Capability Approach.” *Transport Reviews* 31(1): 117–134. https://doi.org/10.1080/01441647.2010.504900.

Bhat Chandra R. 1995. “A Heteroscedastic Extreme Value Model of Intercity Travel Mode Choice.” *Transportation Research Part B: Methodological* 29(6): 471–483. https://doi.org/https://doi.org/10.1016/0191-2615(95)00015-6.

Bianchi Fabio. 2012. “Integrated Fare Systems for Local Public Transport: A Regional Prospective.” In *ERSA Conference Papers* Ersa12p581. https://ideas.repec.org/p/wiw/wiwrsa/ersa12p581.html.

Börjesson Maria, Carl J. Hamilton, Per Näsman, Claire Papaix. 2015. “Factors Driving Public Support for Road Congestion Reduction Policies: Congestion Charging, Free Public Transport and More Roads in Stockholm, Helsinki and Lyon.” *Transportation Research Part A: Policy and Practice* 78: 452–462. https://doi.org/10.1016/j.tra.2015.06.008.

Börjesson Maria, Isak Rubensson. 2019. “Satisfaction with Crowding and Other Attributes in Public Transport.” *Transport Policy* 79: 213–222. https://doi.org/https://doi.org/10.1016/j.tranpol.2019.05.010.

Botte Marilisa, Luigi Pariota, Luca D’Acierno, Gennaro N. Bifulco. 2019. “An Overview of Cooperative Driving in the European Union: Policies and Practices.” *Electronics* 8(6): 616. https://doi.org/10.3390/electronics8060616.

Brand Ralf. 2008. “Co-Evolution of Technical and Social Change in Action: Hasselt’s Approach to Urban Mobility.” *Built Environment* 34(2): 189–199. https://doi.org/10.2148/benv.34.2.182.

Bucsky Péter. 2020. “Modal Share Changes Due to COVID-19: The Case of Budapest.” *Transportation Research Interdisciplinary Perspectives* 8: 3–4. https://doi.org/10.1016/j.trip.2020.100141.

Buehler Ralph, John Pucher. 2011. “Making Public Transport Financially Sustainable.” *Transport Policy* 18(1): 126–138. https://doi.org/10.1016/j.tranpol.2010.07.002.

Burinskienė Marija, Modesta Gusarovienė, Kristina Gabrulevičiūtė-Skebienė. 2014. "The Impact of Public Transport Lanes on the Operating Speed of Buses." In *9th International Conference on Environmental Engineering, ICEE 2014*, January. 1–7. https://doi.org/10.3846/enviro.2014.112.

Butler Luke, Tan Yigitcanlar, Alexander Paz. 2021. "Barriers and Risks of Mobility-as-a-Service (MaaS) Adoption in Cities: A Systematic Review of the Literature." *Cities* 109: 103036. https://doi.org/https://doi.org/10.1016/j.cities.2020.103036.

Campos Vânia Barcellos Gouvêa, Rui António Rodrigues Ramos, Denise De Miranda E Silva Correia. 2009. "Multi-Criteria Analysis Procedure for Sustainable Mobility Evaluation in Urban Areas." *Journal of Advanced Transportation* 43(4): 371–390. https://doi.org/10.1002/atr.5670430403.

Cascetta Ennio, Armando Cartenì. 2014. "A Quality-Based Approach to Public Transportation Planning: Theory and a Case Study." *International Journal of Sustainable Transportation* 8(1): 84–106.

Cats Oded, Roberto Fernandez Abenoza, Chengxi Liu, Yusak Susilo. 2015. "Evolution of Satisfaction with Public Transport and Its Determinants in Sweden: Identifying Priority Areas." *Transportation Research Record Journal of the Transportation Research Board* 2538(1): 86–95. https://doi.org/10.3141/2538-10.

Cats Oded, Yusak O. Susilo, Triin Reimal. 2018. "Erratum to: The Prospects of Fare-Free Public Transport: Evidence from Tallinn." *Transportation* 45: 1601–1602. https://doi.org/10.1007/s11116-017-9785-z.

Chamier-Gliszczyński Norbert. 2016. "Model mobilności użytkowników miast." *Transport Miejski i Regionalny* 6: 27–31.

Cheba Katarzyna, Sebastian Saniuk. 2016. "Urban Mobility – Identification, Measurement and Evaluation." *Transportation Research Procedia* 14: 1230–1239. https://doi.org/10.1016/j.trpro.2016.05.194.

Chen Cynthia, Hongmian Gong, Robert Paaswell. 2008. "Role of the Built Environment on Mode Choice Decisions: Additional Evidence on the Impact of Density." *Transportation* 35(3): 285–299. https://doi.org/10.1007/s11116-007-9153-5.

Chen Jian, Shoujie Li. 2017. "Mode Choice Model for Public Transport with Categorized Latent Variables." *Mathematical Problems in Engineering* 1. https://doi.org/10.1155/2017/7861945.

Cheng Shaowu, Bing Xie, Yiming Bie, Yaping Zhang, Shen Zhang. 2018. "Measure Dynamic Individual Spatial-Temporal Accessibility by Public Transit: Integrating Time-Table and Passenger Departure Time." *Journal of Transport Geography* 66: 235–247. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2017.12.005.

Chien Steven I., Zhaoqiong Qin. 2004. "Optimization of Bus Stop Locations for Improving Transit Accessibility." *Transportation Planning and Technology* 27(3): 211–227. https://doi.org/10.1080/0308106042000226899.

Choo Sangho, Patricia L. Mokhtarian. 2004. “What Type of Vehicle Do People Drive? The Role of Attitude and Lifestyle in Influencing Vehicle Type Choice.” *Transportation Research Part A: Policy and Practice* 38(3): 201–222. https://doi.org/https://doi.org/10.1016/j.tra.2003.10.005.

Chowdhury Subeh, Avishai Ceder. 2013. “Definition of Planned and Unplanned Transfer of Public Transport Service and User Decisions to Use Routes with Transfers.” *Journal of Public Transportation* 16(2): 1–20. https://doi.org/10.5038/2375-0901.16.2.1.

Ciastoń-Ciulkin Aleksandra. 2016. “The Analysis of the Sustainable Mobility Level in Selected European Cities.” In José Vicente Colomer Ferrándiz, Ricardo Insa Franco, Tomás Ruiz Sánchez, *XII Congreso de Ingeniería Del Transporte. 7, 8 y 9 de Junio, Valencia (España)*, 2413–2420. València: Universitat Politècnica de València. http://dx.doi.org/10.4995/CIT2016.2016.3455.

Ciastoń-Ciulkin Aleksandra, Katarzyna Nosal. 2014. “Hierarchizacja czynników mających wpływ na wybór środka podróży na przykładzie Krakowa.” *Transport Miejski i Regionalny* 3: 9–15.

Clements Lewis M., Kara M. Kockelman. 2017. “Economic Effects of Automated Vehicles.” *Transportation Research Record* 2606(1): 106–114. https://doi.org/10.3141/2606-14.

Costa Álvaro. 1996. “The Organisation of Urban Public Transport Systems in Western European Metropolitan Areas.” *Transportation Research Part A: Policy and Practice* 30(5): 349–359. https://doi.org/10.1016/0965-8564(96)00002-X.

Costa Priscila Bahia, Morais G.C. Neto, Adelmo Inácio Bertolde. 2017. “Urban Mobility Indexes: A Brief Review of the Literature.” *Transportation Research Procedia* 25: 3645–3655. https://doi.org/10.1016/j.trpro.2017.05.330.

Cranenburgh Sander Van, Caspar Chorus, Bert Van Wee. 2012. “Substantial Changes and Their Impact on Mobility: A Typology and an Overview of the Literature.” *Transport Reviews* 32(5): 569–597. https://doi.org/10.1080/01441647.2012.706836.

Creutzig Felix, Aneeque Javaid, Zakia Soomauroo, Steffen Lohrey, Nikola Milojevic-Dupont, Anjali Ramakrishnan, Mahendra Sethi et al. 2020. “Fair Street Space Allocation: Adelmo Inácio Bertolde Ethical Principles and Empirical Insights.” *Transport Reviews* 40(6): 711–733. https://doi.org/10.1080/01441647.2020.1762795.

