PERSPECTIVES AND INTEGRATION OF BICYCLE TRANSPORT IN SOFIA, BULGARIA

Borislav Arnaudov¹

Abstract: Public transport is an important element of sustainable development that incorporates responsiveness towards the need for mobility by the population within the framework of the urban transit system. As a part of the public transportation system, bicycle transport, with its environmental aspect, is the bedrock of the idea for accessible public services. This study provides core parameters for the assessment of social and environmental dimensions in order to further develop bicycle transport. It also itemizes the principles that need to be followed with the aim of social and economic sustainability. As a form of transportation in an urban environment, the bicycle traffic, its share and distribution of trips, obstacles and challenges encountered by cyclists in the city, trends and prevalent issues related to the current conditions of cycling infrastructure in Sofia, Bulgaria, were analyzed. In a nutshell, the report delivers a compiled group of suggestions on opportunities that may help to increase the functional efficiency of cycling as part of the transportation system of Sofia, in both, the social and environmental sense.

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Introduction

The unfavorable trend concerning the ever-increasing numbers of personal vehicles used for urban mobility and the problems associated with it cause a major imbalance in the urban transportation system of Sofia, Bulgaria. Prospectively, focusing on the use of bicycles to fulfil needs of urban mobility may be fundamental to create a more efficient and eco-friendly unified system, while providing greater freedom of movement and minimizing both, transportation costs and the detrimental effect on environment, by way of an overall improvement in the transportation system of Sofia (European Parliament, 2015). The principal component towards achieving a uniform transportation policy for development of related infrastructure, particularly in order for it to be safe, secure, convenient and to provide consolidation of the various modes of transportation used within the city transportation network, is the establishing of a pattern for sustainable development of bicycle mobility.

The economic, social, and environmental dimensions for sustainable development of bicycle mobility are correlated or interlinked, none of which can be considered independently without the other two. The transportation system of Sofia, which is at present in a deplorable state primarily due to its economic unsustainability, cannot adequately satisfy the needs of the population and frequently causes a variety of negative implications on the environment and society (Sofia Municipality).

The social criterion appertains to the determination of fair social conditions for all traffic participants, improvements in safety for the most vulnerable participants, and general progress in the quality of life. Social sustainability is also linked to the rights of both, individuals and social groups, to exist in healthy and socially acceptable conditions, unaffected by discrimination, harmful influences, and antisocial activities.

The parameters evaluating the impact of bicycle mobility over the social and environmental dimensions of sustainable development include:

- Length of bicycle lanes
- Accessibility of transportation infrastructure
- Safety of movement
- Personal safety of cyclists
- Health impact of bicycle mobility
- Social and environmental aspects

Nature and Significance of Bicycle Mobility

Automobiles have become the main means of transportation even for very short distances. This development considerably reinforced a series of far-reaching challenges: climate change, air pollution, noise pollution, road safety issues, congestion, degradation of public spaces, dependency on oil,

¹ University of National and World Economy, Sofia, Bulgaria, Faculty "Economics of Infrastructure", Department "Economics of Transport and Energy", barnaudov@unwe.bg

diminishing of the purchasing power of consumers, decrease in physical activity of the population besides many others (Vision for Sofia, Bicycle Transport).

Bicycle mobility holds as a worthy substitute for trips in an urban environment, by reassuring lesser congestion, lower levels of harmful emissions and a general increase in the quality of life through improvement of the population's health status (Urban Mobility Center, 2012). Other merits of bicycle transit encompass its flexibility and freedom of movement, considerable inexpensiveness on purchase and maintenance in contrast to other modes of transit, its near complete deficiency of energy consumption, and the small size of bikes causing minimized use of parking space. Still, one major disadvantage of bicycles is that of their seasonal nature – it's hard to use them year-round due to their dependency on weather conditions.

