DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

SPATIAL ANALYSIS OF BICYCLE ROADS VIA GEOGRAPHICAL INFORMATION SYSTEMS AND QUESTIONING THEIR EFFICICENCY – CASE OF İZMİR

by
Berçin TOPALOĞLU

October, 2019
İZMİR

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We have read the thesis entitled **"SPATIAL ANALYSIS OF BICYCLE ROADS VIA GEOGRAPHICAL INFORMATION SYSTEMS AND QUESTIONING THEIR EFFICIENCY-CASE OF İZMİR"** completed by **BERÇİN TOPALOĞLU** under supervision of **ASSOC. PROF. MUHAMMED AYDOĞAN** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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SPATIAL ANALYSIS OF BICYCLE ROADS VIA GEOGRAPHICAL INFORMATION SYSTEMS AND QUESTIONING THEIR EFFICIENCY - CASE OF İZMİR

ABSTRACT

The rapid population growth in cities today leads to an increase in population density. Rapid constuction that results from population density seperates the urban spaces and causes transportation problems. Besides, the increase in the use of motor vehicles causes many environmental problems. Air and noise pollution caused by vehicle traffic affects both human health and urban life negatively. As a healthier, more economical, environmentally and eco friendly mode of transport, cycling is considered to be a mode of transport with many additional benefits. Within the scope of the thesis, the characteristics of the city center of İzmir, urban transportation infrastructure and the existing bicycle routes were examined and the assessments related to the whole urban area was determined. In this study, the amount of existing bicycle paths, the spatial distribution of bicycles network and quality of the existing bicycle paths in the city were determined by means of geographical information system. Then, a spatial-database containing coordinated graphical data was created and spatial-analysis was performed on this database using geographic information systems. The data related to the population, land use and transportation network infrastructures, which constitute the other parameters related to urban space, was added as an object-layer in the spatial-database and the competencies of the city-wide bicycle paths were questioned by overlapping with the object-layer containing the existing bicycle paths. Another aim of the study is to create a base for the planning studies in the city of İzmir and in this field, to be a guide for a more efficient planning process and to raise awareness on this issue.

Keywords: Urban transportation, bicycle transportation, Geographical Information Systems (GIS)

BİSİKLET YOLLARININ COĞRAFİ BİLGİ SİSTEMLERİ İLE MEKANSAL ANALİZİ VE YETERLİLİKLERİNİN SORGULANMASI - İZMİR ÖRNEĞİ

ÖZ

Günümüz kentlerinde yaşanan hızlı nüfus artışı, kentlerdeki nüfus yoğunluğunun artmasına sebep olmaktadır. Nüfus yoğunluğu ile beraberinde gelen hızlı yapılaşma kent mekânlarını birbirinden ayırmakta ve ulaşım probleminin ortaya çıkmasına sebep olmaktadır. Yanı sıra motorlu taşıt kullanımındaki artış birçok çevre probleminin ortaya çıkmasına neden olmaktadır. Taşıt trafiğinin yaratmış olduğu hava ve gürültü kirliliği hem insan sağlını hem de kent yaşamını olumsuz yönde etkilemektedir. Daha sağlıklı, ekonomik, çevre ve doğa dostu ulaşım türü olan bisiklet birçok ek faydalar sağlayan bir ulaşım türü olarak değerlendirilmektedir. Tez çalışması kapsamında İzmir kent merkezinin özellikleri, kent içi ulaşım altyapısı ve mevcut bisiklet yolları incelenerek kentsel alanın bütününe dair durum tespiti yapılmıştır. Yapılan çalışmada kentteki mevcut bisiklet yollarının miktarı, mekânsal ölçekteki dağılımı ve niteliği coğrafi bilgi sistemi araçları ile tespit edilerek, koordinatlı grafik verileri içeren bir mekânsal-veritabanı oluşturulmuş ve bu veritabanı üzerinde coğrafi bilgi sistemleri kullanılarak mekânsal-analizler yapılmıştır. Kentsel mekâna ilişkin diğer parametreleri oluşturan nüfus, arazi kullanım ve ulaşım ağı altyapısı ile ilgili veriler de, mekânsal-veritabanında birer nesne-katmanı olarak eklenmiş ve mevcut bisiklet yollarını içeren nesne-katmanı ile çakıştırılarak kent geneline dair bisiklet yollarının yeterlilikleri sorgulanmıştır. Çalışmanın bir diğer amacı ise İzmir kenti ve bu alanda planlama çalışmalarına altlık oluşturmak, daha verimli bir planlama süreci için yol gösterici olmak ve bu konuda farkındalık yaratmaktır.

Anahtar kelimeler: Kentsel ulaşım, bisikletli ulaşımı, Coğrafi Bilgi Sistemleri (CBS)

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CHAPTER ONE
INTRODUCTION

The fact that motor vehicles were produced during and after the industrial revolution has led to the entry of vehicles into our daily lives changes in socio-economic movements in cities. This mobility has led to an increase in the urban population density and the shaping of the macroform of cities. These changes, which have caused the city to grow physically, distract the housing, working and service areas from each other and make transportation one of the most important problems of urban life. Therefore, this situation has led to an increase in distances and longer travel times in cities. Although the increase in travel demands in cities has resulted in emergence of various types of urban transportation, the expectation for comfort and the demand for single vehicle access from the source to the destination has led to an increase in vehicle traffic, traffic problems and environmental problems. The increase in density, which is the main cause of transportation problems, has led to an increase in the number of vehicles and subsequent increase in infrastructure investments. The development of the infrastructures also has caused an increase in the number of vehicles and a lack of infrastructure. Thus, the transportation problem has created a vicious circle in itself.

With the acceleration in the urban development after 1950's in our country, motor vehicle use has increased and subsequently caused to rising transportation problems. The policies and projects produced for the solution of the problem have led to greater economic and environmental damages, as they are not long-term. As a result of recent studies, it has been realized that long-term permanent solution in transportation can only be achieved by using sustainable planning and transportation methods, and human-oriented transportation solutions have begun to be focused instead of motorized transportation.

Given the problems that motor transport brings to human life and cities, bicycle transportation, which is one of the non-motorized transport types, is a useful solution. If sufficient infrastructure is provided at much lower costs compared to motorways, bicycles can provide transportation from source to destination with a single vehicle as well as motor vehicles.In addition, given the problems of global warming,

environmental pollution, obesity and lack of physical movement caused by urban life, cycling is considered as a transportation mode that provides many additional benefits.

Unfortunately, bicycle and bicycle transportation is not very common in our country, but it is not seen as a means of transportation by many people. This view is in the opposite position in developed countries where the use of bicycle has taken its place in urban transportation and has gained a seat among the transportation systems. In addition, in these countries, the use of bicycles is provided through various policies in order to promote and encourage the use of bicycles more widely. Our country, on the other hand, is considered suitable for cycling when its topographic structure and climatic conditions are taken into consideration, however, due to social and cultural factors, cycling has been ignored. It has been seen by many people as a toy or a sports vehicle for children. As a result, the culture of bicycle usage for transportation purposes has not formed or has remained limited in narrow areas. The fact that bicycle, as a means of transportation, has not taken place in the planning studies carried out by national or local governments has resulted in the increase in distances, and as a result of this, it has led to inadequacy of transportation infrastructure, which affects the development of bicycle use in transportation adversely (Uz & Karaşahin, 2004).

In this study, it was aimed to obtain information about the current status of bicycle transportation with the help of geographic information systems, to evaluate the distribution and use of space in urban transportation and to question its adequacy.In this context, İzmir was chosen as the application area and spatial and analytical level analyzes and studies were conducted.

Within the scope of the study, after the introduction, in the second part, today's urban transportation systems are examined. Motor transportation and non-motorized transportation types are explained and their situation in cities of the world and our country was compared. The importance and characteristics of bicycle transportation, which is the most important type of non-motorized transportation were explained. Planning studies carried out by leading cities in bicycle transportation and policies developed for the promotion and use of bicycles were evaluated.

In the third part, the development of design and usage starting from the definition of bicycle has been mentioned. Then the history of cycling in Turkey and provides information about the current situation. While explaining the current situation, the status of the bicycle for transportation purposes were examined based on the surveys and planning studies conducted in today's cities.

In the fourth section, the geographical structure of the study area, socio-economic and demographic structure, development of urban macroform and information about urban transport infrastructure were given. Also, information on the bicycle infrastructure of the study area was given and information was given about the works carried out for the development and promotion of bicycle for transportation purposes throughout the city.

In the fifth section, spatial level analysis was performed by using Geographic Information Systems for bicycle routes developed for urban transportation. Then, surveys on bicycle conducted within the scope of İzmir Metropolitan Municipality were explained and evaluated. Finally, camera counting method was used to specify the potential bike users in urban areas where there is no bicycle path. With the help of field study analytical data was produced and the results was evaluated.

In the conclusion, all studies were evaluated and recommendations were developed for the development of bike use in transportation in İzmir and Turkey.

CHAPTER TWO
URBAN TRANSPORTATION SYSTEM

Transportation is a bunch of systems in which human, animal or object is displaced in space and time. The concept of transportation has gained importance with the settlement of people and the establishment of cities and various modes of transportation have been developed in this process. Today, transportation is provided in various ways such as air, land, water, tunnel, and cable.

Urban transportation includes the travel and mobility of the urban population within the city. Previously, transportation within the city was only done by pedestrians and animal carriage. This situation has evolved over time and brought the need for working people to reach their workplaces and homes. As a result, it has been the beginning of the development and continuation of urban transport types (Öncü, 1997).

With the economic and social developments, the increase in the rate of population has increased the daily travel rate of citizens. This increase has led to increase in total urban travel rates. This situation has increased the scope of urban transportation by rapidly increasing its scope and increased travel distances in urban areas. As a result, pedestrian journeys have turned into motor vehicles (Ulaştırma Özel İhtisas Komisyonu, 1995).

Transport systems not only affect the general structure of the city or country, but also affect the economic, social and cultural dynamics of the city or country. The solution of increasing freight and passenger densities in cities in terms of transportation has been made by trying to respond and offer different alternatives depending on the developing technology. In this process, while providing benefits to the environment, society and industrialization, it has caused environmental adversities that disturb people. As a result, when the economic dimension of transportation is examined, it causes costs and rent.

2.1 Current State of Urban Transport System

The rate of population growth in urban areas or the increase in construction rate due to overpopulation have played an active role in the expansion of living spaces. This growth and development realized on spatial scale has separated the settlements from each other. Thus, the developing transportation system based on pedestrian and bicycle has been replaced by motor vehicles (Akbulut, 2016).

The realization of economic, social, etc. activities in urban transportation caused an increase in the demand for motor vehicles. The fact that the majority of the country's population lives in the cities, expansion of the cities, and increasing ownership of automobiles had caused these distances and travel demands to increase. When urban transportation systems fail to respond to these developments, transportation and traffic problems have continue to increase in cities.

> A large majority of European citizens live in an urban environment, with over 60 % living in urban areas of over 10 000 inhabitants. They live their daily lives in the same space, and for their mobility share the same infrastructure. Urban mobility accounts for 40 % of all CO_2 emissions of road transport and up to 70 % of other pollutants from transport (European Commision, 2018).

83.5% of passenger transport in European Union countries is carried out by road, while this figure is 87% in the USA. The second is the airline transportation for European Union countries and the USA. The road passenger transport in Turkey in 2011 was determined to be 242,265 million passenger-km. This figure shows that the 16% increase in the last five years, domestic passenger transport in Turkey. When we look at the 2011 air transport figures, it is seen that there is more demand compared to road transport and therefore the amount of increase is higher. The reason for this is that the recommendations developed for the incentive of air transportation and the decrease in the ticket prices has a large share. This type of transportation, in which the desired comfort and loss of time is minimized during the journeys in the developing country economy, causes the passengers to show interest (Ilıcalı,Camkesen, Kızıltaş, & Ergin , 2015).

Table 2.1 Number of passengers for 2006-2011 by type of transportation (passenger-km million)

Transport Mode	2007	%	2008	%	2009	%	2010	%	2011	%
Mainroad**	209115	97	206098	97.2	212464	97.1	226913	97.3	242265	89.7
Airway**	-		-		-		-		1.016	6.7
Maritime***	843	0.4	848	0.4	887	0.4	848	0.4	848	0.3
Railway **	5553	2.6	5907	2.4	5374	2.5	5491	2.3	8882	3.3

** Domestic and International transport is not included. **It is in passenger-km. ***It is in passenger-miles.*

In urban transportation, individual transportation systems such as cars, trams, ferries, subways etc. constitute public transportation systems. According to the study, considering that there are two people in a car in our country, it is revealed that a secluded bus can carry 30 cars and a full bus can carry 50 cars (Akı, 2015).