Cronin J Joseph, Roscoe Hightower. 2004. “An Evaluation of the Role of Marketing in Public Transit Organizations.” *Journal of Public Transportation* 7(2): 17–36. https://doi.org/https://doi.org/10.5038/2375-0901.7.2.2.

Currie Graham. 2018. “Lies, Damned Lies, AVs, Shared Mobility, and Urban Transit Futures.” *Journal of Public Transportation* 21(1): 19–30. https://doi.org/10.5038/2375-0901.21.1.3.

Czerepicki Andrzej, Tomasz Krukowicz, Anna Górka, Jarosław Szustek. 2021. “Traffic Light Priority for Trams in Warsaw as a Tool for Transport Policy and Reduction of Energy Consumption.” *Sustainability (Switzerland)* 13(8): 4180. https://doi.org/10.3390/su13084180.

Czubała Anna, Agata Jonas, Tomasz Smoleń, Jan. W. Wiktor. 2012. *Marketing usług*. Warszawa: Oficyna a Wolters Kluwer Business.

Dargay Joyce, Mark Hanly. 2002. "Bus Patronage in Great Britain: Econometric Analysis." *Transportation Research Record* 1799(1): 97–106. https://doi.org/10.3141/1799-13.

Dargay Joyce, Laurent Hivert, Diego Legros. 2008. "The Dynamics of Car Availability in EU Countries: A Comparison Based on the European Household Panel Survey." *IATSS Research* 32(2): 44–55. https://doi.org/10.1016/S0386-1112(14)60208-9.

Davern Edward. 2008. "Representative Sample." In *Encyclopedia of Survey Research Methods*. Ed. Paul J. Lavrakas, 720–722. Thousand Oaks, CA: SAGE Publications, Inc.

Davison Lisa J., Richard D. Knowles. 2006. "Bus Quality Partnerships, Modal Shift and Traffic Decongestion." *Journal of Transport Geography* 14(3): 177–194. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2005.06.008.

Delbosc Alexa, Graham Currie. 2011. "Using Lorenz Curves to Assess Public Transport Equity." *Journal of Transport Geography* 19(6): 1252–1259. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2011.02.008.

Dentelski David, Ran Damari, Yanir Marmor, Avner Niv, Mor Roses, Yonatan Dubi. 2023. "Ninety-Nine Percent? Re-Examining the Consensus on the Anthropogenic Contribution to Climate Change." *Climate* 11(11): 215. https://doi.org/10.3390/cli11110215.

Deshpande Rohit, Frederick E. Webster. 1989. "Organizational Culture and Marketing: Defining the Research Agenda." *Journal of Marketing* 53(1): 3–15. https://doi.org/10.1177/002224298905300102.

Dimoula Konstantina. 2018. "The Perceived Attractiveness of Public Transportation." *Business Economics* . https://thesis.eur.nl/pub/47810.

Donovan Craig Poulenez. 1997. "Transport Concepts in European Cities: Tim Pharoah and Dieter Apel. (Avebury Studies in Green Research). Avebury Publishing Ltd., Gower House, Croft Road, Aldershot, Hants GU11 3HR England, 1995. (Distributed in North America by Ashgate Publishing Co.). Book review." *Transportation Research Part A: Policy and Practice* 31(2): 176–177. https://doi.org/https://doi.org/10.1016/S0965-8564(97)89919-3.

Douglas Neil, 2003. "Patronage Ramp-Up Factors for New Rail Services Patronage Ramp-Up Factors for New Rail Services by Neil Douglas" October.

Dryzek John S. 2022. *The Politics of the Earth: Environmental Discourses*. Oxford: Oxford University Press.

Dujardin Claire, Harris Selod, Isabelle Thomas. 2008. "Residential Segregation and Unemployment: The Case of Brussels." *Urban Studies* 45(1): 89–113. https://doi.org/10.1177/0042098007085103.

Eboli Laura, Gabriella Mazzulla. 2008. "A Stated Preference Experiment for Measuring Service Quality in Public Transport." *Transportation Planning and Technology* 31(5): 509–523. https://doi.org/10.1080/03081060802364471.

ECA. 2020. “Sustainable Urban Mobility in the EU: No Substantial Improvement Is Possible without Member States’ Commitment.” https://www.eca.europa.eu/Lists/ECADocuments/SR20_06/SR_Sustainable_Urban_Mobility_EN.pdf%0Ahttps://op.europa.eu/webpub/eca/special-reports/urban-mobility-6-2020/en/.

EEA. 2022. “Air Quality in Europe 2022.” https://www.eea.europa.eu/en/analysis/publications/air-quality-in-europe-2022.

Elias, Wafa, Yoram Shiftan. 2012. “The Influence of Individual’s Risk Perception and Attitudes on Travel Behavior.” *Transportation Research Part A: Policy and Practice* 46(8): 1241–1251. https://doi.org/https://doi.org/10.1016/j.tra.2012.05.013.

EMTA. 2019. “A Perspective on MaaS from Europe’s Metropolitan Transport Authorities.” https://www.emta.com/wp-content/uploads/2022/01/emta_-_maaspaper.pdf.

Eriksson Lars, Margareta Friman, Tommy Gärling. 2008. “Stated Reasons for Reducing Work-Commute by Car.” *Transportation Research Part F: Traffic Psychology and Behaviour* 11(6): 427–433. https://doi.org/https://doi.org/10.1016/j.trf.2008.04.001.

Fernández J. Enrique, Juan Carlos Muñoz. 2007. “Privatisation and Deregulation of Urban Bus Services: An Analysis of Fare Evolution Mechanisms.” *Journal of Transport Economics and Policy* 41(1): 25–49.

Fiorio Carlo V., Marco Percoco. 2007. “Would You Stick To Using Your Car Even If Charged? Evidence from Trento, Italy.” *Transport Reviews* 27(5): 605–620. https://doi.org/10.1080/01441640701322727.

Foote Peter J. 2004. “Making Buses Better in Chicago: Strategic Implementation of Customer-Derived Performance Measures from 1995 to 2001.” *Transportation Research Record* 1884(1): 18–26. https://doi.org/10.3141/1884-03.

Fransen Koos, Tijs Neutens, Steven Farber, Philippe De Maeyer, Greet Deruyter, Frank Witlox. 2015. “Identifying Public Transport Gaps Using Time-Dependent Accessibility Levels.” *Journal of Transport Geography* 48: 176–187. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2015.09.008.

freepublictransport. 2013. “Hasselt.” 2013. https://freepublictransport.info/city/hasselt/.

Freepublictransport.Info. 2020. https://freepublictransport.info/city/.

Friman Margareta. 2004. “Implementing Quality Improvements in Public Transport.” *Journal of Public Transportation* 7(4): 49–65. https://doi.org/https://doi.org/10.5038/2375-0901.7.4.3.

Friman Margareta, Markus Fellesson. 2009. “Service Supply and Customer Satisfaction in Public Transportation: The Quality Paradox.” *Journal of Public Transportation* 12(4): 57–69. https://doi.org/10.5038/2375-0901.12.4.4.

Fujii Satoshi, Ryuichi Kitamura. 2003. “What Does a One-Month Free Bus Ticket Do to Habitual Drivers? An Experimental Analysis of Habit and Attitude Change.” *Transportation* 30(1): 81–95. https://doi.org/10.1023/A:1021234607980.

Gadzinski Jedrzej, Michal Beim. 2010. “Public Transport Accessibility in Poznan.” *Real Corp 2010: Cities for Everyone*, May: 18–20.

Gadziński Jędrzej, Ewa Goras (eds.). 2019. *Raport o stanie polskich miast. Transport i mobilność miejska*. Warszawa: Instytut Rozwoju Miast i Regionów. www.bymouse.pl.

Gallez Caroline, Vincent Kaufmann, Hanja Maksim, Mariane Thebért, Christophe Guerrinha. 2013. “Coordinating Transport and Urban Planning: From Ideologies to Local Realities.” *European Planning Studies* 21(8): 1235–1255. https://doi.org/10.1080/09654313.2012.722945.

Gallo Mariano, Mario Marinelli. 2020. “Sustainable Mobility: A Review of Possible Actions and Policies.” *Sustainability (Switzerland)* 12(18): 7499. https://doi.org/10.3390/su12187499.

