

Effects of Urban Planning and Development on the Quality of Bicycle Infrastructure: A Case Study

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Abstract: The Public Transportation system in Turkey has long been dominated by motor automobiles. In Turkey, both the central government and local governments have been supporting cycling culture and infrastructure. This thesis study creates a framework to evaluate a city's urban planning and development documents for the aim of urban bicycle planning and development. The framework is created from a thorough literature review and from sample urban bicycle plans from different Turkish cities. Also, these Turkish cities were chosen based on their high rates of using urban bicycle infrastructure and having complete and thorough urban bicycle planning and development documents. Furthermore, the framework created from this thesis study consists of different indicators including cycling knowledge and recognition, cycling goals and objectives; cycling planning, policy, and programs; cycling implementation and funding, and cycling maintenance and monitoring. The framework is then applied to Ankara's long-term urban public transportation as a way to illustrate how the framework can be used to evaluate a city's urban planning and development efforts regarding urban bicycle infrastructure.

Keywords: Urban Bicycle Infrastructure, Cycling Education, Cycling Safety, Cycling Encouragement, Bicycle Transportation, Bicycle Integration

JEL Classification: R42, R58

1. Introduction

Bicycle use in Turkey is relatively low due to various reasons such as infrastructure problems, inadequate bicycle paths, parking areas, and social awareness in this direction. However, in recent years, interest in bicycles has increased in some cities of Turkey, paving the way for new projects (IMM, 2020). Bicycle paths have been built in some cities such as Istanbul, Ankara, Izmir, Eskisehir, Kayseri, Bursa, Antalya, Sakarya, Konya, Samsun, and Denizli. However, since then, these paths have not yet been integrated into existing public transport. In the mentioned cities, bicycle use is still not

as widespread as it should be due to the lack of integration and inadequate bicycle paths. Therefore, it is necessary to establish the necessary networks for planning bicycle paths and routes within the scope of urban transportation, to determine design criteria, to understand urban area conditions and the special needs of cyclists.

The aim of this research study is to establish an analytical framework to analyze the capacity of comprehensive master plans to comprehensively plan bicycle transportation. In the first step of the analysis, indicators and strategies obtained from literature reviews and research were examined, then bicycle transportation plans for the cities of Istanbul, Izmir, Antalya, Konya, Kayseri were examined.

In this context, a general evaluation framework was created by researching the relevant bicycle transportation plan indicators. This framework was determined with the following steps:

- searching for keywords of measurable targets and indicators related to sustainability in the plan objectives,
- determining the existence of supporting activities and measures,
- determining the keywords of measurable targets and indicators related to sustainability in the entire plan,
- determining monitoring measures and indicators,
- defining the responsibilities and timeframe to achieve established objectives.

Within the framework of the steps mentioned above, the existing data and suggestions presented in the master plan for the development of bicycle transportation in Ankara have been analyzed. Once the analysis framework is completed, it can be used in two different ways. First, to form the basis for a study in which the comprehensive master plans of different cities in Turkey are analyzed. Second, to provide a framework for cities to evaluate their own planning efforts when creating or developing bicycle transportation plans. In addition, a case study will be conducted for Ankara to show how this framework can be used to evaluate a city's bicycle planning efforts.

The general aim of the research study will be to make an assessment of the role of the bicycle project in improving mobility in Ankara and to suggest a design template that can form the basis for the establishment of bicycle facilities that improve healthy public life, social life and economy in Ankara to urban planners and engineers. . On the other hand, it is aimed to evaluate the non-motorized transportation strategy in Ankara. Specific objective is to evaluate the strategy for non-motorized transport in Ankara including:

- To examine the current condition of bicycling facilities project in transportation system.
- To assess the role of bicycling project in transport system in Ankara.
- Why should urban transportation planners be aware of the importance of their bicycle infrastructure?
- Do bicycle infrastructure that has greater depth and breadth of coverage result in more improved urban plan and development implementation and higher rates of bicycle transportation?

This research study will be answering those questions which is significant for academic purposes and when carried out successfully the answers will benefit city planners, designers, researchers as well as decision makers acquiring valuable information for the questions under study.