In various parts of the industrialized world, cycling is given a low priority as a form of mobility and is mostly used for recreational purposes. Its applications in practical-oriented daily commutes such as trips to work/university/school, shopping, among others is limited. Furthermore, social distribution of cyclists is heavily imbalanced with a majority of trips being undertaken by young men, while women have a notably lower percentage, and the elderly, in both sexes, use it only sporadically.

So far, development of cycling as a mode of mobility in Sofia has been chaotic. The larger part of the city is comparatively small. Distances between the main residential areas and the city center are in the range of 4-8 km., which takes 15-30 minutes to cover by bicycle. With an average speed of 15 km/h for a moderately experienced cyclist, the bicycle is fairly reasonable as concerns travel time in an urban environment. Sofia's topography is characterized by a few steep slopes, yet an appropriately selected path makes them traversable without excess physical strain. Many people opt for a bicycle commute as it provides a relatively constant travel time, is usually independent of the traffic congestion, and thus provides for better time scheduling and management. Bicycles appear to be a reliable mode of transportation, especially in the busy central parts of the city.

Offering opportunities and information for bicycle mobility from home to work is an excellent notion, but realizing it is often tough. A large segment of the population, especially comprising of younger people (aged 15 to 45), are yet to acknowledge cycling as a sustainable mode of mobility to be attracted to it, because at present only 2% of all commuters employ it. This can be seen in Figure 1.

Figure 1: Share of different modes of transport in Sofia

An important mobility indicator applicable in every city is the so called “modal split” – distribution of trips between the different modes of commuting. The chart plainly illustrates that the share bicycles hold is exceptionally low (2 % for 2019), but this also implies the potential for growth of bicycle trips if dedicated policies for this purpose are enacted.

One of the major challenges that needs solution is how this idea is to be identified and how to create a collaboration and cooperation between bicycle mobility, public transit and personal automobiles. Cycling conditions in many regions of Sofia (including central business districts) are anything but safe, convenient or attractive. All cycling lanes in Sofia failed to comply to the expected impact due to the fact that they haven't been safely enough designed or constructed as street infrastructure. Figure 2 presents what the proportion of cyclists was in 2010 and how it changed over time till 2019. As suggested by the data, the last decade marked an increase by 10 times in the number of people using cycling as a mode of urban mobility.

Figure 2: Number of cyclists in Sofia, 2010-2019

Institutional Framework of the Low-Carbon Economy

Europe initiated the global transition towards a low-carbon and circular economy (European Parliament, 2015), along with declaring this development as permanently accelerating. With a view to remain competitive and to achieve the growing mobility needs of the population, it is evident that we need to devise a strategy with lucid and equitable leading principles for the member-states parallel to the provisions for a low-emission transport future. The Strategy for Low-Emission Mobility (Strategy for the development of the transport system of the Republic of Bulgaria until 2020) specifies the structure for the initiatives that are to be planned in the upcoming years, in association with cartographing application areas and studying the various possibilities. All these initiatives as well as their areas of application should be studied jointly for the sake of modernizing the European Economy, strengthening its inner market, and achieving a state of synergy between them. According to Gatovski (2016), “A periodic reassessment and analysis of the demand for transport services is required, which is to be subsequently reflected through changes in the public services supply”.

Consequently, the European Commission had developed Transport Strategy 1 for the restoration of balance which included major investments concerned with enlarging the usage share of public-friendly and environment-friendly transport. The overuse of autos, especially in an urban environment, leads to a rise in health and environmental issues, traffic congestion, and road hazards.

It is vital to successfully apply the strategy of low-carbon economy to solve troubles related to transportation in big cities. More precisely, these can be explained in the following directions:

- Stimulating the usage of alternative energy and low-emission vehicles (50 g/km), electric and hydrogen-powered cars, etc.
- Encouraging a switch to active commuting (especially within the centres of large cities) like cycling, walking, public transportation, ride-sharing, etc.
- Improving the efficiency of the transit systems by fully utilizing digital technologies and practicing flexible fares.