Gardner Benjamin. 2009. “Modelling Motivation and Habit in Stable Travel Mode Contexts.” *Transportation Research Part F: Traffic Psychology and Behaviour* 12(1): 68–76. https://doi.org/10.1016/j.trf.2008.08.001.

George Darren, Paul Mallery. 2021. *IBM SPSS Statistics 27 Step by Step: A Simple Guide and Reference*. New York: Routledge. https://books.google.pl/books?id=g_mAzgEACAAJ.

Górny Agata, Sabina Torunczyk-Ruiz. 2011. “Czy można połączyć ilość z jakością? Możliwości i bariery podejścia ilościowego w badaniach integracji migrantów w Polsce.” *Studia Migracyjne – Przeglad Polonijny* 37(2): 41–58. http://yadda.icm.edu.pl/yadda/element/bwmeta1.element.cejsh-59354bba-0710-4b67-836f-0b9c6838ed76?q=bwmeta1.element.cejsh-e59be621-d630-417b-897c-12b5ef30ed35;1&qt=CHILDREN-STATELESS.

Green Paper on the Impact of Transport on the Environment. A Community Strategy for ‘Sustainable Mobility’, COM(92) 46 final. 20.02.1992.

Gruyter Chris De, Seyed Mojib Zahraee, William Young. 2022. “Understanding the Allocation and Use of Street Space in Areas of High People Activity.” *Journal of Transport Geography* 101: 1–14. https://doi.org/10.1016/j.jtrangeo.2022.103339.

Grzelec Krzysztof. 1997. “Badania marketingowe jako podstawa kształtowania systemów taryfowych w komunikacji miejskiej.” *Biuletyn Komunikacji Miejskiej* 38: 4–8.

———. 2011. “Zarząd Transportu Miejskiego – zarządzanie czy administrowanie?” *Przegląd Komunikacyjny* 5–6: 30–33.

———. 2013a. “Badania marketingowe jako podstawa rozliczeń w ramach umów powierzenia w komunikacji miejskiej.” In *Komisja Transportu Związku Miast Polskich*, 1–6.

———. 2013b. *Funkcjonowanie transportu miejskiegow warunkach konkurencji regulowanej*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.

Grzelec Krzysztof, Katarzyna Hebel, Romanika Okraszewska, Olgierd Wyszomirski. 2023. “Effects of the Covid-19 Travel Restrictions on Metropolises Mobility: Empirical Evidence from the Tricity Metropolis (Poland).” *Prace Komisji Geografii Komunikacji PTG* 26(1): 52–68. https://doi.org/10.4467/2543859xpkg.23.004.17401.

Grzelec Krzysztof, Katarzyna Hebel, Olgierd Wyszomirski. 2020. *Zarządzanie transportem miejskim w warunkach polityki zrównoważonej mobilności*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.

Grzelec Krzysztof, Dominik Okrój. 2016. "Perspektywy obsługi miast autobusami elektrycznymi na przykładzie Sopotu." *Autobusy* 11: 26–32.

Hair Joseph F., Mary Wolfinbarger Celsi, David J. Ortinau, Robert P. Bush. 2013. *Essentials of Marketing Research*. Vol. 12. New York: McGraw-Hill/Irwin.

Handy Susan, Lisa Weston, Patricia L. Mokhtarian. 2005. "Driving by Choice or Necessity?" *Transportation Research Part A: Policy and Practice* 39(2–3): 183–203. https://doi.org/10.1016/j.tra.2004.09.002.

Haustein Sonja, Anu Siren. 2015. "Older People's Mobility: Segments, Factors, Trends." *Transport Reviews* 35(4): 466–487. https://doi.org/10.1080/01441647.2015.1017867.

Hebel Katarzyna. 2013. *Zachowania transportowe mieszkańców miast w kształtowaniu transportu miejskiego*. Gdańsk: Fundacja Rozwoju Uniwersytetu Gdańskiego.

Helbin Maciej, Marcin Wołek, Olgierd Wyszomirski. 2015. "Uwarunkowania reprezentatywności badań marketingowych preferencji i zachowań transportowych mieszkańców na przykładzie Gdyni." *Transport Miejski i Regionalny* 33(5): 15–20.

Henderson Jason. 2020. "EVs Are Not the Answer: A Mobility Justice Critique of Electric Vehicle Transitions." *Annals of the American Association of Geographers* 110(6): 1993–2010. https://doi.org/10.1080/24694452.2020.1744422.

Hensher David A., Corinne Mulley, Norhayati Yahya. 2010. "Passenger Experience with Quality-Enhanced Bus Service: The Tyne and Wear 'superoute' Services." *Transportation* 37(2): 239–256. https://doi.org/10.1007/s11116-009-9240-x.

Hensher David A., John M. Rose, William H. Greene. 2005. *Applied Choice Analysis: A Primer*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511610356.

Hensher David A., Peter Stopher, Philip Bullock. 2003. "Service Quality – Developing a Service Quality Index in the Provision of Commercial Bus Contracts." *Transportation Research Part A: Policy and Practice* 37(6): 499–517. https://doi.org/10.1016/S0965-8564(02)00075-7.

Holden Erling, David Banister, Stefan Gössling, Geoffrey Gilpin, Kristin Linnerud. 2020. "Grand Narratives for Sustainable Mobility: A Conceptual Review." *Energy Research & Social Science* 65: 101454. https://doi.org/https://doi.org/10.1016/j.erss.2020.101454.

Holve Vanessa. 2023. "Planning for Attractive Public Transport." European Platform on Sustainable Urban Mobility Plans. https://www.sptm.si/application/files/9416/6626/9866/sump_topic_guide_planning_for_attractive_public_transport.pdf.

Hrelja Robert, Jamil Khan, Fredrik Pettersson. 2020. "How to Create Efficient Public Transport Systems? A Systematic Review of Critical Problems and Approaches for Addressing the Problems." *Transport Policy* 98: 186–196. https://doi.org/https://doi.org/10.1016/j.tranpol.2019.10.012.

Hulten Michel van. 2015. "Free Fare Public Transport (FFPT) Futures? We Go One Wayor Another Way?". https://freepublictransport.info/wp-content/uploads/sites/7/2015/07/Fare_Free_Public_Transport_Dr_Michel_van_Hulten.pdf.

Hunkin Simon, Katharina Krell. 2020. "Improving the Convenience of Public Transport A Policy Brief from the Policy Learning Platform on Low-Carbon Economy." *European Union Regional Development Fund*. https://www.interregeurope.eu/sites/default/files/inline/Public_Transport_TO4PB_final.pdf.

IGKM. 2023. "Komunikacja miejska w liczbach. Dane za 2022 r. i 2023 r." Warszawa.

Jabkowski Piotr. 2015. *Reprezentatywność badań reprezentatywnych: analiza wybranych problemów metodologicznych oraz praktycznych w paradygmacie całkowitego błędu pomiaru*. Poznań: Wydawnictwo Naukowe Uniwersytetu im. Adama Mickiewicza.

Jagiełło Aleksander. 2021. *Elektromobilnosć w kształtowaniu rozwoju drogowego transportu miejskiego w Polsce*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.

Jain Suresh, Preeti Aggarwal, Prashant Kumar, Shaleen Singhal, Prateek Sharma. 2014. "Identifying Public Preferences Using Multi-Criteria Decision Making for Assessing the Shift of Urban Commuters from Private to Public Transport: A Case Study of Delhi." *Transportation Research Part F: Traffic Psychology and Behaviour* 24: 60–70. https://doi.org/https://doi.org/10.1016/j.trf.2014.03.007.

Jastrzębski Wacław. 2014. "Dylematy i błędy w modelach i prognozach ruchu." *Zeszyty Naukowo-Techniczne SITK w Krakowie* 1(103): 137–164.

Johnson Daniel, Marco Ercolani, Peter Mackie. 2017. "Econometric Analysis of the Link between Public Transport Accessibility and Employment." *Transport Policy* 60: 1–9. https://doi.org/10.1016/j.tranpol.2017.08.001.

Jones Peter, Karen Lucas. 2012. "The Social Consequences of Transport Decision-Making: Clarifying Concepts, Synthesising Knowledge and Assessing Implications." *Journal of Transport Geography* 21: 4–16. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2012.01.012.

