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DEVELOPING A CYCLING SUBSYSTEM AS PART OF A SUSTAINABLE MOBILITY STRATEGY: THE CASE OF GDANSK

Summary. Modal share is an important component in developing sustainable transport within a city. In recent years, many cities have set modal share targets for balanced and sustainable transport modes: 30% of public transport and 30% of non-motorized (cycling and walking) modes. Gdansk strategic documents have set similar goals with some actions already taken towards those goals. The cycle network is increasing popular. Gdansk's cycling infrastructure is more developed than that in other Polish cities. Promotional actions are undertaken each year. Despite that, the share of cycling in the modal split still remains at the low level of 1-3%. The article analyses the case study of Gdansk's cycling policy and its results. The article summarizes the modal share targets set in Gdansk's strategic documents, describes the development of its cycle network and promotional campaigns, and presents the volume of bicycle traffic and its share in the city's modal split. Finally, the article aims to identify the causes behind the low percentage of bicyclists in Gdansk.

Keywords: cycling; transport; modal split; cycling strategy.

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1. INTRODUCTION

In an effort to reduce the strong and increasing global transport pressure on the environment, which comes primarily from air pollution and greenhouse emissions, a change in the modal split is required at all levels of management from local to global. There is a need to reduce the share of motor vehicles and make way for more environmental and active forms of activity, such as walking and cycling [22]. As a consequence, in recent years, many cities have made it their ambition to increase trips made by alternative means of transport: up to 30% using public transport and up to 30% using non-motorized modes (walking and cycling). Many cities have successfully met these targets as a result of their transport strategies, policies and mobility plans, while others have been able to exceed the share of cycling by more than 30% [4].

In Gdansk, despite the city's relatively well-developed network of cycle roads, the share of cycling in terms of overall transport represents 1-3%, falling well behind best practice. Although the city has a cycling policy, promotes cycling and raises awareness, cycling has had a consistently low share for many years.

This article presents a study of Gdansk by looking at its transport policy, including new investment and organizational activities. The spatial, planning, organizational, social and climatic characteristics are identified and how these relate to the cycling subsystem. The article describes the scope of new projects, as well as promotional and educational work as part of the cycling policy. An analysis is made of cycling data, including the share of cycling in the overall modal split. The article aims to identify the reasons for the relatively low share of cycling in the modal split, along with recommendations for further steps and research.

2. CONDITIONS FOR CYCLING IN GDANSK

Gdansk is Poland's sixth largest city by population (more than 460,000) and seventh by size (more than 260 km^2). Nearly 50% of the population are of working age and about 30% are economically active. Meanwhile, primary and middle school students represent 13% [5]; 15% are state university students [15]. These young and able-bodied inhabitants represent the biggest group of potential cyclists. It is fair to say, however, that there may be more potential cyclists, given that a 2009 study of Gdansk transport preferences failed to establish any direct relationship between a willingness to use a cycle and age [7]. More and more people engage in some kind of outdoor physical activity, such as running or cycling. The healthy lifestyle trend fits in with cycling, being seen as an attractive form of transport that delivers the required daily amount of exercise. With cycle paths in Gdansk and in the neighbouring cities that form the Tri-City area, which are located along the main route and the sea coast, as well as within the wooded area of the Tri-City Landscape Park, inhabitants and tourists alike are able to combine transport needs with recreation. A study of transport preferences and a willingness to change transport behaviour established that many people are happy to use bicycle as a means of transport, as long as their expectations are met regarding infrastructure [8], safety [12] [6] and other needs [21].

One of the key factors behind how many people will use a city's cycling subsystem is the availability of bicycles as a means of transport. For a few years, Gdansk has been planning to introduce the city bicycle, but the results have not been very good. With cuts to spending on the city bicycle launch and operation, potential private partners have been losing interest in

the project. The authorities of Gdansk could use Polish good practice and launch its city bicycle system by performing some benchmarking.

Having no city bicycle system can be seen as the next determining factor behind the low share of cycling in city trips. As we know from the experience of other Polish and EU cities, bicycles for hire have some influence on increasing the use of cycling in overall transport. This is because users are given a more flexible choice if they can use a bicycle hire system. In Gdansk, if the weather in the morning is bad for cycling, people will choose a means of transport, which they will use the whole day. A bicycle hire system, however, could make them change their mind when the weather improves later in the day. Today, with no city bicycle hire system, having your own two-wheeler is the only way to cycle in the city. A study in the Tri-City area showed that 70% of households have at least one bicycle for every adult person [9]. Despite this, a high number of potential cycling subsystem users do not have the opportunity to use a bicycle.