Figure 2.1 The amount of space required to transport the same number of passengers-car-bike and bus (Wright & Fjellstrom, 2003)

While transportation systems provide socio-economic benefits, they also have negative effects on the environment. Transport activities meet the increasing demand for freight and passengers while at the same time increasing the level of environmental problems. When the relationship between transportation and environment is evaluated, three different types of impact can be mentioned. First of all, when the global effects are considered, it is the emission of carbon monoxide caused by the increase in vehicle traffic. The transportation sector uses 25% of the world energy and half of the total oil production. This poses a major threat by increasing the global impact of this 25%

source of gas. When the urban impacts of transportation are considered, they are unconsciously ways to meet the demand despite increasing vehicle traffic. This situation causes the cities and surrounding rural areas to become more concrete. Finally, when local impacts are evaluated, they are developed policies and practices focused on automobile use instead of pedestrian and bicycle transportation (Akı, 2015).

2.2 Types of Urban Transport System

Today, transportation is an indispensable element in our daily lives. Different transportation systems and modes of transportation have been developed in order to realize our journeys in and between cities in the world and in our country. These developed transportation systems are classified according to criteria such as whether the system is motorized or non-motorized, according to individual or collective use, whether the selected routes are flexible or stable and will allow them to be used jointly with other systems.

According to Vuchic (2007), transportation and operation are divided into three categories: privete, for-hire and public or common carrier. Private transport consists of private vehicles for own use by the owners. For-hire, also known as paratransit transport, is a transport service that is carried out under the terms of an operator or transport contract. Public transport or mass transportation is the most common type of urban passenger transport and is used by all, fixed line and paid transportation. In addition, the secondary classification of travel divides into two groups, individually or collectively.

2.2.1 Types of Motorized Transport in Urban Transport

In the 19th century, the evolution of motor vehicles had taken place with the use of steam as an energy source. The use of motor vehicles in urban transportation has started with the production of wheeled vehicles that are capable of carrying passengers. From the past to the present, we have started with automobile production. According to the demand, minibuses and buses for public transportation were produced.

In terms of the inter-species distribution in motor transport, road transport has a greater share than other types. Providing direct transport, carrying capacity, flexibility in route selection and easier integration with other types increase the priority of road transport choice. In our country, the trend towards road transport and the increase in the number of motor vehicles tend to increase as in other world cities. Table 2.2 shows the change in the number of motor vehicles per 1000 people. Changes in the country between the years 2003-2009 are differentiated between 1% and 6% in the case of Turkey; this ratio reaches up to 56%. This clearly shows that countries with developed economies have reached a saturation rate of personal vehicle ownership. In Turkey, the existing traffic problems have increased steadily, reaching a larger audience by expanding indicate that this increase (Ilıcalı, Camkesen,Kızıltaş, & Ergin, 2015).

Table 2.2 Number of motor vehicles per 1000 persons

Country	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Change (%)**
ABD	796	810	816	818	820	815	802	1%
Germany	576	537	543	549	553	556	564	-2%
Austria	595	599	549	553	557	561	569	**-4%**
France	594	595	596	598	598	598	598	1%
South Korea	303	311	320	329	329	346	355	17%
Holland	-	494	491	504	504	522	-	6%
England	496	540	517	521	521	526	523	5%
Sweden	-	508	513	517	517	521	519	2%
Japan	581	587	592	594	594	592	589	1%
Norwey	525	535	546	558	558	575	578	10%
Turkey	91	111	118	126	126	138	142	**56%**

In our country, there has been an increase in the rail system investments aimed at reducing the use of personal vehicles in urban transportation in recent years. However, these investments alone are not sufficient in terms of achieving balanced generic distribution and decreasing private car ownership rates. The reasons for not being sufficient are the lack of urbanization culture and well-established transportation infrastructure. The traffic volume and generic distribution rates between 2020 and 2050 were calculated based on the world-wide traffic volume and the generic distribution values of 1960 and 1990. According to the figure, automobile dependence has been reduced and replaced by high speed transportation and high-speed trains and airlines (Ilıcalı, Öngel, & Kızıltaş, 2015).

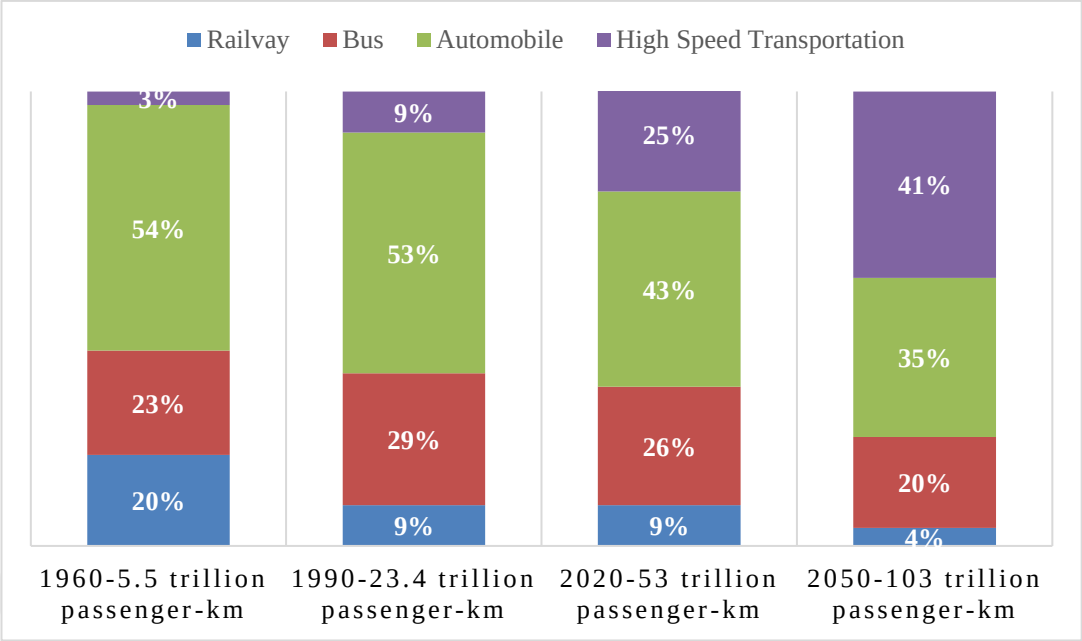


Figure 2.2 World traffic volume in 2050 (Ilıcalı, Öngel, & Kızıltaş, 2015)

When the types of motor vehicles in urban transportation are examined, they are divided into three groups as public and individual transportation: Public transport, individual transport and autonomy transport.

2.2.1.1 Public Transport

Public transport, which is one of the types of motor vehicles, is defined as the journeys made by individuals without the use of individual vehicles. The type of public transport is divided into three parts: rubber wheels, rail and maritime transport. These types, which are used in our country and other cities of the world, provide the transportation of the citizens between the two points.

Rubber wheeled public transport systems are common in developed and developing countries. Since they serve as a collective service rather than a person, they occupy the road less and cause less environmental pollution. Public transport with rubber wheels has a large network structure working on the streets in cities. This system is made by using bus, minibus, private public bus vehicles. It works with fixed route, timetable and price (Vuchic, 2007). Stations and fees are predetermined by local authorities. Rubber wheeled transportation systems are able to meet the demands of travel in both developed and underdeveloped countries in the fastest and safest way. It can be

operated on the existing highway in cities or with its own dedicated infrastructure. Line arrangements in rubber wheeled system are generally arranged in order to provide access to residential areas to the city center (Elker, 1997).

Figure 2.3 Public bus transportation in London (Major of London, 2016)

From the past to the present, when the last ten years have been evaluated, the demand for rubber wheeled transport has been reduced. The reason for this is that the increase in the number of cars leads to traffic congestion and consequently decreases comfort and accessibility. The table below shows the shares of public transport compared to other types in the last decade. While it was 19.5% on average in the 1980s, its average share in the process decreased by 13.3%. Between 1980 and 2000, the largest decrease was observed in Kuala Lumpur, while the smallest decrease was observed in London. The low change in London may be seen as legal regulations for private car owners by local authorities (Ceylan, Başkan, Haldenbilen, & Ceylan, 2007).

Table 2.3 Comparison of world cities according to wheeled use

Cities	1980 (%)	After Years (SY)	SY (%)	Change (%)	10 Years of Change (%)
Amsterdam	20.4	1995	16.9	-16.8	-11.6
Copenhagen	21	1995	17.4	-17.2	-11.8
Frankfurt	35.8	1995	14.2	-60.3	-46
Hamburg	23.1	1995	14.8	-35.9	-25.7
Hong Kong	80.5	1995	14.8	-9.3	-6.3
Kuala Lumpur	30.2	1995	10.8	-64.3	-49.6
Münich	35.2	1995	29.4	-16.6	-11.4
New York	14.1	2001	11	-21.8	-11
Paris	32.5	1995	24.1	-25.7	-18
Tokyo	68.25	1995	56.6	-17.4	-11.9
Toronto	25.7	1990	15.2	-40.8	-40.8
Average	**19.5**		**14.6**	**-19.1**	**-13.3**

Another means of transport used in public transport with rubber wheels is the intermediate public transport system, also known as paratransit. Apart from public transportation, this system becomes a component of urban transportation. The difference of Paratransit system from other rubber wheeled transportation is that travel routes are formed according to the transportation demands in the settlements. In other words, the paratransit system gains flexibility according to the needs of the passengers and is therefore often preferred. It is often preferred in developing countries rather than developed countries. The increasing demand for this type of transportation in developing countries plays a major role in increasing the traffic problems in the city center. According to Roos and Alschuler (1975), the natural fragmented structure of paratransite and various regulatory elements within the sector prevent the system from working at full efficiency and cannot fully reveal its role in public transport.

Another public transportation means in cities is rail systems. These systems, which emerged in parallel with the start of local transit services, has started to use rail technology with partially or completely reserved road rights. To provide this service, three different modes have emerged: suburban railways, electric interurban railways and rapid transit/metro (Vuchic, 2007). In rail systems, the journey takes place on a fixed route and in wagons. Today, rail transportation systems used in urban passenger transport consist of light rail systems, tramway, subway, suburban system, magnetic bed system and monorail.

Figure 2.4 LRT system in Berlin (Railway Pro, 2018)

Rail systems have the capacity to carry more passengers in urban public transportation system than rubber wheeled transportation type. Having an independent line compared to other types of transportation provides a comfortable and easy journey along with facilitating transportation. The following table shows the travel capacities by type of vehicle. According to the table, the system with the highest travel capacity is rail system. According to the values, it is seen that the subway carries 4 times the bus. In this case, it is possible to say that the subway is 4 times more efficient than the bus and reduces the traffic load in the cities by one third.

Table 2.4 Travel capacity by vehicle type

Type of Vehicle	**Number of Passenger (passenger/h)**	**Energy Consumption (passenger-km)**	**Investment Cost (passenger-km)**	**Operating Cost (passenger-km)**	**Air Pollution (passenger-km)**
Automobile	900	100	100	100	100
Minibus	3500	26	9	44	3
Bus	12000	19	6	12	0.8
Tram	20000	22	5	8	-
Metro	40000	19	25	3	-

According to the European Commission's Transport Future Document for Europe in 2050, it will be possible with a sustainable rail system to solve problems such as overpopulation, global warming and excessive oil consumption (Yıldıztekin, 2015).

Rail systems generally serve in transportation corridors with high demands that cannot be met by bus system. Large cities and metropolises can be reached as much as out of the city and is an ideal solution to meet the demands of medium and high travel in cities. Although the investment costs are high, the operating costs are quite low. In addition, when the accident risk ratio is evaluated in terms of energy consumption, traffic congestion and personnel employment, it is seen that it is superior to road transportation.

Sea transportation, which is one of the public transportation systems, is a type of transportation that is used in areas where urban settlement expands along the coast. It is an indispensable type of transportation in coastal cities due to its high level of comfort, safety and relaxing feature in transportation. However, it does not fully meet the travel demands of people, such as other types of public transport, and thus continues to depend on other types.

In our country, it is used as a means of transportation in coastal cities such as Istanbul and Izmir. Sea transport, which started in 1987 in Istanbul, currently provides urban transport with 32 passenger ferries, 25 high speed ferries (sea bus) and 5 car ferries. When the Istanbul city transportation was examined, it was found that 92% of the trips were made by rubber wheeled vehicles, 5.5% by rail and 2.5% by sea (Türk Mühendis ve Mimar Odalar Birliği Gemi Mühendisleri Odası, 2008).

Figure 2.5 Water transportation in İstanbul (Türk Mühendis ve Mimar Odalar Birliği Gemi Mühendisleri Odası, 2008)

As a result of the efforts to increase the efficiency of maritime transport in the city, no positive result was obtained. During the historical development process, the development of road and railway infrastructures in cities has increased the use of private vehicles and the tendency towards the tire wheel system in public transportation. After all, it is possible to say that the current state of maritime transportation is faced with the threat of being a historical and touristic city element by fighting other types of life in urban transportation (Ulaştırma Özel İhtisas Komisyonu, 1995).