2. Literature Review

When legal and administrative initiatives are examined, the Bicycle Lanes Regulation was published by the Ministry of Environment and Urbanization in 2019, and the importance of planning bicycle lanes as an integrated part of the public space was emphasized. Such initiatives aimed to support various applications that increase economic and environmental impacts as well as transportation networks and other means of transport, and to emphasize the social benefits of cycling. However, it is emphasized that bicycle lanes should not be planned based on physical and non-physical factors alone, but should also be considered from a social perspective. These paths should not only be used for recreational activities, but also as systems integrated into urban public transportation systems. In this context, a detailed route planning process and model are envisaged in the regulation, and it is stated that it should provide solutions for different transportation goals. The issues addressed in the route planning model are generally grouped under different headings such as physical, environmental and visual factors (Ministry of Environment and Urbanization, 2019).

In order to better understand the impact of urban planning and development on bicycle infrastructure and systems, numerous studies have been conducted on entire cities to quantify the benefits of improving bicycle infrastructure, facilities, programs, and policies. Pucher et al. (2017) reviewed many of these studies and found that cities around the world have been able to positively increase the modal share of bicycle use by improving urban planning programs aimed at increasing the use of bicycle facilities. The research conducted by Mert and Öcalır (2010) focused on the problems related to

bicycles, which are seen among the transportation types all over the world, how they affect the application conditions and the planning process in Turkey. The research provided recommendations for transportation plans and regulations within bicycle plans. In order for bicycle transportation to become attractive in Turkey, it is shown that the habits of the city people should be directed towards bicycle culture and the central government units should take the necessary steps for bicycle transportation. A study conducted by Bozkurt (2016) examined the application conditions of bicycles, which have an active role in transportation, and the planning process in Turkey through the example of Bilecik. In the research, the frequency of bicycle use in Bilecik transportation was investigated and various suggestions and planned investments were focused on. The difficult topography in the city as the study area makes bicycle use difficult. In the research conducted by Elbeyli (2012), it was stated that bicycles, which are environmentally friendly, fun, fast, economical and healthy transportation types, are suitable for the concept of sustainable transportation. In the study conducted by Ankaya and Aslan (2020), it was stated that

Cycling is fun, economical, safe, environmentally friendly and a healthy sport and suitable for transportation. In this study, the importance of planning criteria, bicycle path examples, historical development of bicycle paths were summarized and examples from Turkey and other countries around the world were emphasized. Cengiz and Kahvecioğlu (2016) focused on the usability of bicycles in transportation by taking into account the transportation network and city characteristics of Çanakkale. The research results concluded that the coastline, Troya Street and Esenler neighborhood in Çanakkale are the most suitable places for bicycle use. In the study conducted by Erçetin (2023), it was stated that bicycle use is necessary to get rid of car dependency and ensure environmental sustainability, and in this context, European cities such as Copenhagen and Amsterdam, which frequently prefer bicycle transportation, were examined, as well as the cities of Ankara, Montreal, Paris and Munich. Ardiçoğlu (2023) investigated the usability of bicycles, as an environmentally friendly and clean transportation type, for the city of Elazığ in his research. Because the city has a linear distribution on the east–west axis and a bicycle network which can providing continuous transportation services between the east and west ends of the city. According to Ardiçoğlu (2023), according to the traffic volume, traffic speed and existing physical texture within the created network; shared roads, bicycle lanes or interchangeable roads can be developed. As a result of the study, Ardiçoğlu suggests that bicycle transportation can be increased in the city with the diversity of social and physical features and can be integrated into other transportation systems.

In the field of urban planning and development, the aim is to increase the number of bicycles used for utilitarian purposes by encouraging the use of bicycles. This increase is one of the desired results and goals. However, the main problem is that people do not prefer bicycles among other transportation options. Therefore, the solution for urban planners and developers is what this research study aims to provide. In other words, it is necessary to create appropriate and sufficient bicycle infrastructure, urban programs and policies to increase the use of bicycles.