Jørgensen Finn, John M Preston. 2007. "The Relationship between Fare and Travel Distance – Some Comments." *Journal of Transport Economics and Policy* 41(3): 451–468.

Kąciak Eugeniusz. 2011. *Teoria środków-celów w segmentacji rynku. Studium metodologiczno-empiryczne*. Warszawa: Oficyna a Wolters Kluwer business. https://repozytorium.kozminski.edu.pl/system/files/Kaciak_Teoria srodkow-celow.pdf.

Kaczmarczyk Stanisław. 2002. *Badania marketingowe. Metody i techniki*. Warszawa: Polskie Wydawnictwo Ekonomiczne.

———. 2009. *Badania marketingowe*. Warszawa: Polskie Wydawnictwo Ekonomiczne.

Karkut Dominika. 2019. "Ocena efektywności wprowadzenia wybranych buspasów w Gdyni." In *V Krakowska Ogólnopolska Konferencja Naukowa Transportu „KOKONAT"*, 8. Kraków: Koło Naukowe Systemów Komunikacyjnych Politechniki Krakowskiej im. T. Kościuszki.

Karoń Grzegorz, Grzegorz Krawczyk, Anna Urbanek, Jerzy Mikulski. 2017. "Sustainable Urban Mobility Planning (SUMP) at Subregional Area Level with the Use of Transportation Model." *Archives of Transport System Telematics*, 10(2): 19–26. https://yadda.icm.edu.pl/baztech/element/bwmeta1.element.baztech-524373ae-3349-408c-ab01-2316da298f6b.

KBR. 2022. "Gdańskie badania ruchu 2022. Raport 3a." Gdańsk.

Kemp René, Saeed Parto, Robert B Gibson. 2005. "Governance for Sustainable Development: Moving from Theory to Practice." *International Journal of Sustainable Development* 8(1–2): 12–30.

Kennedy Christopher, Eric Miller, Amer Shalaby, Heather MacLean, Jesse Coleman. 2005. "The Four Pillars of Sustainable Urban Transportation." *Transport Reviews* 25(4): 393–414. https://doi.org/10.1080/01441640500115835.

Kenworthy Jeffrey R., Felix Laube. 2001. *The Millennium Cities Database for Sustainable Transport: Urban transport, land use, infrastructure, economic and environmental indicators for 100 international cities* [CD-ROM]. Brussels: International Association of Public Transport (UITP) / Institute for Sustainability and Technology Policy (ISTP), Murdoch University.

Kębłowski Wojciech. 2018. "Fare-Free Public Transport in Chengdu: Riding For Free in a Chinese Metropolis." In *Free Public Transit: And Why We Don't Pay to Ride Elevators*. Eds. Jason Prince, Judith Dellheim, 215–221. Québec: Black Rose Books.

Komunikat Komisji do Parlamentu Europejskiego, Rady, Europejskiego Komitetu Ekonomiczno-Społecznego i Komitetu Regionów. Strategia na rzecz zrównoważonej i inteligentnej mobilności – europejski transport na drodze ku przyszłości. 9.12.2020. COM(2020) 789 final. https://eur-lex.europa.eu/legal-content/PL/TXT/HTML/?uri=CELEX:52020DC0789.

Kostakis Arris-Panagiotis, Ipsilandis Pandelis. 2009. "Measuring Customer Satisfaction in Public Transportation An Empirical Study Based in Urban Buses in the City of Larissa (Greece) 'The MUSA Methodology.'" https://api.semanticscholar.org/CorpusID:16732524.

Kovács Roland, László Nádai, Gábor Horváth. 2008. "Automatic Passenger Counting System for Trams." In *15th World Congress on Intelligent Transport Systems and ITS America's 2008 Annual Meeting*. [s.l.], [s.n.].

Krähmer Karl. 2021. "Are Green Cities Sustainable? A Degrowth Critique of Sustainable Urban Development in Copenhagen." *European Planning Studies* 29(7): 1272–1289. https://doi.org/10.1080/09654313.2020.1841119.

Krych Andrzej. 2024. "Transport publiczny a przesunięcie modalne. Rozważania o strategii, planowaniu i metodzie." *Transport Miejski i Regionalny* 9: 3–16.

Lam Debra, Peter Head. 2012. "Sustainable Urban Mobility." In *Energy, Transport, & the Environment*. Eds. Oliver Inderwildi, Sir David King. 359–371. London: Springer. https://doi.org/10.1007/978-1-4471-2717-8_19.

Lättman Katrin, Margareta Friman, Lars E. Olsson. 2016. "Perceived Accessibility of Public Transport as a Potential Indicator of Social Inclusion." *Social Inclusion* 4(3): 36–45. https://doi.org/10.17645/si.v4i3.481.

Lebedeva Olga, Alexander Mikhailov. 2017. "Model of Passenger Counting System Data Treatment." *Transportation Research Procedia* 20: 401–405. https://doi.org/10.1016/j.trpro.2017.01.065.

Lee Sujin, Jinwoo Lee, Suzanne Hiemstra van Mastrigt, Euiyoung Kim. 2022. "What Cities Have Is How People Travel: Conceptualizing a Data-Mining-Driven Modal Split Framework." *Cities* 131 (August): 103902. https://doi.org/10.1016/j.cities.2022.103902.

Leurent Fabien, Edwin Rualès, Rémy Le Boennec. 2024. „On the ratios of urban mobility, Part 2: Is street space a scarce resource for urban transportation? Physical model and a tale of five cities in France." hal-04393899.

Levinson Herbert, Samuel Zimmerman, Jennifer Clinger, Scott Rutherford, Rodney L. Smith, John Cracknell, Richard Soberman. 2003. *Bus Rapid Transit. Transit Cooperative Research Program. Report 90*. Vol. 1: *Case Studies in Bus Rapid Transit*. Washington. [s.n.].

Li Feng, Fu-Wei Yang, Hai-Wei Liang, Wen-Ming Yang. 2017. "Automatic Passenger Counting System for Bus Based on RGB-D Video." In Guo-Quan Weng, Xin-Hua Zheng, Yu-Bin Zhang, *Proceedings of the 2nd Annual International Conference on Electronics, Electrical Engineering and Information Science (EEEIS 2016)*. [s.l.]. Atlantis Press. https://doi.org/10.2991/eeeis-16.2017.29.

Litman Todd. 2004. "Transit Price Elasticities and Cross – Elasticities." *Journal of Public Transportation* 7(2): 37–58. https://doi.org/10.5038/2375-0901.7.2.3.

———. 2021. "Well Measured-Developing Indicators for Sustainable and Livable Transport Planning. 28 March 2025." https://www.vtpi.org/wellmeas.pdf.

Liyanage Sohani, Hussein Dia, Rusul Abduljabbar, Saeed A. Bagloee. 2019. "Flexible Mobility On-Demand: An Environmental Scan." *Sustainability* 11(5): 1262. https://doi.org/10.3390/su11051262.

Loukaitou-Sideris Anastasia. 2014. "Fear and Safety in Transit Environments from the Women's Perspective." *Security Journal* 27: 242–256.

Louviere Jordan, Harry Timmermans. 1990. "Hierarchical Information Integration Applied to Residential Choice Behavior." *Geographical Analysis* 22 (2): 127–144.

Lunani Keshav, Vinod Vasudevan, Vimal Kumar. 2022. "People's Preferences for Improvements in Public Transportation Systems: An Experience from India." *Transportation in Developing Economies* 8(2): 1–12. https://doi.org/10.1007/s40890-022-00155-6.

Mackie Peter, John Preston, Chris Nash. 1995. "Bus Deregulation: Ten Years On." *Transport Reviews* 15(3): 229–251. https://doi.org/10.1080/01441649508716914.

Manski Charles F. 2000. “Economic Analysis of Social Interactions.” *Journal of Economic Perspectives* 14(3): 115–136. https://doi.org/10.1257/jep.14.3.115.

Manville Michael, Brian Taylor, Evelyn Blumenberg. 2018. “Falling Transit Ridership: California and Southern California.” *Its Ucla*, 1–30. https://www.scag.ca.gov/Documents/ITS_SCAG_Transit_Ridership.pdf.