2.2.1.2 Individual Transport

Individual transport is generally defined as the operation of a person and the act of carrying that person through the use of vehicles. Personal transport vehicles are capable of transporting one or more people and have a limited capacity. Automobiles are the best example for individual transportation.

In other words, the beginning of personal transportation dates back to ancient Mesopotamia in 4000 later BC. In 3500, the foundation of the first transportation vehicle was laid with the invention of the wheel. Firstly, these two-wheeled vehicles were then used with horses and the movement of horses enabled the wheels to move simultaneously. The first vehicles to be produced as a result of using the invented wheel in this way are the carts.

Since the 16th century, the increase in the European population has led to an increase in the urban population. The spoils obtained as a result of wars in that period led to the increase of capital, the formation of the bourgeois class and the creation of new areas of investment. In this process, the 18th and 19th century Industrial Revolution has opened the way for new discoveries.

During this period, the steam engine was invented by Denis Papin in 1679 enabled the development of the industry and the formation of the automobile sector. The fact that the vehicle production was costly at that time also affected the purchasing power of people to buy vehicles. In 1900, only 1 in 9.500 people owned cars in the United States. However, in 1908, the Model T produced by the Ford Motor Company, founded

by Henry Ford, completely changed the ownership rate of the vehicle. In addition to running on gasoline, these vehicles, produced by keeping the production costs low, were in demand thanks to its low price that was accessible to people from all walks of life. In 1908, the number of vehicles in the world was 250000, but with the arrival of the Model T, this number had been doubled (Touesnard, 2004) .

Figure 2.6 Ford T model (Cloudlakes, 2018)

From past to present, the mobility rates of motor vehicles in cities have increased in direct proportion with the increase in the number of vehicles. Today, 737 million private vehicles travel 30 billion km and 60 billion passenger-km distance every day. This number reaches 10 trillion km and 20 trillion passengers-km at the end of the year. The US population constitutes 4% of the world's population, while the number of car ownership in the country is 3% of the world's automobiles. This ratio is approximately 7-8 times the other vehicles in the world. In this respect, motor vehicles in the country cover 13 billion vehicle-km per day and reach approximately 20.5 million passenger-km.This number reaches 5.5 trillion vehicle-km and 7.2 trillion passenger-km by the end of the year (Çöl Yılmaz, 2014).

Figure 2.7 Traffic congestion in Newyork, USA (Angerer, 2019)

In the last decade, the use of automobile as a means of transportation has increased significantly. Between 1960 and 2005, the number of automobiles in the US increased from 62 million to 137 million. This increase was effective in increasing the number of kilometers traveled from 944 billion to 2.719 billion. In Sweden, this situation was set that is not very different case from that in the United States. It was found that the number of 1.2 million cars in 1960 increased to 4.2 million in 2005. The number of kilometers covered by cars increased from 56.57 billion in 1999 to 61.82 billion in 2005 (Erikson, 2011).

The number of vehicles in Brazil between 2009 and 2010 was determined 32 million, 78 million in China, 73 million in Japan and finally 20.8 million in India. The number of people per vehicle across the country was calculated 5.9 in Brazil, 17.2 in China, 1.7 in Japan and 56.3 in India (Dia, n.d.). The use of individual vehicles constitutes both advantageous and disadvantageous situations for the user.

It seems cheap for the user to use the tool for a single journey. Secondly, it gives a sense of freedom and independence because the current control is in the hands of the person until they reach the desired destination. Third, it provides a sense of vehicle privacy, comfort and control over the environment. Finally, yet importantly, owning a car is seen as an investment instrument and reveals a sense of social superiority. The

disadvantages of using private vehicles are divided into two groups: individual and collective. Individual personal care costs, vehicle insurance, operating costs, etc. like this. In addition, the financial loss of value of the vehicle over time is also added. The cumulative effects cause an increase in traffic density. In the Netherlands, the number of road vehicles increased by 1.5% between 2015 and 2017. According to 2017 data, the congestion caused by the vehicles caused an increase of 3% (Berg, 2017).

These developments in the developed countries affect the developing countries more. In parallel with the increase in population and developments in urban areas, no improvement has been achieved in transportation infrastructure. Consequently, despite the rapid growth, public transportation has remained limited. Although new roads and multi-storey intersections were built to prevent the increase in vehicle ownership, the proposed solutions led to increased road capacity, traffic congestion and further growth of urban areas.

2.2.1.3 Autonoum Transport

Driverless transportation is the transportation with autonomous vehicles or vehicles called driverless vehicles. The main purpose of this technology is to eliminate the driver factor and to support the technological developments and to produce and spread the vehicles with less risk. The most important of these technological features developed in vehicles is the replacement of the sensory organs of people, radar, lidar, sensor, GPS, computer and advanced advanced control systems are equipped. Although the first attempts on this subject started in the 1920s and 1930s, the first successful trial was the DARPA Autonomous Land Vehicles (ALV) project, which took place between 1987 and 1995.

According to Parent 2015 autonomous vehicles are divided into three. The first systems are those that move only by the driver. Technological advances help the driver. The second type is semi-automatic systems. In this system, the driver intervenes in case of need. The third is fully automated systems. This system is a system that automatically moves without the need for a driver monitoring and control, and automatically calculates the speed limit and the risk of each song.

Today, there are 12 companies working on the development of autonomous vehicles and continuing their test drives. The first serious work on these tools is Google. One hundred autonomous vehicles produced by the company were taken to test drives in Detroit. The speed limit did not exceed 25 mph in driving, and it was successful in the tests by acting in accordance with the existing traffic towers, traffic signs and signaling systems. Targeted on autunoum vehicles; the complete disabling of the driver's initiative is the management of the vehicle management by a system that can be referred to as autopilot. The working principle of the vehicles is to be equipped with computer-aided technological features in addition to the mechanical part of the vehicle. The most important device is the camera system that replaces the human eye in the vehicle. The cameras perceive the environment by means of the vehicle and interact with other objects such as the signaling system and the plates. Secondly, radar systems have been developed to detect and capture motion at close and long distances. In this way, the vehicle can adjust the speed while driving. Sensors, GPS receivers and communication devices are the necessary tools for navigation, and one of the most important systems is the control systems where the vehicle control panel is referred to as-Human-machine interface. Unlike classic cars, all kinds of control operations of the vehicle such as cockpit in the aircraft are carried out from here, and since it is an emergency, the vehicle warns the passenger through this system. In addition, parking assist for automatic parking of vehicles, line change assistance used in line changing of the vehicle, ane lane-chance assistance blind spot/dead spot detector, spot blind spot detection, curb or lane warning system, departure lane departure warning brake assistance, collision avoidance, adaptive cruise control, and cross traffic alert systems that can detect cross-approaching vehicles or objects are also available (Yetim, 2016).

Figure 2.8 Autonomous car by Google (Davies, 2016)

In terms of the structure of autonomous vehicles, production is not only from the hands of a single major manufacturer, but also high technological hardware will require its coordination with other companies. Thus, it will prepare the ground for the formation of many new business lines. In addition, these vehicles, which are produced with the main objective of protecting human life, make fewer mistakes and reduce fuel consumption with intelligent driving techniques. With the introduction of autonomous vehicles in our daily lives, the increase in the number of people sharing the vehicle in terms of public transport will result in a decrease in the number of vehicles and harmful gases released into the air. These systems can be used more efficiently in terms of combating terrorism in military units. Although there are many advantages, the cost of the manufactured vehicle makes the vehicle disadvantageous. Since the infrastructure required for the operation of autonomous vehicles is provided in developed countries and not developed in less developed and developing countries, the transition to this system will be even more costly. With the introduction of autonomous vehicles, it will cause losses in some business and occupational groups.

The first international legal regulations on motor vehicles are the Uluslararası Convention on the International Movement of Motor Vehicles a signed in 1909 in Paris. The first accident involving autunoum vehicles occurred when the test vehicle produced by Google crashed into another vehicle. As a result of the accident, Google's worker was slightly injured. However, it was stated by Google officials that the vehicle was not a fault (Thinktech, 2017).

Regarding the developments related to autonomous vehicles, it is thought that legal arrangements will be made between 2015 and 2025. However, other applications that are aimed to be made are summarized in the table below:

Table 2.5 Expected applications by years

No	Years	Expected Applications
1	2020-2040	Completion of suitable roads for autonomous vehicles
2	2020-2030	Autonomous vehicles for sale
3	2030-2040	Service of autonomous taxis and start of vehicle sharing
4	2040-2050	Having low-income people with autonomous vehicles
5	2050-2060	Car sharing will increase and decrease the need for parking
6	2040-2060	Partial restriction on classic vehicles
7	2060 and later	Fully limited and autonomous use of conventional vehicles is mandatory

The most challenging, complex, expensive and time-consuming phase is the third phase. Because at this stage, it is aimed to establish a system in which there is no traffic confusion and safe travel takes place.

2.2.2 Types of Non-Motorized Transport in Urban Transport

There are two different ways to make transportation systems work more efficiently and improve their performance. The first is to increase the capacity of the motor vehicle. The second way is to provide more efficient use of existing vehicle activities called transport demand management or mobility management. Mobility management is now accepted and implemented by many experts. The following table contains some mobility management strategies to promote non-motorized transport (Litman, 2010).

Table 2.6 Mobility management strategies promoting non-motorized transport (Litman, 2010)

Improves Transport Options	Price Incentives	Land Use Management	Implementation Programs
Transit improvements	Congestion pricing	Smart growth	Commute trip reduction
Walking improvements	Distance-based fees	Location-efficient development	School and campus transport management
Cycling improvements	Parking cash out	Parking management	Tourist transport management
Bicycle parking facilities	Parking pricing	Transit oriented development	Transit marketing
Bike/transit integration	Pay-as-you-drive vehicle insurance	Carfree planning	Nonmotorized encouragement
Guaranteed ride home	Fuel tax increases	Traffic calming	

Non-motorized transportation is active transportation including walking, cycling, wheelchair, skiing, skating. Non-motorized transport plays an important role in mobility management. Mobility management programs aim to reduce the use of motor vehicles, leading a large number of passengers to public transport, shared vehicle use, as well as transition to bicycles and pedestrian transport. The benefits of improving and enhancing non-motorized transport are listed in the table below.

Table 2.7 Benefits of nonmotorized transportation (Litman, 2010)

Improved NMT Conditions	Increased NMT	Shift from Automobile to NMT
Improved user convenience and comfort.	Improved public health and fitness.	Reduced traffic congestion.
Increased travel options.	User enjoyment.	Road and parking cost savings.
Improved basic mobility for non-drivers.	Increased community cohesion (positive interactions among neighbors).	Consumer cost savings.
More attractive and livable communities.		Reduced crash risk to others.
Improved local property values		Air and noise pollution reductions.
		Energy conservation.
		Economic development benefits.
		Supports strategic land use objectives.

Studies have shown that increased non-motorized transport is associated with reduced vehicle use. Every pedestrian and bicycle ride cause a decrease in vehicle travel distance. The high level of non-motorized use in cities reflects the use of land use, such as density, mixed use, street arrangements, parking supply and pricing. Mobility management programs developed for the promotion of non-motorized transport lead to a reduction in vehicle travel distances.

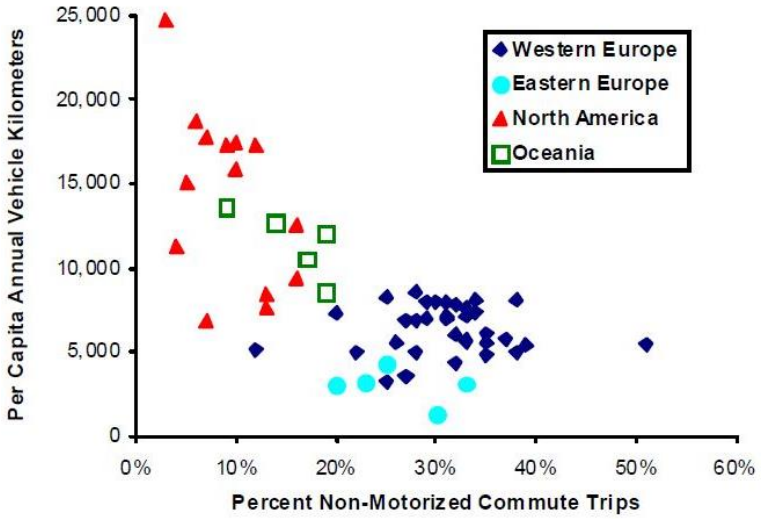


Figure 2.9 Non-Motorized trips by regions (Litman, 2010)

The following figure shows the distribution of urban journeys in different types of countries. The change of non-motorized transportation by country is clearly observed.