The number of bicycle trips changes as a result of general trends in mobility. According to the *Comprehensive Traffic Study of 2009*, the mobility of Gdansk's population equates to 1.9 trips per day [7], which, for a population of 460,000, results in almost 900,000 trips daily. Some of these journeys could be made by bicycle, which is a healthy option and good for the environment. When moving about a city involving distances of up to 7.5 km, the bicycle is a faster and more reliable (no traffic jams) means of transport than the car [18]. In Gdansk, the average journey distance is 6 km [9]; 50% of trips are up to 5 km in length, while 30% are up to 3 km in length [18].

The decision to choose the bicycle as a means of transport depends strongly on the weather. The climate of Gdansk is influenced by the Baltic Sea, in particular the Gulf of Gdansk. Summers are cooler and winters are milder than elsewhere in the country. Even the driest months tend to have a lot of rainfall (from 12.1 to 60 mm as a monthly average). From December to February, temperatures reach values below zero with (occasionally heavy) snowfall. The average annual temperature for 1981-2010 was 9.8ºC in Gdansk (monthly values ranging from 0.1 to 18.2ºC). As we know from research [6], climate does not have to be a key factor for deciding whether to use the bicycle. There are examples from other European cities with a high share of cycling used in daily trips (Eindhoven, Hamburg or Copenhagen), which also have high annual precipitation. This shows that consistent promotional and educational efforts can influence people's transport behaviour and encourage them to cycle, even in bad weather, thereby making cycling a lifestyle choice.

Gdansk works to overcome the weather barrier via its Roads and Greenery Authority, which is responsible for clearing snow away from cycle paths and ensuring that cyclists can use bicycles, even in the winter.

The decision to use or not to use a bicycle is strongly influenced by the city's geophysical landscape and the belts that form it. These factors determine the gradients of cycle routes and their alignment. Gdansk is divided into a lower and an upper terrace (Fig. 2), which are areas divided by a strongly fragmented upland zone, with differences in relative elevation reaching 100 m and gradients in excess of 8%. The elevations, coupled with the gradients, make cycling difficult for many, especially for older people and children.

Following from the topography is the uneven development of the city's cycling infrastructure. The first to be built was a cycle network in the lower terrace. Some of the upper terrace, which is made up of large residential areas and places of recreation, has no cycling infrastructure, nor links with the rest of the network. The links between the upper and lower terraces are not attractive enough.