2.1. Data and Methodology

In order to answer the research questions, first of all, published sources and documents need to be analyzed. In this respect, this method was chosen with the idea that the qualitative research and analysis method would be more appropriate and the content analysis method was applied. Krippendorff (2004) describes content analysis as a research technique that allows obtaining repeatable and valid inferences from texts (or other meaningful materials) in the context of their use. For this reason, as the research method of the study, a comprehensive and in-depth analysis of published documents was conducted. First of all, along with the published documents, transportation plans of metropolitan cities such as Ankara, Antalya, İzmir, Kayseri, Konya and İstanbul were accessed and analyzed within the framework of bicycle transportation.

The table below shows a list of indicators and the urban bicycle plans of the cities used as examples in this article. The cities with relevant planning documents are marked in the table to identify the relevant sections and indicators. The table also highlights the important data and indicators that must be present.

This research study shows that a stand-alone urban bicycle plan covers more indicators than urban bicycle planning and development documented in an integrated public transport plan. Therefore, the efforts and commitment to create a stand-alone urban bicycle plan demonstrate that the Turkish city is determined to increase the modal share of bicycle transportation and facilities and is willing to invest financial resources to determine how to make this possible through the urban planning and development process.

The indicators or factors derived in this research study are not an all-inclusive list of what is included in every urban bicycle infrastructure plan. However, the indicators used here were chosen because of their prevalence in the selected urban bicycle plans and their support from researches in the literature.

Table 1. Performance of Urban Bicycle Plans of Selected Cities

Indicator	Konya	Izmir	Antalya	Istanbul	Kayseri	Ankara
Knowledge and Recognition						
Indicator 1	x	x	x	x	x	x
Indicator 2	x	x				
Indicator 3	x	x	x	x		x
Indicator 4	x	x	x	x	x	x
Indicator 5	x	x	X	x		X
Purpose and objectives of the Urban Bicycle Plan indicators						
Indicator 6	x		x	x	x	
Indicator 7	x		x	x	x	
Indicator 8	x		x	x	x	
Planning Policies and Programs						
Planning						
Indicator 9	x	x	x	x	x	
Indicator 10	x		x	x	x	X
Indicator 11	x	x	x	x	x	X
Principle						
Indicator 12	x	x	x	x	x	
Indicator 13	x	x	X			X
Indicator 14	x		x	x	X	X
Indicator 15	x		x	x	X	
Program						
Indicator 16	x	x	x	x	X	
Indicator 17	x		x	x		x
Indicator 18	x	x	x	x	X	X
Implementation and financing of the urban cycling plan						
Indicator 19	x		x	x	X	
Indicator 20	x		x	x	X	
Indicator 21	x		x	x	X	
Urban Bicycle Plan Maintenance and Evaluation						
Indicator 22	x		x	x	x	x
Indicator 23	x		x	x	x	

3. Discussion of Findings

This research article aims to identify appropriate and effective urban planning and development resources to create an urban cycling infrastructure that will improve cycling transportation and facilities. For this reason, it is aimed to identify appropriate indicators or factors that are necessary and important. From this, a list of different indicators from

various sources has been created that will serve as a framework for analyzing urban cycling plans. In the case study section of this research, Ankara Main Transportation Plan was found, which includes information about urban planning and development for urban bicycle infrastructure from Ankara and also provides sufficient and good coverage of indicators. As a result, it was concluded that Ankara is an urban bicycle plan that defines the basic concepts of urban bicycle planning and development, but does not offer bicycle policies and bicycle program suggestions that could positively affect the rate of bicycle transportation and facilities in the city.

4. Conclusion

Ankara, as the capital of Turkey, is a city where transportation problems are among the priority issues, along with its rapidly growing population. Since the 1970s, there has been a significant increase in the use of private cars, with the start of production of domestic automobile factories such as Tofaş and OyakRenault (Yulu and Doldur, 2019). During the same period, a significant increase has been observed in the number of rubber-tired public transportation vehicles such as buses, minibusses, shared taxis and service vehicles. This rapid increase has caused serious problems, especially in the city's central business district and its surroundings.