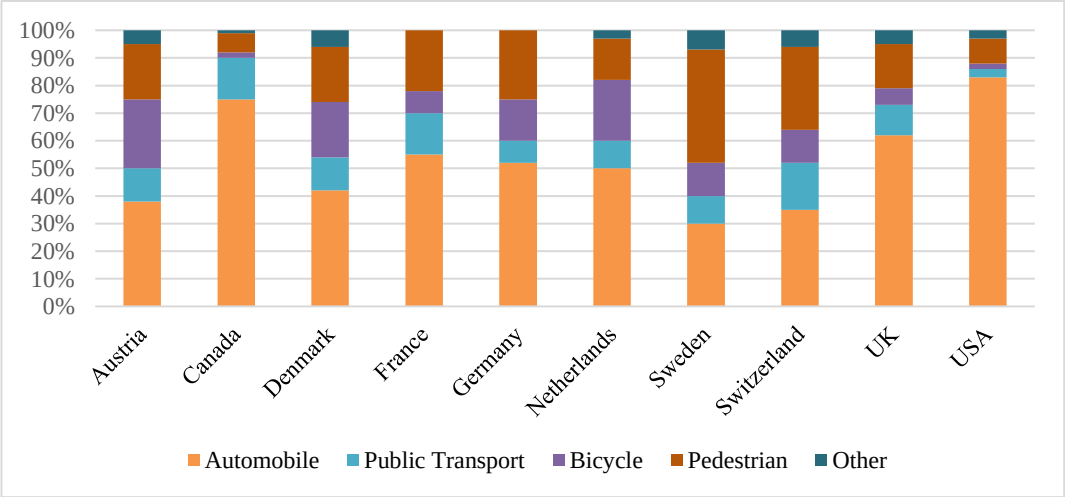


Figure 2.10 Urban mode split rates by lands (Çöl Yılmaz, 2014)

Non-motorized transportation provides many advantages in urban transportation. Bicycle and pedestrian transportation are a user-friendly mode of transportation. People play an active role in reducing environmental problems such as congestion, parking fees and pollution. However, although the rate of cycling is high in countries such as Sweden, Denmark and the Netherlands, this rate is 5% when taken together with other countries within the European Union.

The traditional planning method in cities aims to reduce the importance of non-motorized transportation. Many travel surveys emphasize that 2% to 5% of travel takes place by non-motorized transport, and hiking and cycling are insignificant. However, these studies ignore short-distance trips, non-work trips, children-made trips, recreational trips and transfers from non-motorized transport to motorized transport. It is three to six times larger than the actual results of many surveys without motorized transport (Litman, 2010).

2.2.2.1 Pedestrian Transportation

Pedestrian; people who use public spaces in public places and adjacent to the vehicle road for their own mobility, make their own transportation, use walking as a physical vehicle, move in urban spaces by walking or by wheelchair in case of disability. Pedestrian access is the name given to all of these actions of pedestrians (Surat & Yaman, 2015). Pedestrian transportation, which has the largest share in urban transportation systems, is an indicator of the level of livability in terms of responding to many socio-cultural, commercial, recreational, etc. needs of the city. Ensuring the comfortable, safe and healthy circulation of pedestrians within urban spaces has always been of indispensable importance in organizing accessible urban spaces.

Pedestrian transportation, which covers a large part of urban transportation since history, is among the ignored subjects. The increase in the use of motor vehicles despite the freedom of movement recognized by the cities has caused many elements to disappear. Spreading in urban areas and increasing distances between these areas led to an increase in the number of vehicles. The increase in the width of the streets and streets in cities to solve this situation caused the pedestrian pavements to shrink and disappear in places. The purpose of pedestrian transportation should be to open spaces for pedestrian journeys as a type of transportation and to create spaces that enrich social and cultural life free of traffic complexity and vehicle occupation (Surat & Yaman, 2015).

Another disregard for pedestrian transport is the pedestrian zone. These are the open spaces created for the purpose of reducing vehicle and pedestrian traffic in cities. Commercial areas are closed at certain times of the day and in residential areas, vehicle traffic is slowed down and pedestrians are provided with a safer and more comfortable

movement area. The first implementation took place in 1926 in Essen, Germany. II. Another practice before World War II was the Rockefeller Center in New York, USA. In our country, it was first discussed at the International Roads Congress in Istanbul in 1955. When the first examples are examined, the Kızılay-Sakarya Pedestrian Zone Arrangement has been made with the idea of increasing the urban walking areas and green areas and strengthening the regressing socio-cultural functions (Yıldırım, Özel, & Oktay, 2002).

Figure 2.11 Stroget, Copenhagen (Imagui - Comunidad en castellano para compartir fotos online, n.d)

The failure of cities to develop due to the pressure of motor vehicles led to the emergence of urban mobility plans. The concept of sustainable development, which emerged in 1980 and 1990, has emerged as a global mission and priority. In 1987, the Brundland Commission identified sustainable development as a "To meet today's needs without hindering the chance of future generations to meet their own needs", although a single and clear method for urban sustainability is not clear (Brundtland Commission, 1987). Urban sustainability is only possible through sustainable transportation planning. In 2002, the Center of Sustainable Transportation stated that it would have to meet certain criteria in order to be sustainable:

- To ensure that individuals and communities can safely access their basic access needs,

- To support a vibrant economy and to choose between modes of transport.
- Limit emissions and waste to the extent the planet can tolerate.

In this respect, “Sustainable Urban Mobility Approach” and “Traditional Transportation Planning Approach” differ from each other. While the traditional transport planning approach focuses on how mobility of vehicles should be realized, the focus on sustainable urban mobility is on mobility and accessibility of all population groups. The comparison of these two approaches with 10 items is given in the table below.

Table 2.8 Comparison of traditional and sustainable planning approaches (Böhler-Baedeker,Kost & Merforth, 2014)

No	Traditional Transport Planning Approach	Sustainable Urban Mobility Plan Approach
1	Focuses on traffic solutions.	Focuses on people.
2	Primary Goal: Optimum traffic flow capacity and speed.	Primary Objective: Environmental quality and health, social equity, economic applicability, sustainability, accessibility and quality of life.
3	It is focused on certain modes of transportation.	It focuses on the balanced development of all relevant modes of transport and transition to sustainable modes of transport.
4	The infrastructure is focused.	It focuses on providing integrated actions for cost-effective solutions.
5	Includes short, medium- and long-term planning.	It includes short, medium- and long-term planning in line with a long-term vision and strategies.
6	It depends on administrative boundaries.	According to travel patterns such as home-to-work, the function depends on the winning area boundaries.
7	It is the working area of traffic engineers.	It is an interdisciplinary field of study.
8	This is a planning study carried out by experts.	It is a planning study carried out with the participation of all relevant stakeholders in a transparent approach.
9	Limited impact assessment.	Regular and continuous monitoring and evaluation of plan impacts.
10	It is the sectoral planning document.	Stable and sectoral planning document related to various policy areas. (Land use, spatial planning, health, social services, etc.)

Today, many cities have lack of data on non-motorized transport modes. Traffic congestion and parking demand pressure, especially in developing countries, give priority to motorized modes of transportation in terms of positioning investment and land use in the city. For example, in the long-term transportation plan study in the San Francisco Metropolitan Area is defined by "It is difficult to accurately measure

regional investments needed for pedestrian transport and security measures". This implies that it is not necessary to include specific strategies in the plan to improve the pedestrian transport system. In the transportation plan study in San Francisco, the budget allocated for investment expenditures for non-motorized transportation, which is 13.4% of the mode choice rate, is around 2%. For this reason, it is important to recognize the non-motorized modes of transport by the citizens and the cities. The Bicycle Innovation Lab, an association in Denmark, has created an inverse traffic pyramid based on the priority of demanding modes of transport. As indicated in the figure, having a transportation mode priority is very important for reducing the negative effects of transportation and access demands on urban development and urban economy.

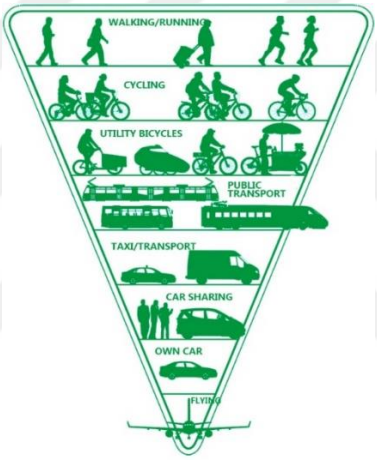


Figure 2.12 Reverse traffic pyramid (Layman, 2017)

In 2012, Brazil rearranged urban mobility policies to improve pedestrian access. The fact that vehicle ownership in urban areas was 52% caused slowdown in urban mobility and led to different solutions. With the proposed regulation, the urban mobility plan was compulsory in all cities with a population of more than 20.000. As of 2015, planning studies have been completed in 3.065 settlements. It was first introduced in 1982 under the concept of mobility in France but was legalized in 1996 with the Air Quality Act-Loi sur l'Air et l'Utilisation Rationnelle de l'Energie. With the regulation, urban mobility plans were made compulsory in areas with a population of 100.000 or more.

It is possible to clean the city from motor vehicles and to make the journeys in a healthier and safer environment with urban mobility plans. According to the 2008

study in Bremen, Germany, the current pedestrian access was fixed 21% in Bremen, 30% in Frankfurt, 22% in Dresden, 27% in Leipzig and 27% in Dusseldorf (Bremen Municipality, 2015). In the scenarios developed in the developed urban mobility plan, the current pedestrian transportation is determined as 22%, while a serious percentage increase in bicycle transportation is targeted. In another European city, Stockholm, pedestrian mobility was found to be higher than other cities. While the rate of pedestrian transportation is 38% throughout the city, it is 54% in the central region. This is due to the fact that the city is compact and the central areas are more convenient for pedestrians and are more functional. In the pedestrian mobility plan developed for the city, it is aimed to make 60% of the journeys in the central region as of the year 2030 as pedestrians (Stockholms Stad, 2016). In the Netherlands, which is the best city in the world for bicycle and pedestrian transportation, they make one third of the travels of people over 75 years of age on foot. While the use of pedestrian and bicycle is 29% in the 0-11 age group, the rate of walking is 20%, the rate of bicycle use is 23% and the rate of public transport is 18% among the 28-24 age group (Kibar, Çelik, & Aytaç, 2015).

Today, pedestrian transportation in the cities of our country cannot improve due to the pressure of motor vehicles. Pedestrian use areas in urban planning are occupied by vehicles and restrict the continuity of pedestrian mobility. In urban areas, pedestrian sidewalks, which must be large enough for pedestrians to use, are either absent or occupied by persons or vehicles for other purposes. In order to prevent this, in order to develop pedestrian transportation in cities, it is necessary to abandon the vehicle-oriented planning approach and develop policies in line with this target. These policies should be implemented in such a way that vehicle and pedestrian traffic is well constructed and pavement arrangements are free from other occupations such as parking lots.

2.2.2.2 Bicycle Transportation

Today, individual and public transportation with motor vehicles is an indispensable element in traffic in daily life. Especially when traveling in the city, the pressure of cars is even greater. As a result of this, high vehicle traffic, air and noise pollution

adversely affect the development of cities. Planning of cities according to motor vehicle traffic becomes dangerous and stressful for urban bicycle use.

When it comes to motorless transportation, the first thing that comes to mind is helping to make the journeys healthier and reducing the traffic load in the cities. A bicycle is generally defined as a means of transport that travels and moves on two wheels on the basis of manpower without the driver's use of fuel and pedal. On the other hand, the bicycle path is defined as the road that is reserved for the bicycles used for transportation, sports, entertainment or touring in the city without disrupting the motor vehicle traffic. The use of bicycles is the most widely used means of transportation in the world since its production. It is known that the number of passengers transported from bicycle use in Asia is higher than that of all cars in the world (TC Çevre ve Şehircilik Bakanlığı, 2017).

Despite the environmental and noise pollution caused by motor vehicles, parking problems and traffic density, non-motor vehicles have been used as an alternative. In China, 41 million bicycles produced annually increase the incentive to make transportation with non-motorized vehicles. In Japan, 15% of people go to work with bicycles and more than 10 million bicycles are sold annually.