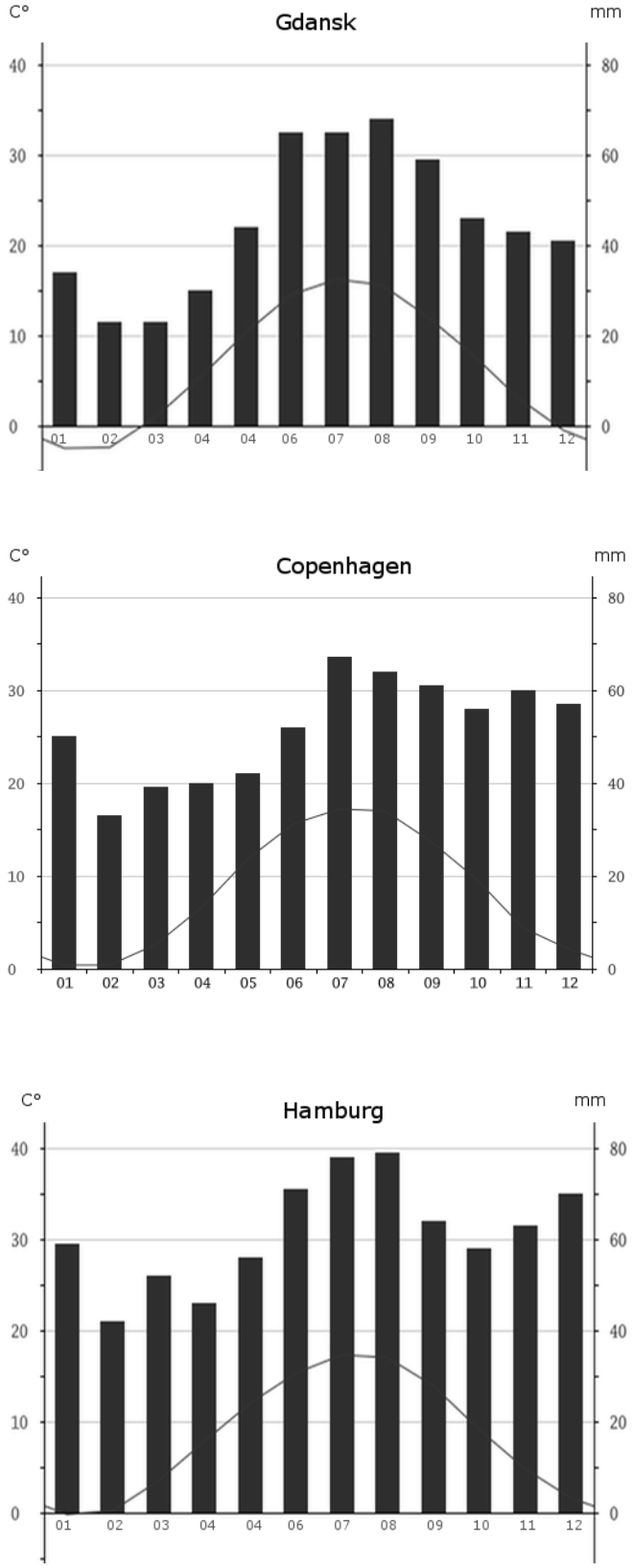

Fig. 1. Climate charts for the cities of Gdansk, Copenhagen and Hamburg [3]

Fig. 2. Altitude model of Gdansk, illustrating the geographical division into the upper and lower terraces [26]

Despite that, among other Polish cities with a population of more than 100,000, a survey recognized Gdansk as the most bicyclist-friendly city. The survey looked at cycling infrastructure and the approach to the development of cycling conditions (limited traffic zones, bicycle stands, signage, systemic solutions, promotion) [16].

3. DEVELOPMENT OF CYCLING AS AN ELEMENT OF GDANSK'S TRANSPORT POLICY

Gdansk's cycling policy has developed in a phased approach. Initially, the city authorities' only interest in building a cycling subsystem came down to solving problems as they arose. As an example, white lines were painted on pavements to indicate cycle paths [14]. Faced with public discontent, as well as the effects of the city's cycling policy and strong bottom-up pressures to improve cycling conditions, the local authorities started to work together with the city's active non-governmental organizations (NGOs). The milestones of the cooperation include:

- The Consultancy, Advisory and Initiating Team for the Development of Cycling (1998) and (2011) the Active Mobility Unit set up by the Mayor within Gdansk City Hall
- the appointment of Poland's first mayoral cycling representative (2006), currently the Cycling Officer (2009)
- the development of standards for building Gdansk's cycle roads, which combine legal and technical requirements with cyclists' demands (2000) [10]; they were subsequently updated (2008) [17]
- the development and implementation of Gdansk cycling projects in 1999-2001, 2002-2005 and 2007-2013
- the signing of the Brussels Charter (2009) [2]
- the signing of the Gdansk Charter of Active Mobility (2010)
- conducting the Bicycle Policy Audit (BYPAD) (2010) [11]
- establishing technical standards and principles of planning, designing and organizing cycle traffic, which are subsequently made into local law (2012)

The "Gdansk Investment and Promotional Cycling Project 2002-2005" aimed to increase the share of cycling from 5-10% for the whole city by 2013. Today, we know that the target has not been achieved and many of the planned activities were never implemented.

In the BYPAD action plan, it was stated that, by 2020, Gdansk should become a leading cycling metropolis not only in Poland, but for all Central and Eastern European countries. By signing the Brussels Charter, the authorities of Gdansk committed to setting a target of at least 15% for the share of cycling in the modal split of trips by 2020, as well as pursuing further growth if this target is achieved [2].

In the Mobile Gdansk programme, a priority was set for cycling, walking and public transport [20]. The programme documentation emphasizes the need to replace costly road projects with new traffic layouts and changes in people's traffic customs.

As part of the *Transport and Mobility Strategy for the Metropolitan Area* [13], Gdansk is set to pursue a programme of active mobility until 2030, which assumes an 8% share of cycling annually and 15% in the summer months.

To achieve the goals set out in the strategy papers, most of the work concentrates on developing the cycling infrastructure. One of Poland's best cycling infrastructures was built in stages between 1991-2001, 2002-2005 and 2007-2013 under the aegis of the Gdansk cycling projects, which resulted from the cooperation between Gdansk City Hall and NGOs.