In the 1970s, serious problems arose in urban transportation in Ankara. Although the 140 buses purchased by EGO in 1969 temporarily met the demands, in the following years, the demand for travel could not be met due to the inability to continue purchasing vehicles and the private sector not investing in transportation (Ankara Metropolitan Municipality, 1999). By 1975, private cars had caught up with the passenger transportation rate of public transportation vehicles in urban transportation in Ankara. Today, 310 million 301 thousand 401 people, equivalent to approximately 50 times the city's population, travel by buses, 105 million 769 thousand 323 passengers by metro, and 33 million 288 thousand 816 people by Ankaray. There are 1 million 870 thousand 5 private cars. In the same period, the cable car, which served 1 million 455 thousand 981 passengers, was the least preferred means of transportation (TRT, 2023)

The aim of this study is to evaluate the urban transportation planning studies carried out in Ankara based on rail systems and to reach an evaluation about both the planning studies and the rail systems currently in operation and under construction.

The Ankara Main Transportation Plan is a good starting point with the broad information and awareness it provides regarding urban bicycle infrastructure. However, the plan can

be improved to help achieve its goals of encouraging more citizens to use bicycles and to benefit more from bicycle facilities in the city. Similarly, the Ankara Main Transportation Plan can make improvements in this framework by deepening the scope of the factors and indicators presented.

Two projects, SMART Ankara and EIT (European Institute of Innovation and Technology) Urban Mobility, supported by the European Union, are being carried out by the EGO General Directorate for the development of bicycle transportation infrastructure in Ankara. The electric bicycle sharing system, which was put into practice as a pilot project, was tested for three months by 110 bicycle volunteers who are members of the AKK (Ankara City Council) Bicycle Assembly, and this is an important step towards the widespread use of bicycle transportation in Ankara and its adoption as a sustainable transportation facility.

There are also the benefits and arguments for a self-sufficient urban public transport plan. For many years, other public transport facilities have been ignored in the face of car-focused public transport models. However, clear recommendations for bicycle programmes and bicycle policy changes with specific goals and objectives will help to create a developed, complete and coherent urban bicycle infrastructure that will enable cyclists to use bicycle transport and facilities safely and efficiently.

While a stand-alone urban public transport plan would allow for improved and more efficient urban cycling infrastructure to be considered than a comprehensive urban public transport plan, a stand-alone urban cycling plan would distance urban cycling infrastructure from the effects of other forms of public automobile transport. In the same context, a stand-alone urban cycling plan would give sufficient scope to ensure adequate urban planning and development to accommodate increased cycling access and facilities in the city.

Note: This article has been prepared by using the preliminary studies of the master's thesis titled "Impacts of Urban Planning and Development on the Quality of Bicycle Infrastructure: A Case Study", which will be conducted by Serag Gamberlo under the supervision of Assoc. Prof. Dr. Özdemir Sönmez, at the Istanbul Commerce University, Institute of Science, Urban Systems and Transportation Management Thesis Master's Program.

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Appendix A

This research study appendix part will contain a table that shows keywords that can be used to help future studies and researchers used this framework to urban bicycle transportation and facilities plans. In addition, this list of keywords is essential because universal nomenclature is not applied when discussing urban planning and development issues related to urban bicycle infrastructure. Increasingly, urban planning and

development documents are made available on city websites .pdf format. .pdf format allows the urban planning and development to be scanned for keywords, highlighting each time in the document the keyword is used. By using a keyword search of urban planning and development documents, a researcher may more easily and readily scan planning documents. However, it is essential to use a different keyword for each topic to ensure each urban planning and development document is adequately searched. This part of thesis, while not exhaustive, will provide much of the verbiage used to clearly describe each indicator. When searching a .pdf, if either word in a search is present, the program will flag the term or concept. This feature helps to ensure complete and adequate scanning of urban planning and development documents. Furthermore, scanning the urban planning and development document alone will not be sufficient to account for indicators. The researcher will have to read and analysis the text that was flagged by the keyword to ensure the context of the use of keywords. On the other hand, the use of keywords should also be used in conjunction with the table of context to determine if and where in the urban planning and development planners discuss each of the indicator, and that full section should be examined to determine if an indicator has been addressed, and to what extent.