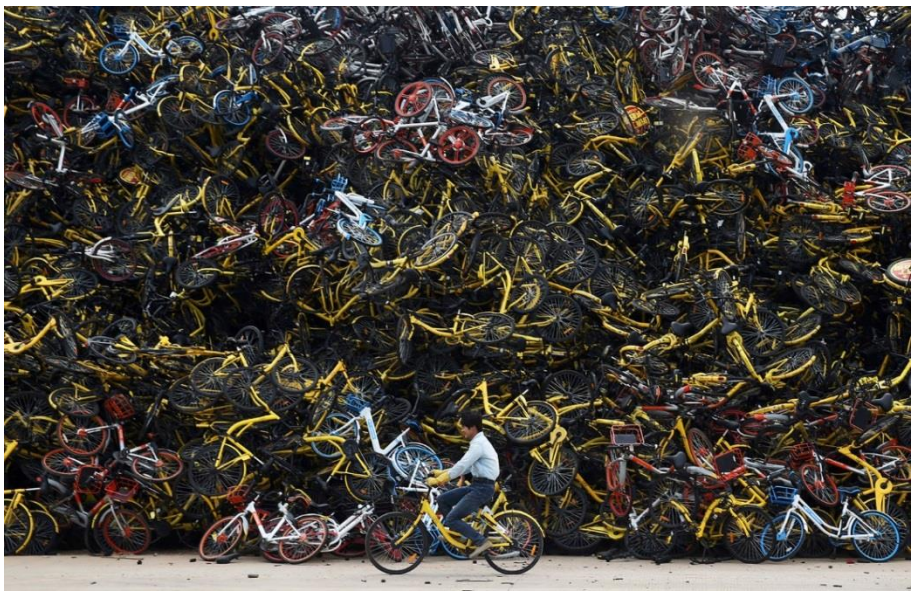


Figure 2.13 Bicycles used in China as a result of bike-share system (Taylor, 2018)

The bicycle has the same characteristics as the car in terms of transportation. The cyclist can travel on his/ her own route without having to adhere to a certain timetable, and can travel from door to door and non-stop. Since bicycle transportation is carried out with body power, it does not require additional fuel and engine. Thus, it is environmentally sensitive and causes no air and noise pollution. Due to its design and structure, bicycles do not occupy as much space as motor vehicles on the road and the need for parking turns out to be less than these vehicles. In a 3m wide lane on the highway, 400-600 m cars and 600-800 people can be transported, while the same width can have 6-7 thousand bicycles. Bicycles used as non-motor vehicles occupy 16 spaces in the parking space reserved for a car. This stituation shows that bicycles use parking spaces more efficiently (Uz & Karaşahin, 2004).

Cycling is an important part of sustainable transport approach. In this context, countries carry out strategic studies on bicycle transportation and provide guide to guide local studies. Table 2.9 contains data on population, cycling rates of countries. Accordingly, the cycling rate of Scandinavian countries such as the Netherlands and Denmark, which have a national cycling transport strategy, is quite high compared to other countries.

Table 2.9 Comparison of national cycling strategies of European cities

Countries	**Population**	**2014 Cycling Trip Rate**	**Cross-species Cycling Rate**	**National Cycling Strategy Name**
Netherlands	17.02 million	**36%**	26% (2010)	-
Denmark	5.7 million	**23%**	16% (2010-2013)	A New National Bicycle Strategy:
Hungary	9.9 million	**22%**	19% (2013)	National Cycling Concept 2014-2020
Swedish	9.9 million	17%	-	-
Finland	5.5 million	14%	8% (2010-2011)	National Strategy for Walking and Cycling 2020
Belgium	11.4 million	13%	8% (2010)	Total Plan - Get Belgians on the Bikes
Germany	82.7 million	12%	10% (2012)	National Cycling Plan 2020 -Joining Forces to Evolve Cycling
Slovenia	2.1 million	9%	6.7% (2005)	National Cycling Network Development Strategy in the Republic of Slovenia
Czech Republic	10.6 million	8%	7% (2013)	Czech National Cycling Development Strategy for 2013 – 2020

Table 2.9 continues

Countries	**Population**	**2014 Cycling Trip Rate**	**Cross-species Cycling Rate**	**National Cycling Strategy Name**
Slovakia	5.4 million	7%	%1.5-2% (2012)	National Strategy of Development of Cycling Transport and Cycle Touring in the Slovak Republic
Austria	8.7 million	6%	7% (2010)	Cycling Master Plan Implementation Successes and New Priorities 2011-2015
Latvia	2 million	6%	-	Latvian Cycling Development Program
France	67 million	4%	2.7% (2010)	Action Plan for Soft Mobility -
Spain	47 million	3%	-	-
United Kingdom	66 million	3%	>2% (2008-2015)	-
Greece	11 million	2%	-	-
Ireland	4.8 million	2%	2.4% (2011)	Ireland's First National Cycle Policy Framework
Luxembourg	0.58 million	2%	-	Soft Mobility, National Action Plan

Figure 2.14 Bicycle usage in Holland (Schroder, 2012)

Urban Mobility plans developed to reduce the supply of motor vehicles are important in terms of increasing and encouraging the use of bicycles. In Copenhagen, one of the cities with the highest urban mobility rate, the Copenhagen Bicycle Transportation Strategy Plan based on the years 2011-2030 was prepared. The plan developed faster travel, safety, comfort, urban life and more user-oriented goals and strategies. In current, bicycle use was 36%, public transport was 28%, private car was 29% and pedestrian was 7% according to the distribution of choice in work and school

trips. Within the scope of the strategies developed by the year 2030, the ratio of bicycle transportation is aimed to be 50% on business and school trips (Good, Better, Best, 2011).

In Melbourne, Australia, the Melbourne Bicycle Plan study was carried out for the purpose of 2013-2017 and Integrated Cities. In the 2030 targeted plan, strategies were developed to increase the use of bicycles by developing targets for security, parking, integration and bicycle infrastructure. The share of bicycle use, which is 4% in daily trips as of 2009, is expected to be 10% in 2030. Similarly, it is aimed to increase the share of pedestrian journeys from 20% in 2009 to 30% in 2030 and to reduce the use of private vehicles by approximately half by increasing non-motorized transportation (Melbourne Municipality, 2016).

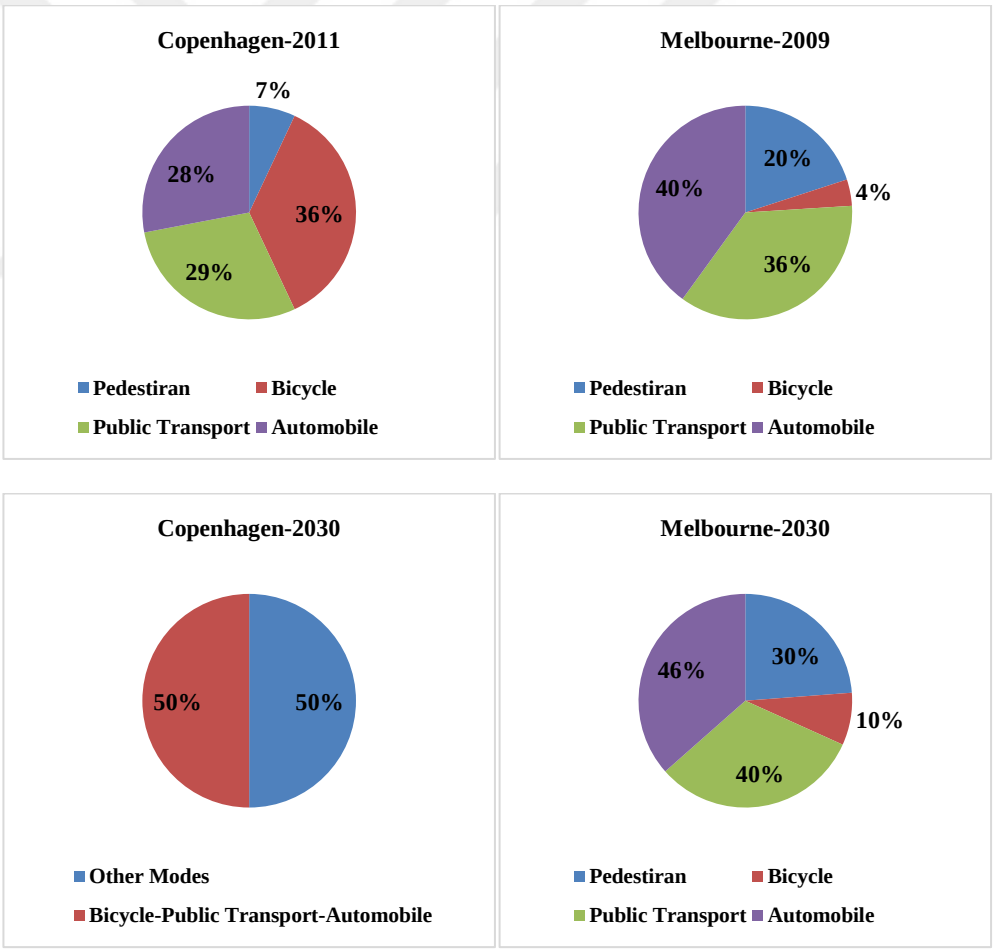


Figure 2.15 Bicycle plan comparisons of Copenhagen and Melbourne

The general structure of the bicycle consists of a simple mechanism that can be used by people of all ages and groups. There are issues to be considered in order to integrate bicycles in urban transportation. The city's natural structure, physical-spatial structure and socio-economic factors constitute the basic components of bicycle transportation. The slope of the city's natural structure is important for bicycle users. According to the Republic of Turkey Ministry of Environment and Urbanization (2017), if the slope is 4% in distance-based slope analysis, it is accepted as suitable for long road construction. Another natural component of the climate is important in terms of cycling path and use. Travel distance in cities is another factor affecting bicycle transportation. Cycling trips should be suitable for short and medium-distance passengers, and long-distance trips must be integrated with the public transport system. In urban bicycle transportation, income status, education, cultural level and user age range also affect the urban population.

When the countries with high bicycle usage rates are evaluated, it is seen that they have developed many policies and strategies to make bicycle transportation widespread and sustainable. The Superblock Model has been developed to provide greater cycling access throughout Barcelona. With the developed and targeted superblocks model, it gives priority to non-motorized transportation within an area of 400x400 meters, includes traffic calming applications, and provides controlled access to certain points within the area by defining the circulation of private vehicles on the wall. While the current situation leads to the monotonous use of the city, multiple and human-scale functions can take place within the defined areas of the Superblock model (Ajutament de Barcelona, 2014). With this model developed, it is predicted that the city of Barcelona will serve 95% of the bicycle network which currently serves 72% of the population. In Melbourne, a similar approach to the city of Barcelona has been put forward for strategies for shared road practices that impose speed limitation on private vehicles (Melbourne Municipality, 2014).

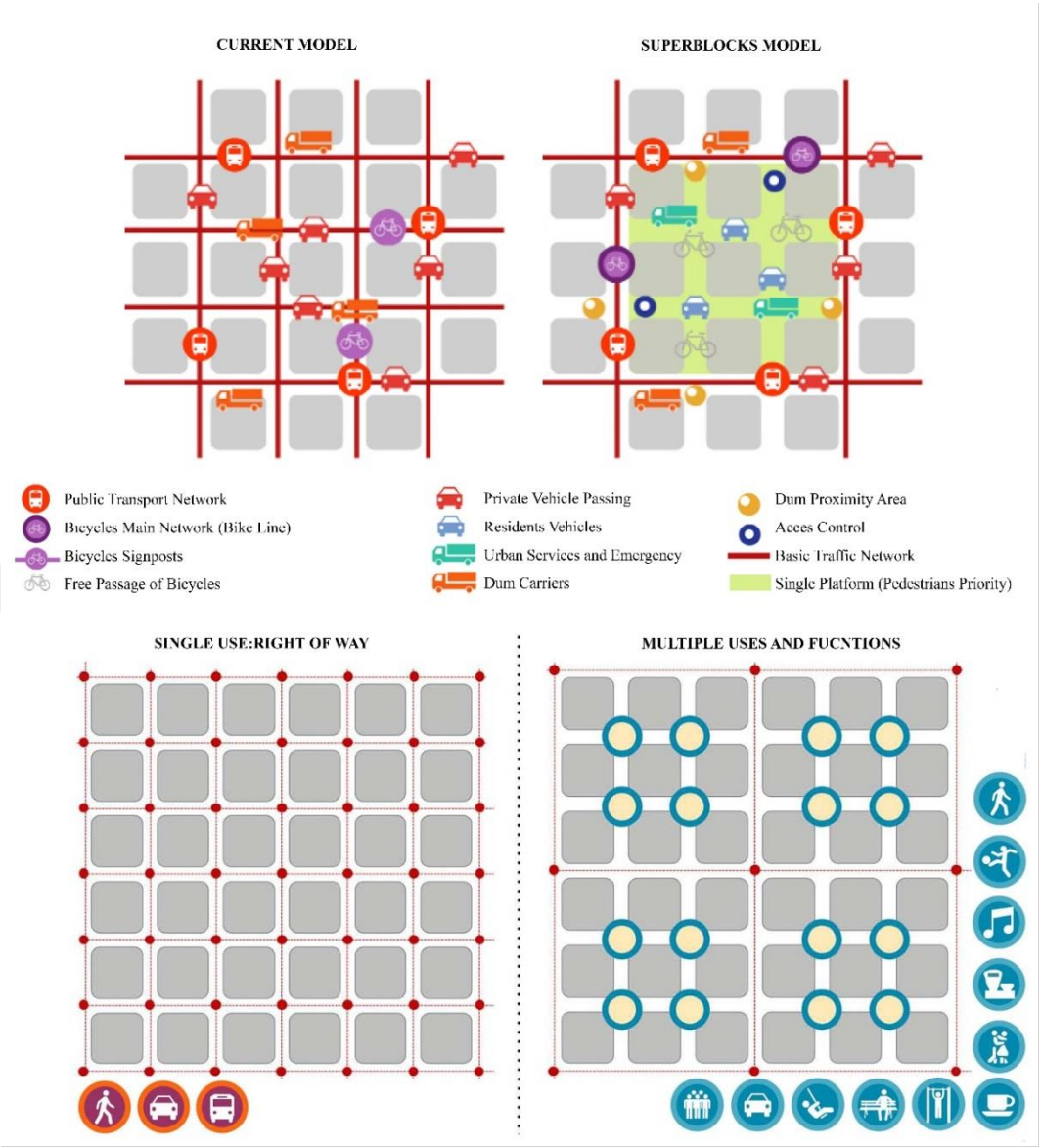


Figure 2.16 Super-Block model (Ajutament de Barcelona, 2014)

It is seen that efforts are being made in Copenhagen to ensure the accessibility of bicycles and other modes of integration. In line with this target, bicycle parking areas have been built in the transfer centers. In addition, public transport is reserved for bicycles and external equipment is installed outside the vehicle (Good, Better, Best, 2011).