The first such project, entitled "Concept of Gdansk's Cycle Network Including the Design of a Cycle Road Along Gdansk's Main Transport Axis", included a network of recreational routes, of which 150 km were segregated cycle roads, while proposed routes within pedestrian and cycle routes, one-way streets and unpaved roads had a total length of 200 km. It also included a number of activities linked to changing the perceptions of cycling. While the project helped to increase the number of cycle roads, the priorities set out in the project document have not been accomplished. The concept's principles and guidelines were subsequently applied when developing new Gdansk cycling projects in the years to come.

The next project was delivered between 2003 and 2005. Known as the "Gdansk Investment and Promotional Cycling Project", it aimed to build 30 km of cycle roads and 70 km of streets with traffic-calming measures. Eventually, only 15 km of cycle roads were built with no traffic-calming programme [11].

The "Development of Cycling within the Tri-City Conurbation in 2007-2013" project was implemented between 2007 and 2013. It aimed to build and improve 26 cycle roads that were 34.64 km long, as well as build 14 cycle hubs and 12 cycle parking sites to strengthen the network's transport character [28].

According to 2016 data, Gdansk's cycle network is now 568.2 km long, of which 388.2 km are on streets with traffic-calming measures with a speed limit of no more than 30 km/h, while 117 km are segregated cycle roads and 42.2 km are one-way streets, where cycles are allowed to ride in the opposite direction (contraflow lanes) [27].

Considering the city's geophysical characteristics, we can say that the cycling subsystem must be complemented with new point infrastructure and a city bicycle hire system. With the launch of the Pomorskie Metropolitan Rail (PKM) in 2015, the service may become a milestone in developing cycling. The train service not only connects Gdansk's lower and upper terraces, but also offers a potentially attractive link between the Kashubia Lake District and the Tri-City area. It runs partly across the city's non-urbanized areas, where some stations are difficult to access on foot (the distances are too long for walking), which makes them ideal for a B&R scheme. This, however, means that modern B&R facilities (not just bicycle stands) are needed as close to PKM stations as possible, with sufficient spaces, CCTV and

service points. Steps should also be quickly taken to offer tickets that will come with free bicycle parking.

Given that the city does not have a bicycle hire scheme, as mentioned before, cycling represents a small proportion of Gdansk's modal split. If accompanied with a well-functioning B&R system, the city bicycle scheme could provide a basic means of transport for people who commute to B&R hubs by bicycle and travel within the lower terrace during the day.

There are many solutions across Europe for integrating different types of transport, including B&R, which could be recommended to the authorities of Gdansk. One of them comes from Warsaw, which built about 60 free B&R cycle parking facilities for ticket holders (for tickets valid for not less than 24 h). You can use public transport to get to the capital's city centre and then change to a city bicycle. This is further encouraged by Warsaw's dense network of stations (more than 200) and free bicycle hire for up to 20 min. Operating in conditions similar to Gdansk's path density per km^2, in 2015, Warsaw's city bicycle system recorded about 380,000 registered users and 200,000 cycle leases monthly (on average since 2012) [24]. Even with three times as many residents as Gdansk, Warsaw did well and showed that there is potential if a city bicycle system is well organized and maintained.

4. PROMOTION AND EDUCATION

The point of departure for promoting cycling and educating the public on the benefits of city cycling is the claim that Polish people clearly constitute a pro-motorization nation. This is part of the pro-consumer attitude of the Polish public, a fact that has to be viewed in the context of Poland's social and economic transition in the last 25 years. The car is not only a means of transport, but, as with many other goods, also an expression of social and individual aspirations and a person's position in society. These characteristics must be included when identifying the scope and tools for promoting and educating in relation to cycling, with the emphasis placed on the consequences of the uncontrolled growth of motorization and the benefits of pro-environmental transport behaviour.

Gdansk's first broad promotion of cycling took place in the early 1990s and was delivered by NGOs. Today, the Civic Environmental League (OLE) is still running the campaign it launched in 1997 called the "Gdansk Cycling Campaign" (initially "Gdansk: A City of Cycles"). One of the elements of the campaign is the "Great Bike Ride" and accompanying events (competitions, races, picnics, movie shows etc.). At present, cycling promotion and education are the responsibility of the staff of the Active Mobility Unit within Gdansk City Hall. They are involved in international congresses and local training, as well as organize regular active mobility congresses. The Metropolitan Transport Union of the Gulf of Gdansk has been teaching road safety since 2012 in primary schools and middle schools, with cycling is given a great deal of attention in the teaching programme. The Active Mobility Unit used EU projects (CiViTAS-MIMOSA, PIMMS TRANSFER), as well as delivered their own initiatives, to promote cycling to children (via art competitions about cycling for primary school students, "Cycling May"), youth ("Cycling May"), and the staff of big companies and inhabitants ("Cycling Fridays", "Cycling to Work", "U-lock" as a gift campaign). Information activities included vertical signage, distributing cycling maps and operating the "rowerowyGdansk.pl" website.