Matyas Melinda. 2020. “Opportunities and Barriers to Multimodal Cities: Lessons Learned from in-Depth Interviews about Attitudes towards Mobility as a Service.” *European Transport Research Review* 12(1): 7. https://doi.org/10.1186/s12544-020-0395-z.

Meissonnier Joël, Cyprien Richer. 2021. “Rush Hour. Why despite Flexible Working Workers Resist Change?” *Applied Mobilities* 7 (January): 1–13. https://doi.org/10.1080/23800127.2020.1860512.

Mendryk Aleksandra. 2013. “Modelowe ujęcie strategii marketingowej przedsiębiorstw organizujących usługi przewozowe na rynku transportu miejskiego w Polsce”. *Transport Miejski i Regionalny* 10: 30–37.

Miller Harvey. 2007. “Place-Based versus People-Based Geographic Information Science.” *Geography Compass* 1(3): 503–535. https://doi.org/10.1111/j.1749-8198.2007.00025.x.

Mills Gareth, Peter White. 2018. “Evaluating the Long-Term Impacts of Bus-Based Park and Ride.” *Research in Transportation Economics* 69: 536–543. https://doi.org/https://doi.org/10.1016/j.retrec.2018.07.028.

Mohring Herbert. 1972. “Optimization and Scale Economies in Urban Bus Transportation.” *American Economic Review* 62(4): 591–604.

Monkelbaan Joachim. 2019. “Overview of Governance Theories That Are Relevant for the SDGs.” In *Governance for the Sustainable Development Goals. Sustainable Development Goals Series*. 21–48. Singapore: Springer. https://doi.org/10.1007/978-981-13-0475-0_2.

Moszoro Marian. 2010. *Public-Private Partnerships in the Utilities Sector*. *Economic Policy*. Warsaw: SGH Warsaw School of Economics.

Mościcka Albina, Krzysztof Pokonieczny, Anna Wilbik, Jakub Wabíński. 2019. “Transport Accessibility of Warsaw: A Case Study.” *Sustainability (Switzerland)* 11(19): 1–21. https://doi.org/10.3390/su11195536.

Mugion Roberta Guglielmetti, Martina Toni, Hendry Raharjo, Laura Di Pietro, Samuel Petros Sebathu. 2018. “Does the Service Quality of Urban Public Transport Enhance Sustainable Mobility?” *Journal of Cleaner Production* 174: 1566–1587. https://doi.org/https://doi.org/10.1016/j.jclepro.2017.11.052.

Mukherjee Satarupa, Iqbal Jamal, Richard Leclerc, Nilanjan Ray. 2011. “Anovel Framework for Automatic Passenger Couting.” In *2011 18th IEEE International Conference on Image Processing*. 2969–2972. Brussels. Belgium. doi: 10.1109/ICIP.2011.6116284

Munch Emmanuel, Laurent Proulhac. 2023. “Is Work Hours’ Flexibility Really a Solution to Morning Peak Period Congestion? Comparative Analysis between Paris and San Francisco.” *Journal of Transport Geography* 113: 103712. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2023.103712.

Myrvoll Tor A., Jan E. Håkegård, Tomoko Matsui, François Septier. 2018. "Counting Public Transport Passenger Using WiFi Signatures of Mobile Devices." In *2017 IEEE 20th International Conference on Intelligent Transportation Systems, Proceedings, ITSC*. 1–6. Yokohama, Japan. https://doi.org/10.1109/ITSC.2017.8317687.

MZKZG. 2018. "Preferencje i zachowania komunikacyjne mieszkańców Sopotu w 2018 r." Sopot.

———. 2023. "Preferencje i zachowania komunikacyjne mieszkańców Rumi."

———. 2024. "Preferencje i zachowania komunikacyjne mieszkańców Kosakowa. Raport 2023 r."

Nakamura Kazuki, Yoshitsugu Hayashi. 2013. "Strategies and Instruments for Low-Carbon Urban Transport: An International Review on Trends and Effects." *Transport Policy* 29: 264–274. https://doi.org/https://doi.org/10.1016/j.tranpol.2012.07.003.

Newman Peter, Jeffrey Kenworthy. 1999. *Sustainability and Cities: Overcoming Automobile Dependence*. Washington: Island Press.

Nijkamp Peter, Karima Kourtit. 2013. "The 'New Urban Europe': Global Challenges and Local Responses in the Urban Century." *European Planning Studies* 21(3): 291–315. https://doi.org/10.1080/09654313.2012.716243.

Nosal Katarzyna, Wiesław Starowicz. 2010. "Wybrane Zagadnienia Zarządzania Mobilnością." *Transport Miejski i Regionalny* 3: 26–31.

Nurvala Juha-Pekka. 2015. "'Uberisation' Is the Future of the Digitalised Labour Market." *European View* 14(2). https://doi.org/10.1007/s12290-015-0378-y.

Oliver Richard L. 1997. *Satisfaction: A Behavioral Perspective on the Consumer*. McGaw-Hill Series in Marketing. New York: McGraw-Hill.

Oña Juan De, Rocio De Oña. 2014. "Quality of Service in Public Transport Based on Customer Satisfaction Surveys: A Review and Assessment of Methodological Approaches." *Transportation Science* 49 (December). https://doi.org/10.1287/trsc.2014.0544.

Oña Juan De, Rocío de Oña, Laura Eboli, Gabriella Mazzulla. 2013. "Perceived Service Quality in Bus Transit Service: A Structural Equation Approach." *Transport Policy* 29: 219–226. https://doi.org/https://doi.org/10.1016/j.tranpol.2013.07.001.

———. 2016. "Index Numbers for Monitoring Transit Service Quality." *Transportation Research Part A: Policy and Practice* 84: 18–30. https://doi.org/https://doi.org/10.1016/j.tra.2015.05.018.

Oskarbski Jacek. 2020. "Modele ruchu w nowoczesnym zarządzaniu transportem drogowym." *Transport Miejski i Regionalny* 6: 11–19.

Ozbay Kaan, Duygu Ozmen, Joseph Berechman. 2006. "Modeling and Analysis of the Link between Accessibility and Employment Growth." *Journal of Transportation Engineering* 132(5): 385–393. https://doi.org/10.1061/(ASCE)0733-947X(2006)132:5(385).

Páez Antonio, Kate Whalen. 2010. “Enjoyment of Commute: A Comparison of Different Transportation Modes.” *Transportation Research Part A: Policy and Practice* 44(7): 537–549. https://doi.org/https://doi.org/10.1016/j.tra.2010.04.003.

Pakoński Krzysztof. 2001. *Zintegrowane zarządzanie finansami zorientowane na cele*. Series Zintegrowane Zarządzanie Finansami. T. 1. Warszawa: Municipium. https://books.google.pl/books?id=D8GYygAACAAJ.

Paprocki Wojciech. 2018. “Granice możliwości oraz wymogi efektywności w nowych koncepcjach mobilności.” In *Mobilność w aglomeracjach przyszłości*. Eds. Jerzy Gajewski, Wojciech Paprocki, Jana Pieregut. 208–222. Sopot: Centrum Myśli Strategicznych.

Parham Susan, Alasdair Jones. 2020. “Exploring Sustainable Urbanism in Masterplanned Developments: A Collective Case Study of Slippage between Principles, Policies, and Practices.” *Journal of Urbanism* 14(1): 97–124. https://doi.org/10.1080/17549175.2020.1793802.

Parkan Celik. 2002. “Measuring the Operational Performance of a Public Transit Company.” *International Journal of Operations & Production Management* 22(6): 693–720. https://doi.org/10.1108/01443570210427695.

Parkhurst Graham, Francesca Kenny, Phil Goodwin. 1992. *Quality Attributes of a Journey: Their Identification and Impact on Travellers. Report to Department of Transport*. 7–57. University of Oxford. https://uwe-repository.worktribe.com/OutputFile/1110239.

Paulssen Marcel, Dirk Temme, Akshay Vij, Joan L Walker. 2014. “Values, Attitudes and Travel Behavior: A Hierarchical Latent Variable Mixed Logit Model of Travel Mode Choice.” *Transportation* 41(4): 873–888. https://doi.org/10.1007/s11116-013-9504-3.