Figure 2.17 Examples of public transport and bicycle integration (Benl, 2014; Ergün, 2013)

The combination of bicycle transportation with today's technology is useful for the generation and analysis of many data. The data generated by taking advantage of smartphone applications can be determined which route is used in intensive cycling, and the relevant data is used for network planning. The Riderlog and Strava applications used in the cities of Melborune and Barcelona assist in the production of heat maps in the cities. With the smart mobile application that can be used in the city of Copenhagen, if the cargo bike is selected from the application, the shortest route calculated according to the intensity of the bike via GPS suggests routes where the user is less likely to encounter physical obstacles (City of Cyclists, 2017). On the other hand, the cycling application in London also allows users to see the locations of nearby bicycle cafes and shops and the nearest maintenance/repair points for bicycle repair. In April 2017, UrbanCyclers, one of the organizations providing bicycle application infrastructure, created a smart mobile application specific to the city in cooperation with Prague Municipality. There are 4 important features in the created application. With information and guidance, it provides suggestions for users to examine the route status and to make safer route guidance. Secondly, one of the most important features of the application is the collection of many big data, such as GPS data, user data, and user feedback on the cycling system in the city. In order to make cycling a more fun activity, it offers the opportunity to challenge other users, collect points from cycling, earn rewards and promote cycling. Finally, in-app surveys collect and evaluate feedback from users (Urbancyclers, 2018).

Other practices for increasing and promoting bicycle use are forums with bicycle communities. This bi-annual study, held in Melbourne, listens to the experiences and

problems of bicycle users and provides solutions. In addition, the Share Our Streets awareness program aims to instill a culture of road-sharing to potential pedestrians, bikes and private car drivers. Cycling activities such as *Tweed Ride* and a *Wheelie Good Day* are also organized to increase bicycle awareness and public health (Melbourne Municipality, 2016). In the state of South Carolina, the United States, a 10-course training program is organized in Physical Education classes to encourage middle school students to live healthy and cycle (Davis, 2011).

The shared cycling system is one of the most important means of promoting bicycle use in cities. In this system, which has been developed with the aim of contributing to transportation within the city, bicycle stations are installed and users can be reached from one station to another station by bicycle. The shared bicycle system; It is known that it provides opportunities for non-bicycle owners or those who do not bring their bicycles to the system, creates new bicycle users and improves the image of the city and the use of bicycles. Bike sharing systems show that cities see bicycle as a sustainable transportation option. The fee schedule for the shared bike system varies depending on the type of membership or the time of use. For instance;

Barselona

- In the year the city's shared bicycle system was opened, the annual subscription fee was determined as 6 Euro instead of 24 Euro for the first 4 months.
- The system is free for the first 30 min. The fee after the first 30 minutes is 0.3 Euro per hour.
- There is a 2-hour usage restriction to promote the use of transportation. The price rises in time-out (Barcelona de Servis Municipals, 2016)

Bremen

- There is no registration fee.
- In order to encourage the use of bicycles for transportation purposes, the Flexible Zone application provides an extra fee for leaving bicycles in an off-center area.
- The annual membership option is free for the first 30 minutes (Wkbike, n.d).

Kopenhag

- Monthly and annual membership options 140 and 600 minutes. The right to free use is defined.
- There is a 25 km usage limit to promote the use of bicycles for transportation by more users.
- Standard membership fees are based on minutes.
- Bicycles are electric (Dalhof, 2015)

Melbourne

- Standard and weekly membership is free for the first 30 minutes and annual membership is free for the first 45 minutes (City of Melbourne, 2018)

Stockholm

- There is a quota of 3 hours daily use (City Bikes, 2018).

The shared cycling system is considered as part of the transport system and the need to integrate with other forms of public transport is recognized. In line with this goal, bicycle parking areas have been added in the transfer centers, stations and stall areas in the cities. The selected fleet has an important place in the shared bike system. When the shared cycling system fleet of Detroit, New York and Copenhagen was examined, the city of Detroit preferred bicycles for the disabled and disadvantaged individuals.

In New York and Copenhagen, the shared bicycle system was equipped with a fleet of electric bikes.

Figure 2.18 Detroit MoGo bike shared systems bicycles (Zaveri, 2018)

Figure 2.19 New York ve Kopenhag electric shared bicycle system bikes (Patrick, 2016; Peters, 2014)

Developing and promoting non-motorized transport in cities is an important element for sustainable transport. The use of bicycles in cities is increased, the development and continuity of pedestrian zones is ensured, and the gases released by private vehicles are minimized. For this reason, it is important to determine and implement the energy efficiency strategies in the most accurate way. The European Union 2011 White Paper states that in 2050 it is aimed to reduce transport emissions by 60%. By 2030, it is aimed to reduce the number of fossil fuel vehicles in the city by 50% and to eliminate the fossil fuel vehicles in 2050 (Avrupa Komisyonu, 2011). Within the scope of the Sustainable Energy Action Plan, it is aimed to reduce the greenhouse gas emissions caused by transportation in İzmir by 15% compared to the current situation (Çevre Koruma ve Kontrol Dairesi Başkanlığı Sağlıklı Kentler ve

Temiz Enerji Şube Müdürlüğü, 2016). Congestion pricing is implemented in the city of London in order to restrict private vehicle traffic. In addition, there are practices limiting the environmental impact of private vehicle traffic such as "Low Emission Zone" and "Ultra Low Emission Zone".

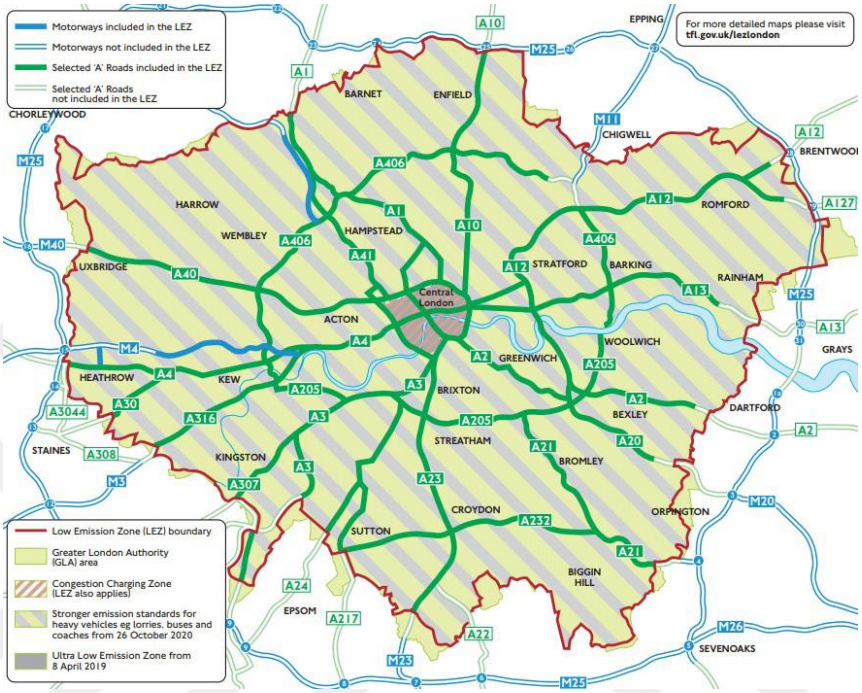


Figure 2.20 London low and ultra emission zone limits (Transport for London, 2018)

Looking at international practice examples, it is seen that recyclable materials can be used for bicycle transportation infrastructure. The world's first recycled bicycle path, made from recycled bottles, glasses and packaging, was implemented in the Netherlands. The 30-meter road made of recycled plastic (equivalent to more than 218.000 plastic cups) is three times as durable as an alternative to the asphalt road. There are also sensors on the road to detect road temperature, durability and the volume of bicycle passing over the road. The prefabricated sections of the bike path are light and hollow, easy to transport and assemble 70% faster. Cables and electrical wiring can be easily installed on the road and the road is designed to drain rainwater. Asphalt cycle paths produce 1.5 million tons of CO_2 emissions per year. This amount corresponds to 2% of global road transport (Boffey, 2018).

Figure 2.21 Recycled plastic road profile applied in the Netherlands (Hickman, 2018)

Although the recycled bicycle path is permeable to the pits, it can be easily removed and recycled if the road is severely damaged or damaged. The use of plastic to build bicycle paths can help keep plastics away from the landfill (Hickman, 2018).

Figure 2.22 Example of recycled bike path (Boffey, 2018)

CHAPTER THREE
USE OF BICYCLE URBAN TRANSPORTATION IN TURKEY

The fact that motor vehicles are an indispensable part of transportation in the world is the main reason of the problems related to transportation and environment in urban traffic. The use of motor vehicles for long journeys is acceptable situation. These vehicles, which are also preferred in short and medium distance journeys, cause problems such as environmental pollution, traffic congestion, traffic accidents and economic losses.

In today's world cities, bicycle use has been begun to encourage preventing problems caused by the use of motor vehicles. Therefore, it is aimed to reduce environmental and transportation problems and to ensure the development of healthier and cleaner communities.

3.1 Bicycle and History

The transition from the human engine to the mechanization of the invention of steam engines did not affect all regions of the world at the same time and in the process. In less developed and underdeveloped countries, the transition from horse carts to motor vehicles occurred later than in developed countries (Germanculture, 2019).

The bicycle, where people moved with their own body forces, has been discovered by German inventor Karl von Drais in 1817 about 200 years ago. The bike called "Laufmaschine" consisted of two wheels, which were fixed by a rod from the center. The rider who used the bicycle had to push his foot to ensure movement. This two-wheeled structure, discovered by Karl von Drais, was able to replace horses and pioneered the formation of modern bicycles in the 19th century (Erdoğmuş, 2016). Before the invention of Karl von Drais, in 1791, the invention of the Conte de Sivac “Celerifere” Karl was accepted from the ancestors of the fast bike.

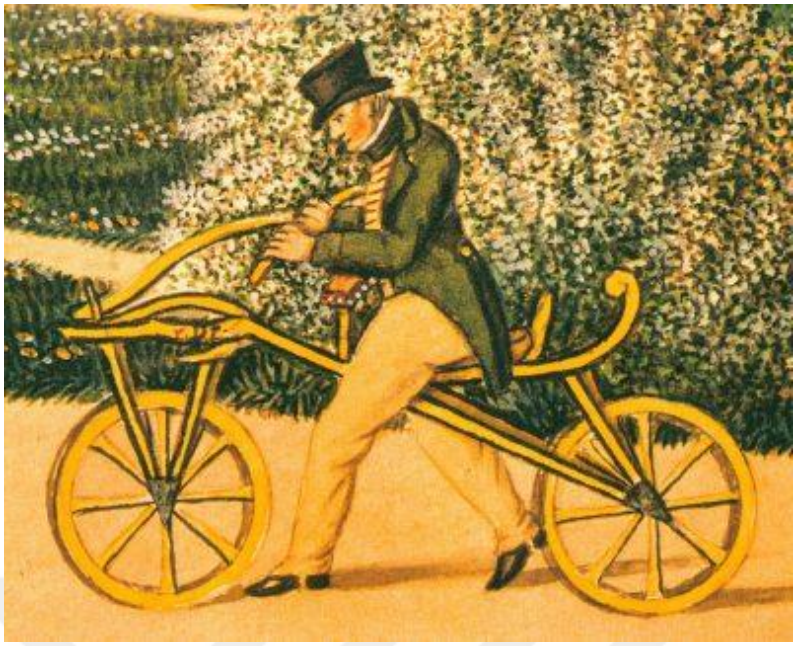


Figure 3.1 Karl von Drais on his original Laufmaschine, the earliest two-wheeler, in 1819 (Germanculture, 2019)

The invention of Karl von Drais has begun to be used in England and Germany with the name of “fun horse”. After that in 1839, pedal was found by Scottish Kirkpatrick Macmillan and so the first drafts of today’s bicycle were occured. In this model, the back and forth operation of the pedals allowed the rear wheels to move and rotate so that the bicycle could move (Bisikletliler Derneği, 2019).