Despite the wide range of promotional and educational elements, the cycling campaigns are not sufficiently coordinated and only provide information about the objective of a specific project. In this context, the promotional and educational policy reflects Gdansk's lack of a comprehensive cycling policy. The experience of European cities shows that, by coordinating promotional efforts, cities are better able to promote cycling effectively. This is achieved through multiple activities, which are consistent delivered, while there is determination in the messages that they communicate.

5. RESULTS: SHARE OF CYCLING IN MODAL SPLIT

New infrastructure, the city's declared pro-cycling policy and a well-developed network of cycle roads have had a limited effect on Gdansk's modal split. Cycling continues at a low level of 1-3% for the whole city. Gdansk's cycling data are quite consistent. Cycling levels are presented in cycling studies that measure cycling at selected points and for different cross-sections in the city. They are conducted annually by the Gdansk Development Bureau [19]. The second source of cycling data in Gdansk are 25 automatic cycle counts situated along the main routes. The data are updated every day and uploaded to the relevant website [27]. In addition, trip numbers by different means of transport are generated from comprehensive traffic counts, which are regularly carried out in Poland's major cities, including Gdansk (the most recent count was in 2009) [7].

Gdansk City Hall's cycle counts are a tool for monitoring and evaluating the city's cycling policy. They help to interpret the changing numbers of cycle network users. Automatic counts are a source of data for analysing the changing volumes of cycle traffic, depending on the time of year and weather, and help to explain the tendency in overall changes in the number of cycle trips. Comprehensive traffic counts help to determine the number of cycle trips and their share in all of the trips in the city. By using a uniform set of conditions that influences cycle trips (time of year, day, weather), the results generated are comparable between successive counts. According to a 2009 study of transport behaviour of the Gdansk population, only 2% of respondents said they used the bicycle as a means of transport [7].

A comparison was made of cycle traffic data in 2011-2014, which showed that, while cycle traffic grew significantly, it differed from cross-section to cross-section by several to some 50%. On average, in 2011-2014, the number of cyclists went up by 44.2%, while it went by 12.5% in 2013-2014.

Based on population mobility data for 2009 (1.9) [7] and 2014 (2.42 in the Tri-City area) [13], and by assuming a steady population (a slight upward trends was recorded within that period), we can see an increase in all trips by more than 27%. This would suggest that the share of trips within the modal split went up in the last three years by 2% to reach 4%. This assumption will be verified by the comprehensive traffic study due to take place in 2016.

Data from automatic counts also confirm that cyclist numbers are increasing. We can see that, in the summer, cycle traffic on some sections exceeds design assumptions. Analysis of the data shows that cyclist numbers change regularly, depending on the time of year and day of the week. By comparing cycling data with weather forecasts, we can demonstrate a relationship between cycling and weather. Using data from automatic counts and overall trips, the share of cycle trips within the modal split was calculated separately for each month in 2014 (Fig. 3).

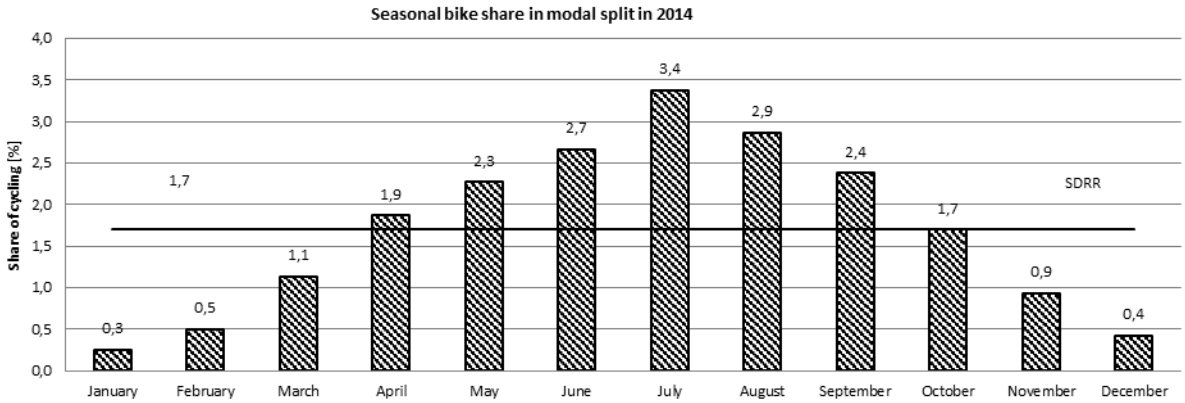

Fig. 3. Share of cycle trips as part of the modal split (monthly)