Indicator Keywords

Indicator	Keywords
Indicator 1	Bicycle infrastructure, bicycle transportation, bicycle facility, bicycle lane, bicycle path, bicycle route, transportation mixed-use trail, transportation shared path, transportation shared trail
Indicator 2	Green gas emission, fossil fuel consumption, fuel effects, gas consumption, gasoline effects, oil consumption, petroleum consumption
Indicator 3	Improve air quality, Co2 effects, carbon dioxide effects, climate change, green gas emissions, global warming, decreasing greenhouse gas, decrease pollution.
Indicator 4	Improve air quality, asthma illness, wellness, health, healthy lifestyle, negative body mass index, BMI, obesity, physical exercise, and pollution effect.
Indicator 5	Overpopulation, traffic jams, peak travel times, transportation roadway capacity, overcrowding
Indicator 6	Bicycle transportation use, cycling, bicycle riders, objectives, increase
Indicator 7	Bicycle transportation safety, bicycle facilities safety, safety levels, bicycle safety, bike safety
Indicator 8	Goals and objectives
Indicator 9	Bicycle transportation, bike lanes, bike paths, bike route, bike facilities, bicycle lanes, bicycle paths, bicycle routes, urban bicycle infrastructure, mixed-use bicycle trails, bicycle shared paths, bicycle shared trails.
Indicator 10	Bicycle transportation, bicycle facilities, end-of-trip, bicycle facilities, bicycle lockers, bicycle lockups, bicycle parking, bicycle racks, bicycle showers
Indicator 11	Public participation input, citizens participation, public participation

Indicator	Keywords
Indicator 12	Bicycle transportation accessibility, bicycle facilities accessibility, bicycle transportation network, connected bicycle network, bicycle network connectivity, continuous improvement, direct bicycle network, direct bicycle route, bicycle network
Indicator 13	Solid, impenetrable, opaque, urban density, urban development, mixed-use transportation, short-distance trip, public transportation-oriented development, TOD
Indicator 14	Bicycle racks, bus network, bus system, direct buses network, transportation integration, and integrate public transportation, integrate bicycle transportation, light rail, light bike station, public transportation, rail station, public transportation station, transit stop, tramcar, trolley bus
Indicator 15	Bicycle transportation design, bicycle design guidelines, bicycle infrastructure, new bicycle road, bicycle redevelopment, bikes road design, urban engineering, urban planning, urban development, bike road, bike road work, bicycle street, bicycle street design, street urban engineering, street bike project, bicycle stereoscope, bicycle street work
Indicator 16	Cycling education, cycling safety, bikers' education, safety education, bicycle interaction, cycling program, cycling programmatic, bicycle safety
Indicator 17	Bicycle to school, bicycle to work, bike to school, bike to work, cycling encouragement, cycling encouragement program, cycling program, bicycle programmatic, cycling promotion, cycling promotional, cycling promotional program
Indicator 18	Cycling laws, cycling enforcement, cycling laws, bicycle program, cycling safety, cycling safety enforcement, bicycle safety program
Indicator 19	Complete bike streets, cycling design, cycling design standards, cycling design guidelines, bicycle facility design, cycling guidelines, cycling standards, bike road design, bike street design
Indicator 20	Bicycle project financial estimate, cycling fund, cycling funding, financial estimates, project funds, project funding, bonds, funding sources, project funding sources, project grants, project resources
Indicator 21	Bicycle capital improvement plan, bicycle project, improvement project, bicycle project list
Indicator 22	Cycling best practices, cycling maintains, cycling maintenance, potholes, snow removal, sweep, trash removal
Indicator 23	Cycling capacity, cycling evaluation, cycling evaluations, cycling goals, cycling monitor, cycling monitoring, cycling program evaluation, cycling program, cycling program performance, cycling progress

Figure 1. Indicator Keywords