In the early 1960s, following the development of simple cycling models; a great revolution took place in terms of cycling history. Pierre Michaux and Pierre Lallement, the two French transport manufacturers, have developed the design they call Velocipede. In this model, the previous mechanical crank drive was added. This model is considered to be the most important moment in the history of bicycles. In four years, the French producers have collected the necessary funds for the production of bicycles and produced 400 bicycles a year. The interest of the bicycles attracted the attention of the states of the period. In the 1870s, bicycle was produced with the support of the French Ministry of Defense. These bikes were used in the French-German War in 1871 (Bicycle history, n.d).

Figure 3.2 Macmillan's first bicyle "velocipide" (Simpson, 2017)

In 1885, it produced the prototype by British John Kemp Stanley near the present-day version of the bicycle. Produced bicycles have become a much-needed figure rather than popular in terms of society. The bikes are designed to be a chain-based drive that follows the rear wheel like modern-day.

In 1888, Ireland produced bicycles with tires filled with air. This situation, which took place during the bicycle evolution, allowed the development of the bicycle industry. However, due to the high price of materials and labor costs, it was not used by the public at the first stage. In the late 1800s, the increase in factories and the acceleration of mass production allowed the bicycle to become widespread. The rapid dissemination of cycling was effective in the development of cycling.

The use of bicycles in the early 20th century became to importance in France. It was accessible to many people from the city center to the people living in the countryside. However, with the increase in automobile usage in the 1950s, the use of bicycles has started to decrease. With the oil crisis in 1974, the popularity of the bicycle has been revived. The best example of this situation was cycling in the Netherlands. Economic policy in the Netherlands after the Second World War has been effective in the growth of the country. With this growth, the population has been enriched and accordingly a significant increase in the number of cars has been observed. The

increase in the number of automobiles has led to an increase in traffic accidents, occupation of public spaces and the destruction of houses and parking areas. The "Kind de Kindermood" movement has started with the increasing child deaths. With the country's oil crisis in 1973, 3 million vehicles could not have been found gas (Gürkan, 2015). The public, who could not deal with the austerity policies of the government, have begun to cycling. As a result of the crisis, it has been understood that the means of transportation should be as beneficial as economic.

3.2 Beginning of Bicycles in Turkey

With the invention of bicycles in Europe in the 19th century, the transition to daily life has been rapid. In the early days, bicycle was known as a vehicle used by the elite. However, with the increase in production in time, it has become widespread for both transportation and sports purposes. However, with the increase in production later, it became widespread for both transportation and sports use. The first person to pedal in our country was Thomas Stephans. Thomas, who reached Ankara by the Istanbul, Izmir and Ankara highway, was welcomed enthusiastically by the people and governors of Ankara. He also traveled from Ankara to Yozgat and Sivas and completed his five-day journey (Özdemir, 2015).

In the Ottoman Empire, bicycles began to spread towards the end of the 19th century. The bicycle, which was first used among non-Muslims in Istanbul, began to spread among Muslims in the 1890s. The bicycle, with its Ottoman name, velocipet, was brought by levantines and started to be used as a pleasure tool. But then it started to be used for different purposes. It was first used in governmental units such as the postal organization, the police and the army, and later became widespread in other units.

Figure 3.3 Police with bicycles in the Ottoman (Canerik, 2018)

Velosipet was first used widely in the Ottoman capital, Istanbul. In addition, the cities where cycling is widely used are İzmir and Thessaloniki. Levantine families in Izmir pioneered the implementation of other innovations in the West as well as pioneering in bringing the bicycle to the city. In 1897, he organized a bicycle race across the country at the wooden tribune velodram in Thessaloniki. However, prior to this date, the city of Izmir has carried out many activities to promote the use of bicycles. For this purpose, a bicycle race was organized on 15 May 1895. Clubs established by Izmir Bornova levantines at the beginning of the 20th century have ensured that cycling and athletics competitions are held regularly. In Istanbul, the first competition was held on 18 August 1895 in Trabya (Süme & Özsoy, 2010).

The use of bicycles as a means of transportation in the Ottoman Empire took place in the early 1900s. In 1907, the bicycles used in Istanbul were started to be registered by giving a number. With the instruction brought in 1913, the requirement for obtaining licenses, flats and order numbers for bicycles and wheelbarrows was introduced. In addition, it is required to have a lantern in order to be suitable for night use. In 1914, bicycles were charged for crossing the Galata Bridge.

Figure 3.4 Bicycle drive licens (Uludağsözlük, 2015)

During the Republican era, cycling became more and more involved in daily life. At the same time, many improvements have been experienced in the sportive sense. The Bicycle Federation was established in 1923. National team athletes participated in the Paris Olympics in 1924, but for technical reasons could not find the opportunity to compete. Presidential Cycling Turkey Tour which was held in 1964 is the most important cycling tour for Turkey, which has still been taking place.

3.3 Bike Transportation in Turkey Cities and Legislation Concept

The use of bicycles as a means of transportation in urban transportation in Turkey, unfortunately it is not as common as in Europe and other world cities. However, in some cities in our country, it is known that the rate of bicycle use is much higher than the national average. Especially in industrial cities such as Izmit, Adapazari, cities where climatic conditions and topography are suitable such as Adana and Gaziantep and in many rural and urban areas in the Aegean Region, the use of bicycles is quite common.

Transportation planning studies in our country started in the 1970s and continues to the present day. The studies conducted before 1970 were short and narrow in scope due to the conditions of the period and included works that emphasized a certain

transportation investment. Transportation studies were carried out with public institutions between 1970 and 1985. The purpose of these studies is to provide integration between upper scale plans made for cities and decisions to land use in terms of transportation. For this purpose, a total of 10 transportation studies have been carried out in Istanbul, Izmir and Ankara. In the studies carried out after 1985, studies have been carried out to ensure that the rail system investments correspond to the travel demand levels. According to the results of analysis through studies and planning studies in our country on urban transportation conducted by Özalp & Öcalır (2008), it can be inferred that approximately 80% of them are prepared in the period after 1985. Accoding to study, it has been determined that 28% of them did not have housing survey and traffic count, on 50% of them deman estimation was done by using computer simulation model, and 70% had a relation with master plan. Moreover, it has been founded that 56% of them cover all transportation types, 52% of them developed suggestion to rail system, and 16% of them were proposed to develop green species. Within this scope, transportation studies have been carried out in many cities. However, in the evaluation of the past planning studies, it is seen that the plans have been made by considering public transport and urban traffic densities.

In recent years, when urban transportation planning studies in our country were examined, it is seen that suggestions have been made about bicycle transportation. Some of the urban transport plans prepared after 1995 is as follows;

- Bursa Urban Development Project Urban Transportation Improvement Study (1997)
- Emergency Action Plan in Istanbul Transportation Short- and Medium-Term Solutions for the Solution of Transportation Problems (1998)
- Ankara Traffic and Transportation Improvement Study (1998)
- Denizli Urban and Near Environment Transportation Master Plan (2003)
- Eskişehir Transportation Master Plan (2003)
- Gaziantep Urban and Near Environment Transportation Master Plan (2006)

- Konya Urban and Near Environment Transportation Master Plan (2001)
- Samsun Urban Transportation Master Plan, Transportation Study and Community Feasibility Study (2002)
- Istanbul Metropolitan Area Integrated Urban Transport Master Plan (2009)
- İzmir Metropolitan Municipality Transportation Master Plan (2009)
- Konya Transportation Master Plan (2013)
- Revision of İzmir Metropolitan Municipality Urban and Close Environment Transportation Master Plan (2017)
- Gaziantep Transportation Master Plan (2017)
- Antalya Metropolitan Municipality Transportation Master Plan (2017)
- Kayseri Transportation Master Plan (2017)
- Bursa Transportation Master Plan (2018)

However, the special sections reserved for bicycles within these plans are very limited (Kaya & Öcalır, 2010). In many cities or towns in Turkey, regardless of bicycle transportation plan, cycling routes for transportation in the city had planned and built the inclusion of the bicycle routes required for cycling in the transportation plans first began after the 17 August 1999 earthquake. Bike transport is also included in reconstructed urban plans for earthquake-affected cities. Bike transport is also included in reconstructed urban plans for earthquake-affected cities. However, the fact that the areas where the earthquake resistant houses are located to limited in terms of topography makes it difficult to adopt the application for bicycle transportation.

Today, there are studies conducted in some cities within the scope of developing an established bicycle culture and adopting bicycle as a means of transportation. Konya city is known as the city where most of bicycle ownership in Turkey. In 2015, the city of Konya, which has a 142 km bicycle network, has been completed and the projects that are being completed are expected to be added 167 km more to reach an

uninterrupted cycling network. For the safety of cycling use in heavy traffic, 447 km of dedicated bike lanes and numerous bicycle parks are available. In order to meet the transportation and navigation needs, it is aimed to establish 500 Smart Bicycle Systems (Konya Büyükşehir Belediyesi, 2016).

Figure 3.5 Konya nextbike application (Konya Büyükşehir Belediyesi, 2016)

Turkey's largest city of Istanbul work to integrate the urban transportation of bicycle transportation began about ten years ago. According to the results of the Study, Planning and Design of Bicycle Roads and Pedestrian Roads in Istanbul by the Transportation Planning Directorate in 2006, there are 83.3 km of bicycle paths. It has been determined that 82.3 km more will be added to the existing bicycle paths with the application projects. When the plan is completed, it is aimed to have a total of 1.050 km in 2023. EMBARQ Turkey - by the Sustainable Transport Association according to the results of the survey conducted with 200 people, 31% of participants were female, 69%’s was male (EMBARQ Türkiye, 2014).

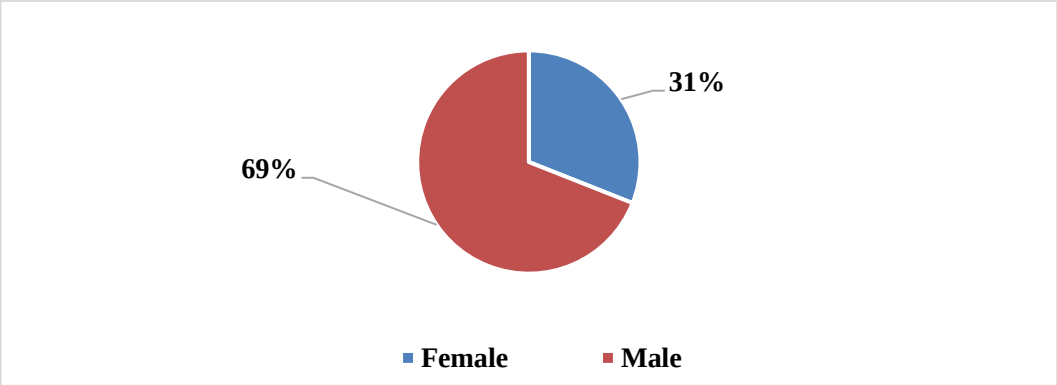


Figure 3.6 Distribution of participants by gender (EMBARQ Türkiye, 2014)

The distribution of the participants in the age groups was observed to be at most 28-32 years with 21.5%. This rate was followed by 14% and 14-18 years. It was found that 94.5% of the participants had bicycles. When the use of bicycles was examined, it was found that 75.5% used it for hobby, entertainment or social activity while only 15% used it for transportation purposes.

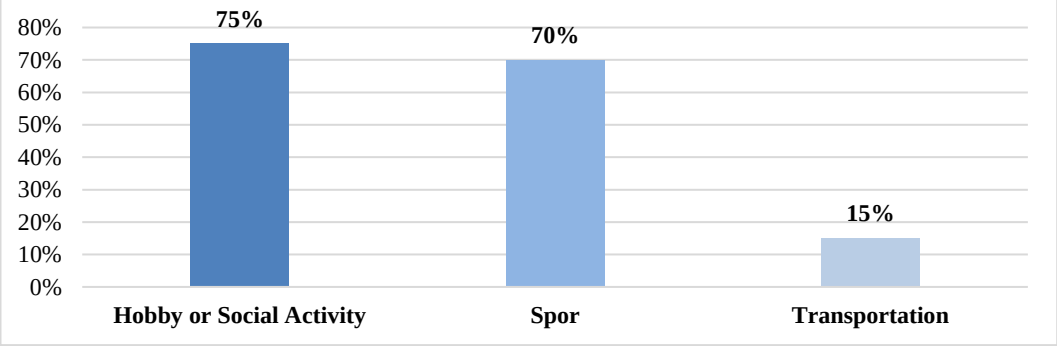


Figure 3.7 Status of participants according to the purpose of use of bicycles (EMBARQ Türkiye, 2014)

When the study was examined out according to transportation purposes, it was found that 76.7% was work-related. This rate was 56.7% followed by shopping, while the lowest share was in the delivery or transportation category with 13.3%.