Pedersen Pål Andreas. 2003. “On the Optimal Fare Policies in Urban Transportation.” *Transportation Research Part B: Methodological* 37(5): 423–435. https://doi.org/https://doi.org/10.1016/S0191-2615(02)00022-X.

Peek Gert Joost, Mark Van Hagen. 2002. “Creating Synergy in and around Stations: Three Strategies for Adding Value.” *Transportation Research Record* 1793(1): 1–6. https://doi.org/10.3141/1793-01.

Pilko Hrvoje, Krunoslav Tepeš, Tadej Brezina. 2015. “Policy and Programs for Cycling in the City of Zagreb – A Critical Review.” *Promet – Traffic and Transportation* 25(5): 405–415. https://doi.org/10.7307/ptt.v27i5.1694.

Polat Cihat. 2012. “The Demand Determinants for Urban Public Transport Services: A Review of the Literature.” *Journal of Applied Sciences* 12(12): 1211–1231. https://doi.org/10.3923/jas.2012.1211.1231.

Polis. 2017. “Mobility As a Service: Implications for Urban And.” September. Brussels. https://www.polisnetwork.eu/document/mobility-as-a-service-implications-for-urban-and-regional-transport/.

Pousin Frédéric. 2005. “«La forme et le flux. Figures urbaines et architecturales de la mobilité» Compte rendu d’une note du centre de prospective et de veille scientifique.” *Natures Scienes Société* 13: 208–210.

"Preferencje i zachowania komunikacyjne mieszkańców Gdyni w 2018 r." 2019. Gdynia.

"Preferencje i zachowania komunikacyjne mieszkańców Sopotu w 2024 r." 2024. Gdańsk.

Preston John. 1999. "An Overview of Public Transport in the United Kingdom And Forecasts for the new Millenium." In *Sixth International Conference on Competition and Ownership in Land Passenger Transport, Cape Town, South Africa. Plenary Session. 20 September 1999*. 1–23. University of Sydney.

Pucher John, Hyungyong Park, Mook Han Kim, Jumin Song. 2005. "Public Transport Reforms in Seoul: Innovations Motivated by Funding Crisis." *Journal of Public Transportation* 8(5): 41–62. https://doi.org/https://doi.org/10.5038/2375-0901.8.5.3.

Redman Lauren, Margareta Friman, Tommy Gärling, Terry Hartig. 2013. "Quality Attributes of Public Transport That Attract Car Users: A Research Review." *Transport Policy* 25 (January): 119–127. https://doi.org/10.1016/j.tranpol.2012.11.005.

Reeven Peran van. 2008. "Subsidisation of Urban Public Transport and the Mohring Effect." *Journal of Transport Economics and Policy* 42(2): 349–359.

Reinsel David, John Gantz, John Rydning. 2017. "Data Age 2025: The Evolution of Data to Life-Critical." *IDC White Paper.* http://www.seagate.com/www-content/our-story/trends/files/Seagate-WP-DataAge2025-March-2017.pdf.

Ricci Andrea, 2003. Urban Transport Pricing. Discussion Paper Istituto di Studi per l'Integrazione dei Sistemi 3. Roma: Istituto di Studi per l'Integrazione dei Sistemi.

Rietveld Piet. 2005. "Six Reasons Why Supply-Oriented Indicators Systematically Overestimate Service Quality in Public Transport." *Transport Reviews* 25(3): 319–328. https://doi.org/10.1080/0144164042000335814.

Rokicka Ewa (ed.). 2013. *Jakość życia mieszkańców Łodzi i jej przestrzenne zróżnicowanie (Quality of Life of the Citizens of Łódź and Its Spatial Diversification – in Polish).* Łódź: Wydawnictwo Uniwersytetu Łódzkiego.

Rosetti Manuel. 2000. "Design of an Integrated Transit Monitoring System Based on Radio Frequency Identification." *International Journal of Services Technology and Management* 1(2/3): 188–204. https://doi.org/10.1504/IJSTM.2000.001572.

Rudnicki Andrzej. 1999. *Jakość komunikacji miejskiej*. Kraków: SITK.

———. 2010. "Zrównoważona mobilność a rozwój przestrzenny miasta." *Czasopismo Techniczne. Architektura* 107(1-A): 57–74.

Saliara Klotildi. 2014. "Public Transport Integration: The Case Study of Thessaloniki, Greece." *Transportation Research Procedia* 4: 535–552. https://doi.org/https://doi.org/10.1016/j.trpro.2014.11.041.

Sambor Andrzej. 1999. *Priorytety w ruchu dla pojazdów komunikacji miejskiej*. Warszawa: IGKM.

Sanchez Thomas W., Qing Shen, Zhong-Ren Peng. 2004. "Transit Mobility, Jobs Access and Low-Income Labour Participation in US Metropolitan Areas." *Urban Studies* 41(7): 1313–1331. https://doi.org/10.1080/0042098042000214815.

Santos Georgina, Hanna Maoh, Dimitris Potoglou, Thomas von Brunn. 2013. "Factors Influencing Modal Split of Commuting Journeys in Medium-Size European Cities." *Journal of Transport Geography* 30: 127–137. https://doi.org/10.1016/j.jtrangeo.2013.04.005.

Sargious Michel Amin, Natarajan Janarthanan. 2011. "Forecasting Demand for the Park-and-Ride Mode and Determining the Optimal Location of Stations." *Canadian Journal of Civil Engineering* 10 (February): 695–702. https://doi.org/10.1139/l83-098.

Savage Ian. 1993. "Deregulation and Privatization of Britain's Local Bus Industry." *Journal of Regulatory Economics* 5(2): 143–158. https://doi.org/10.1007/BF01065363.

Scheiner Joachim. 2010. "Interrelations between Travel Mode Choice and Trip Distance: Trends in Germany 1976–2002." *Journal of Transport Geography* 18(1): 75–84. https://doi.org/10.1016/j.jtrangeo.2009.01.001.

Schneider Benjamin, Susan S. White. 2004. *Service Quality: Research Perspectives*. Thousand Oaks: Sage Publications.

Schneider François, Giorgos Kallis, Joan Martinez-Alier. 2010. "Crisis or Opportunity? Economic Degrowth for Social Equity and Ecological Sustainability. Introduction to This Special Issue." *Journal of Cleaner Production* 18(6): 511–518. https://doi.org/https://doi.org/10.1016/j.jclepro.2010.01.014.

Schwartz Shalom H. 1992. "Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries." In *Advances in Experimental Social Psychology*. 25. Ed. Mark P. Zanna. 1–65. London: Academic Press. https://doi.org/https://doi.org/10.1016/S0065-2601(08)60281-6.

Scruton, Roger. 2012. *Green Philosophy. How to Think Seriously about the Planet*. New York: Atlantic Book.

Sen Akshaya K., Geetam Tiwari, Vrajaindra Upadhyay. 2007. "Should Bus Commuting Be Subsidized for Providing Quality Transport Services? – A Case for Delhi." *Sadhana – Academy Proceedings in Engineering Sciences* 32(4): 329–345. https://doi.org/10.1007/s12046-007-0028-4.

Shiftan Yoram, Harry Geerling, Dominic Stead. 2012. *Transition towards Sustainable Mobility: The Role of Instruments, Individuals and Institutions*. London: Routledge. https://doi.org/https://doi.org/10.4324/9781315549996.

Siemer Anna R., Jefferson K. Rajah. 2024. "The Modeling Public Transportation Attractiveness in System Dynamics: The Significance of Safety Perception." In *International System Dynamics Conference 2023, Chicago, July*. 23–27. https://www.researchgate.net/publication/377702997_Modeling_Public_Transportation_Attractiveness_in_System_Dynamics_The_Significance_of_Safety_Perception.

Sierpiński Grzegorz. 2016. "Ocena systemu transportowego oraz preferencje osób podróżujących, jako wsparcie kształtowania podziału zadań przewozowych – studium przypadku dla konurbacji górnośląskiej." *Prace Naukowe Politechniki Warszawskiej. Transport* 111: 487–499.