The strategy papers, which set out how Gdansk's cycle traffic is going to develop, take account of the conditions that are specific to this means of transport. The initial and optimistic assumptions of the share of cycling in the modal split were modified as a result of actual experience and the specific factors that determine the use of cycles in journeys within Gdansk.

With regard to the planned share of transport within the modal split, a point is raised that cycling could grow mainly in the pro-environmental segment and lead to a diminishing role for public transport and walking [1]. This is not confirmed in comparative analyses of 40 European cities [25], which were conducted for the purposes of this paper: there are no clear statistical relationships between high shares of cycling and relatively low shares of public transport within the modal split. Such a situation may be possible in Polish cities, where the pro-motorization attitudes pervade, while a willingness to use a bicycle for (non-recreational) journeys within the city can be primarily found in people who do not use cars. While an increase in cycling can lead to a decrease in car usage, as seen in German examples (Fig. 4), this can only happen if a city has a consistent policy for supporting pro-environmental means of transport and restricting the use of cars.

Some recommended actions for Gdansk would include the introduction of city centre driving charges (e.g., Berlin's "Umweltzone", or "Green Zone") to reduce traffic involving cars that do not meet emission requirements.

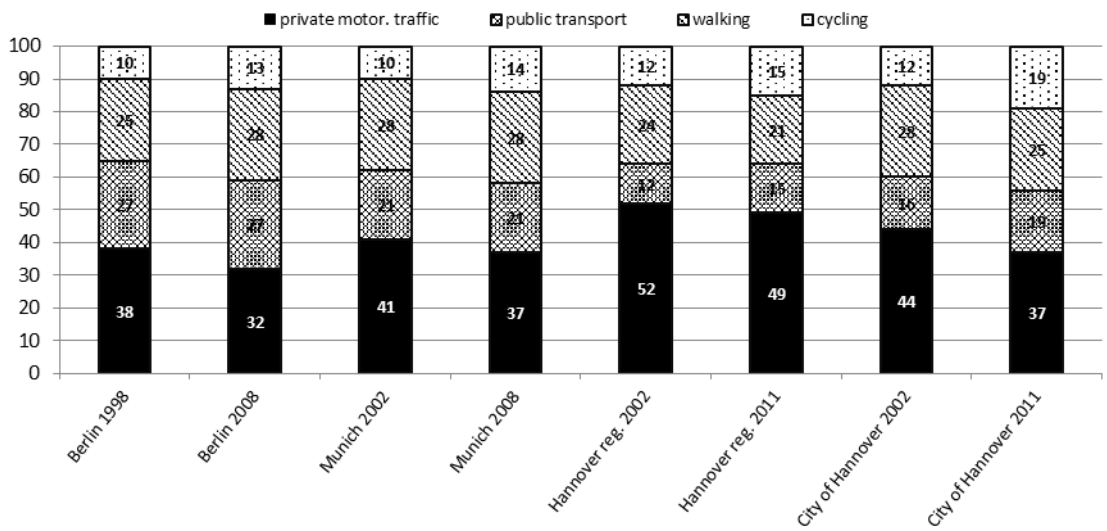

Fig. 4. Change in the modal split in German cities [23]

6. CONCLUSION

Analysis of how Gdansk's cycle transport is developing as an element of sustainable mobility shows that the share of cycling, as a means of transport and a sustainable mobility target, depends on the following:

- the city landscape and weather
- transport policy and its implementation
- level of development of linear and point infrastructure, especially availability of B&R
- lack of a city bicycle system
- lifestyle and how it can be changed through education and promotion

Once identified, the conditions should inform recommendations that will help to increase the share of cycling in journeys within the city, leading to more effective efforts towards meeting sustainable mobility targets, such as:

- building B&R facilities to meet cycle users' expectations, especially around PKM train stations
- launching a city bicycle system
- integrating cycle trips with public transport trips by organizing them jointly (a common ticket to use both public transport and B&R facilities)
- preparing mobility plans for large sources of traffic (institutions, schools, universities, workplaces) where cycling may be a preferred mode
- integrating promotional efforts

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