If properly accomplished, these measures will lead to an improvement in air quality, less noise pollution, less traffic congestion and improved safety. The advantages to commuters range from more efficient and less energy-consuming vehicles, to better connections between different transportation modes, to increased safety and reduced delays, all thanks to the implementation of Intelligent Transport Systems. Additionally, local authorities will play an integral part in the implementation of this strategy, as they are the ones who should ensure their contribution of stimuli towards alternative energy and low emissions, while promoting active forms of commutation (cycling and walking), public transportation and/or shared mobility solutions, such as car-sharing or leasing, ride-sharing, etc., in order to reduce congestion and pollution. This new approach to Urban Mobility reaches beyond the sector of transportation and we should examine its future advancement in the context of contemporary economic tendencies, such as shared economy and circle economy. This further acts as an opportunity to modernize the economy of the Bulgarian capital in entirety and to guide it towards a more sustainable evolution.

Sofia, thus possesses the golden opportunity to lead the initiative of the revamping of urban transportation, with the drafted reforms serving as the foundation for general standardization, execution of digital solutions in urban mobility, more equitable social conditions and suitable market rules. The whole of this will help to reduce the socio-economic costs of transportation, such as time loss in

congestion, severe injuries or deaths, health risks due to pollutants and noise, simultaneously assuring the satisfaction of the demands of citizens and the environment all the same. General regulations, standards and digital services will promote the realization of multimodal transportation services in the city of Sofia.

Analysis on Cycling as a Mode of Mobility

Cycling is an enjoyable means of commuting that is healthy, clean, and inexpensive. It is also an efficient way to use the costly spaces in urbanized areas. Bicycles are a good option for daily travel, regardless of gender or age. Within the last 10 years, bicycles have gained a rapidly growing popularity, both, in daily commutes and in recreational activities or hobbies alike. They have numerous perks as they are relatively fast in the congested urban environment, do not cause air pollution, save expenses and time to the modern man by eliminating the needs of fuelling and cruising in order to find a parking spot, and last but not the least, they reduce the risk of cardiovascular diseases.

The creation of an adequate system for commuting by bicycle comes under the investments in cycling lanes and bicycle parking places. The economic logic behind such policies is the fact that a person on a bicycle consumes lesser common resources, occupies lesser common space, contributes lesser to traffic congestion, air pollution and noise in comparison to a person in an automobile. Yet, the construction of cycling lanes within different districts of Sofia is always marked by disputes with automobile traffic, since the only feasible way to construct new cycling lanes is by using the space from either the automobile lanes or the pedestrian sidewalks. Even when bike lanes are poorly planned and placed without a parallel policy towards the reduction of automobile movement within the city centre, the results are rather negative.

The main objective of the research is to put together an analysis of the bicycle traffic and present detailed proposals on how to improve the availability and efficacy of bicycle usage, by tracking the dispensation, intensity and volume of bicycle flows in Sofia. This tracking has been done by applying the following data and indicators – length of bicycle lanes, share or proportion of bicycle trips as compared in the modal split, safety of movement, personal safety of the cyclists, availability of transportation infrastructure, influence of bicycle transport over the general population's health, number of cyclists passing through a specific corridor (or junction), and number of bicycle parking spots.

Figure 3 visualizes the outlined findings of an author's survey regarding what the main causes for the citizens of Sofia are for not using bicycles for their daily needs. The research has been carried out between active cyclists and people not using a bicycle, but who would change their commuting modes if cycling conditions were to improve.

The chart displays that over 80% of the participants do not use bicycles as a means of transport because of dangerous and incompatible infrastructure. This reveals that it is necessary to not only build infrastructure, but the lanes constructed should be also safe and interconnected. In order to meet the

cyclists' demand, it is important to construct dedicated, safe and reliable bicycle lanes with appropriate bicycle parking spots and stands to complement them.