Siripipatthanakul Supaprawa, Pattanapong Chana. 2021. "Service Marketing Mix (7Ps) and Patient Satisfaction in Clinics: A Review Article." *International of Trend in Scientific Research and Development*, 5(5): 842–850. https://www.researchgate.net/profile/Supaprawat-Siripipatthanakul-2/publication/353444465_Service_Marketing_Mix_7Ps_and_Patient_Satisfaction_in_Clinics_A_Review_Article_of_the_Creative_Commons_Attribution_License_CC_BY_40/links/60fd32ad1e95fe241a886708/Se.

Sobański Krzysztof. 2000. "Systemy transportu zbiorowego w aglomeracjach kanadyjskich. Zasady funkcjonowania transportu publicznego w aglomeracji Vancouver." *Transport Miejski i Regionalny* 7–8: 33–36.

Spickermann Alexander, Volker Grienitz, Heiko A. von der Gracht. 2014. "Heading towards a Multimodal City of the Future?: Multi-Stakeholder Scenarios for Urban Mobility." *Technological Forecasting and Social Change* 89: 201–221. https://doi.org/https://doi.org/10.1016/j.techfore.2013.08.036.

Spirin Iosif, Dmitry Zavyalov, Nadezhda Zavyalova. 2016. "Globalization and Development of Sustainable Public Transport Systems." In *16th International Scientific Conference Globalization and Its Socio-Economic Consequences*, *University of Zilina, The Faculty of Operation and Economics of Transport and Communication, Department of Economics, 5th – 6th October*. https://www.researchgate.net/publication/335881616_GLOBALIZATION_AND_DEVELOPMENT_OF_SUSTAINABLE_PUBLIC_TRANSPORT_SYSTEMS.

Standing Craig, Susan Standing, Sharon Biermann. 2019. "The Implications of the Sharing Economy for Transport." *Transport Reviews* 39(2): 226–422. https://doi.org/10.1080/01441647.2018.1450307.

Starowicz Wiesław. 2001. *Kształtowanie jakości usług przewozowych w miejskim transporcie zbiorowym*. Szczecin: Wydawnictwo Naukowe Uniwersytetu Szczecińskiego.

Starowicz Wiesław, Katarzyna Gretkowska. 2003. "Wyniki badań preferencji i ocen pasażerów w zakresie jakości komunikacji zbiorowej w Krakowie." *Transport Miejski i Regionalny* 7–8: 24–25.

Steg Linda. 2005. "Car Use: Lust and Must. Instrumental, Symbolic and Affective Motives for Car Use." *Transportation Research Part A: Policy and Practice* 39(2): 147–162. https://doi.org/https://doi.org/10.1016/j.tra.2004.07.001.

Storchmann Karl. 2003. "Externalities by Automobiles and Fare-Free Transit in Germany – A Paradigm Shift?" *Journal of Public Transportation* 6(4): 89–105. https://doi.org/10.5038/2375-0901.6.4.5.

Sukhov Alexandre, Lars E. Olsson, Margareta Friman. 2022. "Necessary and Sufficient Conditions for Attractive Public Transport: Combined Use of PLS-SEM and NCA." *Transportation Research Part A: Policy and Practice* 158 (March): 239–250. https://doi.org/10.1016/j.tra.2022.03.012.

Susilo Yusak O., Kees Maat. 2007. “The Influence of Built Environment to the Trends in Commuting Journeys in the Netherlands.” *Transportation* 34(5): 589–609. https://doi.org/10.1007/s11116-007-9129-5.

Suzuki Haruna, Satoshi Fujii, Tommy Gärling, Dick Ettema, Lars E. Olsson, Margareta Friman. 2014. “Rules for Aggregated Satisfaction with Work Commutes.” *Transportation* 41(3): 495–506. https://doi.org/10.1007/s11116-013-9484-3.

Szreder Mirosław. 2021. “Non-Random Errors and Their Importance in Testing of Hypotheses.” *Wiadomości Statystyczne. The Polish Statistician* 66(3): 7–21. https://doi.org/10.5604/01.3001.0014.7984.

Świder Jacek. 2024. “Estonia kończy z darmowym transportem. Podróżni wolą własne samochody.” Interia. 6.11. https://biznes.interia.pl/gospodarka/news-estonia-konczy-z-darmowym-transportem-podrozni-wola-wlasne-s,nld,7132185.

Thamizh Arasan V. Perumal Vedagiri. 2010. “Microsimulation Study of the Effect of Exclusive Bus Lanes on Heterogeneous Traffic Flow.” *Journal of Urban Planning and Development* 136(1): 50–58. https://doi.org/10.1061/(ASCE)0733-9488(2010)136:1(50).

Thevathasan Amirthalingam, Balasingham Balachandran. 2007. “Customers Perceptions of Metropolitan Train Services in Melbourne.” In *30th Australasian Transport Research Forum*. 1–15. Engineers Media.

Thoemmes Jens. 2015. “L’histoire oubliée des horaires individualisés: de la désynchronisation choisie à la flexibilité pour l’entreprise.” *Revue Française de Socio-Économie* 1(11): 35–53.

Thøgersen John. 2012. “The Importance of Timing for Breaking Commuters’ Car Driving Habits.” *COLLeGIUM: Studies Across Disciplines in the Humanities and Social Sciences* 12: 130–140.

Thøgersen John, Berit Møller. 2008. “Breaking Car Use Habits: The Effectiveness of a Free One-Month Travelcard.” *Transportation* 35(3): 329–345.

Thompson Edward P. 1967. “Time, Work-Discipline, and Industrial Capitalism.” *The Past and Present Society* 38: 56–97.

Tyler Nickolas. 2017. “Safety Accessibility and Sustainability: The Importance of Micro-Scale Outcomes to an Equitable Design of Transport Systems.” *IATSS Research* 41(2): 57–65. https://doi.org/https://doi.org/10.1016/j.iatssr.2017.06.002.

Tyrinopoulos Yannis, Constantinos Antoniou. 2008. “Public Transit User Satisfaction: Variability and Policy Implications.” *Transport Policy* 15(4): 260–272. https://doi.org/10.1016/j.tranpol.2008.06.002.

———. 2013. “Factors Affecting Modal Choice in Urban Mobility.” *European Transport Research Review* 5(1): 27–39. https://doi.org/10.1007/s12544-012-0088-3.

Ubbels Barry, Peter Nijkamp, Erik Verhoef, Steve Potter, Marcus Enoch. 2001. “Alternative Ways of Funding Public Transport A Case Study Assessment.” *European Journal of Transport and Infrastructure Research* 1(1): 73–89.

UITP. 2018. “Report. Artifical Intelligence In Mass Public Transport.” https://www.uitp.org/wp-content/uploads/sites/7/2025/04/AI_PT_ExecutiveSummary_UITP_APCTE.pdf.

Ulahannan Arun, Stewart Birrell. 2022. “Designing Better Public Transport: Understanding Mode Choice Preferences Following the COVID-19 Pandemic.” *Sustainability (Switzerland)* 14(10): 5952. https://doi.org/10.3390/su14105952.

Urbanek Anna. 2019. “Pomiar zrównoważonej mobilności miejskiej: przegląd badań.” *Studia i Prace Kolegium Zarządzania i Finansów*, 171: 61–80. https://doi.org/10.33119/sip.2019.171.4.

Vega Amaya. 2011. “A Multi-Modal Approach to Sustainable Accessibility: A Case Study for the City of Galway, Ireland.” In *Proceedings of the Irish Transport Research Network Annual Conference*. IRTN.

Vidovic Krešimir, Petar Colic, Saša Vojvodic, Anamarija Blavicki. 2022. “Methodology for Public Transport Mode Detection Using Telecom Big Data Sets: Case Study in Croatia.” *Transportation Research Procedia* 64(C): 76–83. https://doi.org/10.1016/j.trpro.2022.09.010.

Volinski Joel. 2012. *Implementation and Outcomes of Fare-Free Transit Systems. Transit Cooperative Research Program (TCRP) Synthesis 101*. *Transportation Research Board*. https://cvtdbus.org/wp-content/uploads/2018/09/2012-07-TCRP-fare-free-report.pdf.

Vos Jonas De. 2020. “The Effect of COVID-19 and Subsequent Social Distancing on Travel Behavior.” *Transportation Research Interdisciplinary Perspectives* 5. https://doi.org/10.1016/j.trip.2020.100121.