Figure 4 represents what would motivate people to use bicycles more often and for extended periods of time as a means of commutation. All the respondents used all the possible answers by placing them according to their respective weightage. Potential cyclists attributed significance most to the infrastructure – to be built out of the car traffic lanes, without level crossing and conflicting points. This calls for all-inclusive measures towards increasing road safety and improving the image of bicycle commuting in terms of safety and increasing its popularity. Pointing out the need of bike lanes between residential areas and the city centre clearly indicates that people are willing to use bicycles for their daily commute to work/university/school.

The indicator “length of bike lanes” measures the combined length of existing bike lanes. This helps in estimating the progress in constructing cycling infrastructure. The presence of such infrastructure is crucial to the development of bicycle mobility as a means of transportation in an urban environment. It clearly demonstrates the need for constructing convenient, safe and well-connected bike lanes, along with complementary transportation infrastructure offering bicycle parking spots, and other means to accommodate cyclists. Table 1 depicts the length of existing bike lanes and planned extensions on main Sofia boulevards.

Bike Lanes	Built (2018)	Planned (up to 2022)
Bulgaria Blvd.	3 km	4 km
Hristo and Evlogi Georgievi Blvd.	4 km	5 km
Gen. Totleben Blvd.	5 km	3.5 km
Tsar Boris III Blvd.	4 km	6 km
Gotze Delchev Blvd.	2.5 km	5 km
Buxton Blvd.	1.6 km	2.5 km
Maria Louisa Blvd.	2.5 km	1 km
Ivan Geshov Blvd.	2.5 km	2 km
Total	25.1 km	29 km

Source: Development program for bicycle transport of Sofia Municipality, 2016-2019)

The heaviest load of bicycle traffic is observed on boulevard (Blvd.) “Tsar Boris III” and its junctions, together with Blvd. “Ivan Geshov”, Blvd. “Evlogi and Hristo Georgievi”, and Blvd. “Bulgaria”. A shared feature in all these boulevards is that they are served by already constructed bike lanes from the main city routes. Despite the efforts of the Sofia Municipality in constructing new lanes and improving the existing ones, their share is still as low as 2% and the city lacks a complete cycling network. Another issue is that within the existing lanes too, there is a small fraction meeting the demands for convenience, safety and comfort of the cyclists, and at the same time, there is an abundance of conflicting points with car traffic.

The indicator “accessibility of transportation infrastructure” identifies the connections between the existing lanes, the presence (or lack of such thereof) of a complete and continuous cycling network, and

its relation to the stops or stations of other means of urban transit. The primary challenges observed in the construction of bicycle infrastructure in Sofia are – the lack of an integrated and continuous network of bike lanes, the presence of too many conflicting points with automobile traffic, an inadequate complementing infrastructure, lack of connectivity between bicycle infrastructure and the other existing means of transportation, scarcity of links to the metropolitan, and a dearth of appropriate and safe bicycle stands. Construction of more bicycle parking lots, especially ones with CCTV surveillance and security, in the vicinity to shopping centres, restaurants, places of culture, administrative buildings, universities, and schools will act as an incentive for a larger group of people to use bicycles as their main mode of commuting.

One of the chief indicators of road safety is the number of casualties per 1 million people. For the intention of making an unbiased appraisal of the safety of cyclists, two indicators are taken into account – “safety of movement” and “personal safety of cyclists”. They describe the safe movement of all participants during traffic, including that of pedestrians. Table 2, below, shows the data of fatal accidents involving cyclists in Bulgaria for the period 2010-2019.