Waerden Peter van der, Emilie Couwenberg, Geert Wets. 2018. “Travelers’ Preferences Regarding the Interior of Public Buses: A Hierarchical Information Integration Approach.” *Public Transport* 10(3): 529–543. https://doi.org/10.1007/s12469-018-0189-z.

Walker Jarrett. 2009. “How Flexible Should Bus Service Be?” In *11th Conference on Competition and Ownership in Land Passenger Transport. Delft University of Technology (The Netherlands) 20–25 September*. https://ses.library.usyd.edu.au/bitstream/handle/2123/5924/4-05-088-2009-08-14-Walker-How-flexible-should-Bus-Service.pdf?sequence=1&isAllowed=y.

Walker Orville C., Robert W. Ruekert. 1987. “Marketing’s Role in the Implementation of Business Strategies: A Critical Review and Conceptual Framework.” *Journal of Marketing* 51(3): 15–33. https://doi.org/10.2307/1251645.

Wall Graham, Mike McDonald. 2007. “Improving Bus Service Quality and Information in Winchester.” *Transport Policy* 14(2): 165–179. https://doi.org/https://doi.org/10.1016/j.tranpol.2006.12.001.

Wallin Andreassen Tor. 1995. “(Dis)Satisfaction with Public Services: The Case of Public Transportation.” *Journal of Services Marketing* 9(5): 30–41. https://doi.org/10.1108/08876049510100290.

Wanner Thomas. 2015. “The New ‘Passive Revolution’ of the Green Economy and Growth Discourse: Maintaining the ‘Sustainable Development’ of Neoliberal Capitalism.” *New Political Economy* 20(1): 21–41. https://doi.org/10.1080/13563467.2013.866081.

Webster F. Vernon, Philip H. Bly. 1981. “The Demand for Public Transport.” *Transport Reviews* 1(4): 323–531. https://doi.org/10.1080/01441648108716470.

Weinberg Daniel H. 1979. “The Determinants of Intra-Urban Household Mobility.” *Regional Science and Urban Economics* 9(2): 219–246. https://doi.org/https://doi.org/10.1016/0166-0462(79)90014-0.

Weinstein Aaron. 2000. “Customer Satisfaction Among Transit Riders: How Customers Rank the Relative Importance of Various Service Attributes.” *Transportation Research Record* 1735(1): 123–132. https://doi.org/10.3141/1735-15.

Weitz Barton A., Harish Sujan, Mita Sujan. 1986. “Knowledge, Motivation, and Adaptive Behavior: A Framework for Improving Selling Effectiveness.” *Journal of Marketing* 50(4): 174–191. https://doi.org/10.2307/1251294.

Wesołowski Jacek. 2008. *Miasto w ruchu. Dobre praktyki w organizowaniu transportu miejskiego*. Łódź: Instytut Spraw Obywatelskich.

Wilson David. 1999. “‘Travel Card Work and Met Ticket Fail?’ Lessons in the Integration and Implementation of Transport Systems.” In *23rd Australasian Transport Research Forum, 29 September – 1 October*. 17–26. Perth, Western Australia.

Wiśniewski Jerzy. 2014. “Dylematy stosowania współczynnika korelacji Spearmana.” *Studia Ekonomiczne / Uniwersytet Ekonomiczny w Katowicach* 181: 174–84.

Wöhner Fabienne. 2022. “Work Flexibly, Travel Less? The Impact of Telework and Flextime on Mobility Behavior in Switzerland.” *Journal of Transport Geography* 102: 103390. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2022.103390.

Wolański Michał. 2011. *Efektywność ekonomiczna demonopolizacji komunikacji miejskiej w Polsce*. Warszawa: SGH Oficyna Wydawnicza.

———. 2022. *Skuteczność interwencji w zakresie mobilności miejskiej*. Warszawa: SGH Oficyna Wydawnicza.

Wolański Michał, Bartosz Jakubowski. 2014. “Metoda i projektowanie badań typu Integrated-Hierarchical Information Integration na potrzeby wyceny atrybutów jakościowych usługi transportowej.” *Transport Miejski i Regionalny* 3: 16–22.

Wołek Marcin. 2016. *Gdynia’s Sustainable Urban Mobility Plan (SUMP) and Its Development. Implementation Status Report G1.1*. https://www.mdpi.com/2071-1050/10/2/479/s1?version=1518349802.

Wójcik Szymon. 2019. “The Determinants of Travel Mode Choice: The Case of Łódź, Poland.” *Bulletin of Geography. Socio-Economic Series* 44: 93–101. https://doi.org/10.2478/bog-2019-0018.

Wyszomirski Olgierd. 1997. *Funkcjonowanie rynku komunikacji miejskiej*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.

Wyszomirski Olgierd (ed.). 2002. *Gospodarowanie w komunikacji miejskiej*. Gdańsk: Wydawnictwo Uniwersytetu Gdańkiego.

———. 2008. *Transport miejski. Ekonomika i organizacja*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.

Wyszomirski Olgierd, Krzysztof Grzelec. 1998. *Badania marketingowe w komunikacji miejskiej*. Warszawa: Izba Gospodarcza Komunikacji Miejskiej.

Yáñez Maria F., Sebastián Raveau, Juan de Dios Ortúzar. 2010. "Inclusion of Latent Variables in Mixed Logit Models: Modelling and Forecasting." *Transportation Research Part A: Policy and Practice* 44(9): 744–753. https://doi.org/https://doi.org/10.1016/j.tra.2010.07.007.

Yang Tao. 2010. "Clustering Method for Counting Passengers Getting in a Bus with Single Camera." *Optical Engineering* 49(3): 037203. https://doi.org/10.1117/1.3374439.

Yi Chang. 2006. "Impact of Public Transit on Employment Status: Disaggregate Analysis of Houston, Texas." *Transportation Research Record* 1986(1): 137–144. https://doi.org/10.1177/0361198106198600117.

Zafirovski Milan. 1999. "What Is Really Rational Choice? Beyond the Utilitarian Concept of Rationality." *Current Sociology* 47(1): 47–113. https://doi.org/10.1177/0011392199047001005.

Zajfert Michał. 2018. "Wpływ czynników jakościowych komunikacji miejskiej w Polsce na substytucję środka transportu." *Przegląd Komunikacyjny* 8: 2–9.

Zawieska Jakub. 2018. "Perspektywy implementacji Mobility-as-a-Service w polskich aglomeracjach." In *Mobilność w aglomeracjach przyszłości*. Eds. Jerzy Gajewski, Wojciech Paprocki, Jana Pieregut, 30–50. Sopot: Centrum Myśli Strategicznych.

Zhao Jinhua. 2009. *Preference Accommodating and Preference Shaping: Incorporating Traveler Preferences into Transportation Planning*. Massachusetts Institute of Technology. PhD thesis. http://web.mit.edu/uis/theses/Dissertation_Jinhua_Zhao_v3.2_final.pdf.

Zhao Pengjun, Shengxiao Li. 2017. "Bicycle-Metro Integration in a Growing City: The Determinants of Cycling as a Transfer Mode in Metro Station Areas in Beijing." *Transportation Research Part A: Policy and Practice* 99: 46–60. https://doi.org/https://doi.org/10.1016/j.tra.2017.03.003.

Zijlstra Toon, Thomas Vanoutrive, Ann Verhetsel. 2015. "A Meta-Analysis of the Effectiveness of Park-and-Ride Facilities." *European Journal of Transport and Infrastructure Research* 15(4): 597–612. https://doi.org/10.18757/ejtir.2015.15.4.3099.

ZKM. 2018. "Preferencje i zachowania transportowe mieszkańców Gdyni. Raporty z wynikami badań z lat 2008–2018." Gdynia.

Zuidgeest Mark H.P., Marc J.G. Witbreuk, Martin F.A.M. van Maarseveen. 2000. „Sustainable Transport: A Review from a Pragmatic Perspective." In *Proceedings of the South African Transport Conference (SATC) — "Action in Transport for the New Millennium." 17–20 July 2000*. 1–10. Pretoria, South Africa.

Sources of law

Act of 16 December, 2010 on Public Transport (consolidated text: Journals of Law of 2025, item 285, as amended).

Regulation (EC) No. 1370/2007 of the European Parliament and of the Council of 23 October 2007, on public passenger transport services by rail and by road (OJ EU L 315/1, 03.12.2007).

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