Table 2: Number of cyclist fatalities, 2010-2019										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Bulgaria	27	17	32	31	29	29	27	31	28	25
Sofia	8	3	4	7	5	6	5	7	5	4

Source: European Commission, Traffic Safety Basic Facts, 2018

The data presented in table 2 displays a distinct trend towards the reduction of cyclists falling victim to incidents in Bulgaria. Specifically, for Sofia, these are incidents prevalent in the dark hours of evenings or at night. Statistical data also exhibits that the more cyclists there are on the street, the more the number of incidents per travelled km decreases. The prime reason for this is the increased awareness and tolerance displayed by drivers of cars and public transit busses towards the increase number of cyclists. Therefore, a simple increase in bicycle transportation improves road safety in the city as a whole effecting all participants in traffic.

The indicator “effect of bicycle transport over general health of the population” refers to the development in general physical health. People using bicycles in urban surroundings benefit through increase in muscle tonus and fitness, improvement of metabolism, regulation of blood pressure, and improvement in personal mobility, energy and stamina. According to the statistics of WHO, Bulgaria comes second in matters related to per capita deaths by cardio-vascular diseases (European Commission, State of Health in the EU, Bulgaria, 2017). Using a bicycle for at least 30 minutes a day helps to maintain better health status among people and makes them not only healthier, but also happier.

Social and environmental aspects mirror the impact of bicycle mobility in relation to the economy, environment, climate, energy efficiency, healthcare, sports, etc. The need to integrate policies is dictated by the exigency to mitigate the consequences of climate change, to address the demands for decarbonisation of the transport sector, and the common objective to improve the quality of life in the city. Following such a mixture of policies and measures for increasing the share of bicycle commuting in the modal split will help to achieve substantial and well-defined environmental, health and economic benefits. The increase in the significance of the environmental aspect will lead to reviews of past paradigms and why many countries put considerable efforts to modify roads and urban infrastructure concerning the needs of cyclists. Bicycle transport is not only advantageous to the climate, environment and general health, but it also aids in enhancing the purchasing power of the population by assigning financial resources from fuel, car consumables and other car ownership related costs to other essentials.

Conclusion

For the true development of cycling transportation, metropolises need to enhance safety, comfort and the general appeal of the terrific potential provided by cycling, by means of more bike parking areas, its inclusion into the public transit, holistic road safety education targeted at both, cyclists and drivers, broad spectrum of promotional events with the purpose of increasing enthusiasm, and extensive public support for cycling.

Besides this, funded programs of “Safe route to work/university/school”, aimed at assisting the workers and/or students to reach their desired destinations by bicycle, also need to be established. These call for the following measures amongst others:

- Broader scope of bicycle infrastructure.
- Rise in the number of bicycle stands and parking spaces.
- Incorporation of bicycles with the other modes of transportation like buses and urban rail systems.
- Provisions for the safe access to the transportation infrastructure of Sofia by cyclists, which dictates the requirement of better safety, security and comfort. These will further lead to more and more people using bicycles for their daily commute, thus increasing its social and economic effect.
- Improvement in quality of bicycle infrastructure will entail less accidents and reduced risks to the health and safety of cyclists. This will also stimulate people, living in more distant areas of the city, to switch their mobility preferences in favour of bicycles.
- Greater safety and security of the urban environment results in greater use of public transit, larger share of bicycle usage, and an increase in the number of people choosing to walk as their way of navigating the city, which in turn contributes to lesser congestion and pollution, thus inducing general health and well-being of the population.
- Development of the transportation system of the city in such a direction will then also help to guarantee better working conditions in the transportation sector.

The sustainable development of bicycle transport envisions greater freedom of mobility, a stronger economy, better energy security, a cleaner environment, and a healthier society for everyone. It is such a means of transport that improves the quality of life for the city's inhabitants and serves as an incentive for a cleaner and more sustainable urban mobility. It is a mode of mobility which allows people to see that their transportation needs can be met in a more efficient, affordable, yet pleasant way, by combining different modes of transportation. To this end, a more responsible investment of public funds towards establishing a cleaner, safer, and smarter transportation system, is needed; a system corresponding to the priorities of renewing the urban environment and stimulating bicycle mobility.

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