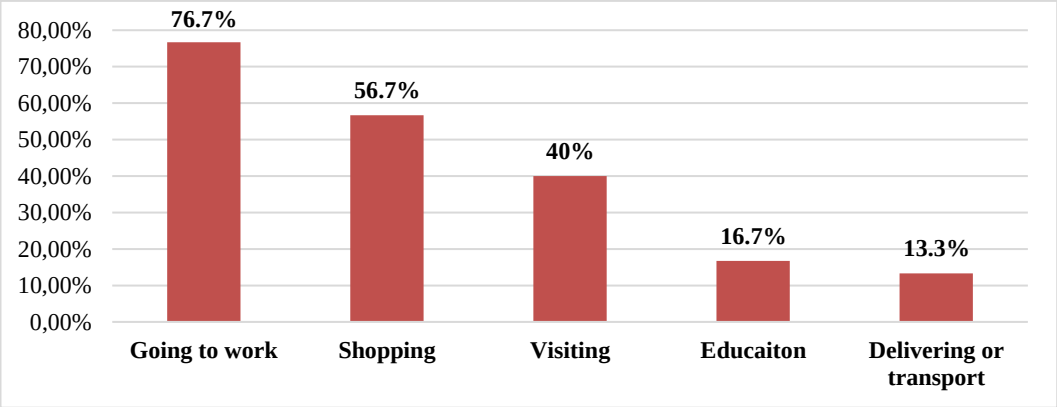


Figure 3.8 Status of participants according to reasons for use of bicycles for transportation (EMBARQ Türkiye, 2014)

When the types of accidents experienced by the participants were asked, it was found that there was a collision with motor vehicles with a rate of 42.9%. It was observed that this rate was followed by collision with pedestrian with 37.1% and self-accident with 14.3%.

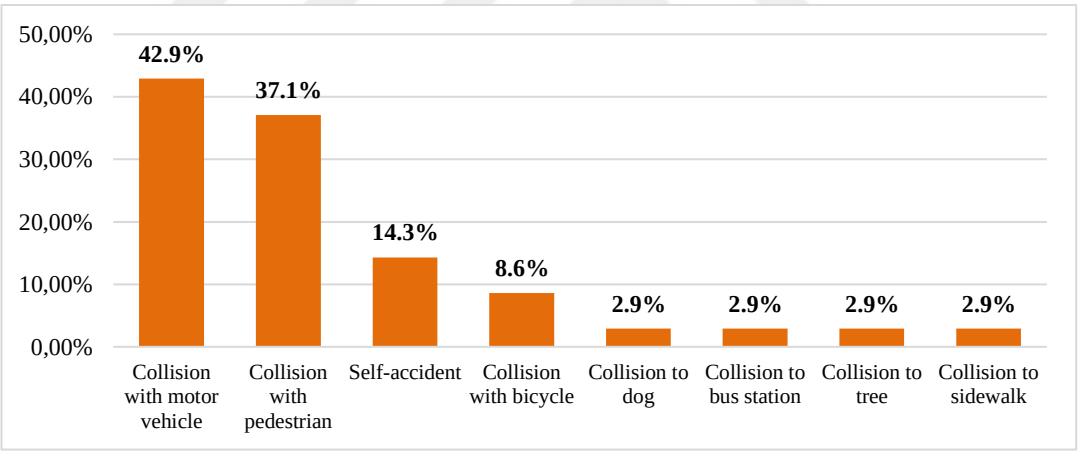


Figure 3.9 Types of accidents experienced by users (EMBARQ Türkiye, 2014)

At the end of the interview with the participants, questions were asked to promote bicycle use. The necessity to spread public spots was the most common answer with 78%. In other answers, while the rate of the requirement of motor vehicle users to comply with the rules is 55%, the necessity of organizing educational campaigns is found to be 47%. The aim of creating a sustainable bicycle transportation system and creating a bicycle sharing system in our country has been developed in our cities such as Mersin, Antalya, Kocaeli and Bursa as in Konya.

CHAPTER FOUR
USE OF BICYCLE IN URBAN TRANSPORTATION IN İZMİR

The use of bicycles in the city plays a great role in the relation of the city with its physical, geographical and historical. Transportation in Izmir is commonly done by motor vehicles like in other cities in Turkey. The priority for investment throughout the city is mostly given to road transportation. This situation leads to both a decrease in the rate of bike use in urban transportation and a change in the existing structure of the city.

4.1 General Characteristics of İzmir Province

In this part of the study, the existing land structure, socio-economic and urban transportation infrastructure in İzmir province will be examined and the current situation structure will be revealed.

4.1.1 Topography

Located in the west of Turkey Izmir and Aegean region, geographically 37º45' and 39°15' north latitude and 26º15' and 28º 20' is located between east longitude. Izmir is located on the Aegean coast and is surrounded by Manisa in the east, Balıkesir in the north and Aydın in the south.

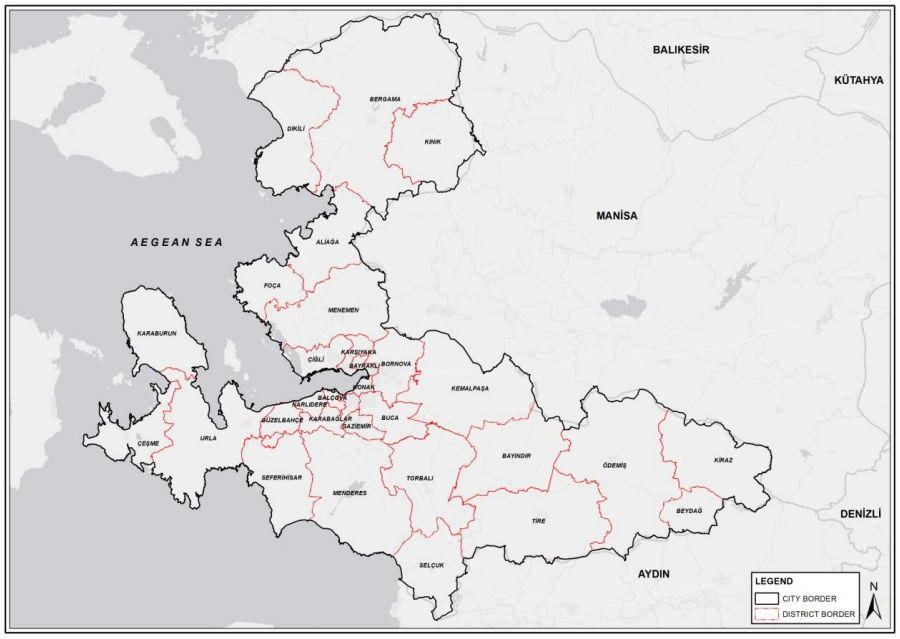


Figure 4.1 City of İzmir and districts (via Arcmap program)

In Turkey, one of three provinces gained Metrepolitan status is İzmir. With the amendments made in the process, the authority limits of the Metropolitan Municipality have gradually expanded and become the current state.

With the Law No. 3030, the boundaries of metropolitan municipalities cover 11 districts. With the Law No. 5216, the borders are divided into 21 districts and finally with the Law No. 6360, a structure covering 30 districts was formed. Thus, Izmir Metropolitan Municipality border has reached the provincial border.

4.1.2 Social-Ecomics Structure

In this section, data on the economic structure and population distribution in İzmir province are compiled and explained.

4.1.2.1 Economic Structure

Most recent made in 2011 Gross Value Added (GSKD) according to the calculation Izmir in Turkey has a share of İzmir's GVA per capita is TRY 19,187. When the contribution of sectors to İzmir is evaluated; the share of the services sector is 67.7%, the share of the industrial sector is 26.9% and the share of the agricultural sector is 5.4% (Türkiye İstatistik Kurumu, 2011).

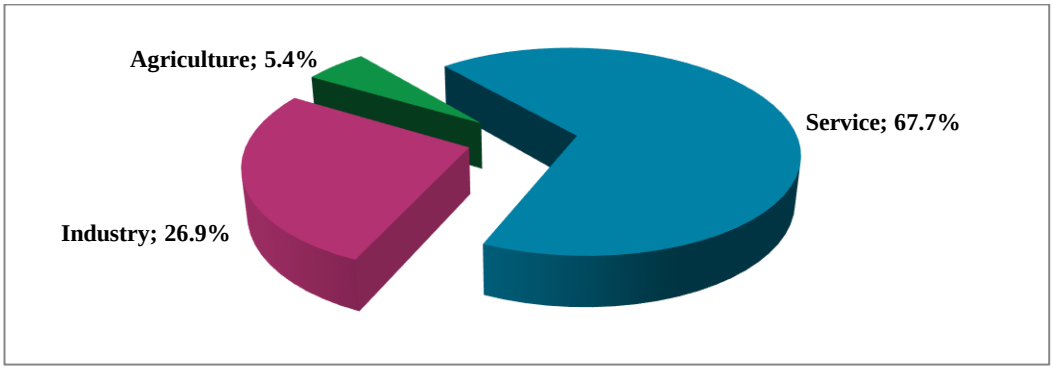


Figure 4.2 Sectoral distribution of economic structure in İzmir province (%) (Türkiye İstatistik Kurumu, 2011).

Izmır Province, 4% of Turkey's agriculture, Turkey 6.5% of the industry, Turkey 7% of the services sector provides alone. GSKD of Izmir rate in Turkey is 6.6%. İzmir ranks third after İstanbul (27.2%) and Ankara (8.6%).

While trade, industry and tourism are concentrated in the central districts where the population is denser, agriculture and animal husbandry are more common in the districts where the population is less. The tourism sector occupies an important place in the district economy in the districts of the coastal areas of İzmir. In the city center, trade activities are generally performed; small industrial estates, organized industrial zones, free zones and technoparks also contribute to the development of urban industry.

In the 2014 Global Metro Monitor report prepared by Brooking Institute and JP Morgan Chase, Izmir was ranked 2nd among the rising cities in 300 cities. In the study, the Turkey serves as a bridge between Europe and Asia, showed that in a short time as well as investments in heavy industry, infrastructure projects, roads and job creation has been noted that the power forward (İzmir Ticaret Odası, 2016).

4.1.2.2 Demographic Structure

Izmir is the third largest city in Turkey, 2018 Address Based Population Registration System (ADNKS) has a population of 4320519. Analysing of TR3 Turkey Aegean Region and Izmir province of the years 2017 to 2018 population indicators, the population in the province in recent years have increased 12.54 ‰. This population growth has remained below the Turkey average of 14.77 ‰. When TR3 Turkey Aegean Region and Izmir province of the years 2017 to 2018 population indicators, the population in the province in the last year have increased 9.5 ‰. This population increase is below the average in Turkey with 14.8 ‰. With the population growth of the city, the population density increased to 3 people/h in 2018. Population density is considerably higher than the average in terms of Turkey.

Table 4.1 Turkey and Izmir province comparative demographic ındicators (Türkiye İstatistik Kurumu, 2017)

Years	**Total Population**		**Annual Population Growth (per mille)**	**Population Density**	
	2017	**2018**	**Total**	**2017**	**2018**
İzmir	4279677	4320519	9.5	35.7	36.0
Ege Bölgesi (TR3)	10383963	10514200	12.5	11.6	11.8
Türkiye-TR	80810525	82003882	14.8	10.5	10.7

4.1.3 Development of Urban Macroform and Existing Land Use Structure

The city of Izmir, which has hosted many civilizations in the historical process, has developed as a trade and port city since ancient times. It is possible to divide the factors that form the macroform formation of the cities into natural and artificial. Natural factors include topographic limiters, river beds and seismicity. Motorway, highway, railroad and land use decisions, which play a decisive role in terms of macroform, are artificial factors. In this section, the effects of spatial plans affecting the urban macroform on the structure of the city and the existing land structure will be explained.

4.1.3.1 Development of Urban Makraform

Many planning studies have been implemented in the historical process in İzmir. First of all, the planning studies that started in the Republican era are continuing today.

4.1.3.1.1 Spatial Structure between 1922 and 1950. Before the Republic, Izmir survived the Greek occupation on 9 September 1922 and tried to survive with the urban collapse. While the Greek army withdrew from the city, it burned many places on fire and caused a total of 20-25 thousand buildings and an area of 2 million 600 thousand square meters. In 1925, after the proclamation of the Republic, the René and Raymond Dangér brothers had a partial urban plan on completely burnt areas. The aim of the plan was to create a contemporary structural environment with the help of foreign expert architects and planners. The development plan made by expert's traffic was prepared in the style of European cities targeting green areas, regular streets, two-storey houses in the garden, and wide and tree-lined boulevards. The 1950s were the years when the transportation infrastructure of the city began to form and the establishment of the traffic light system was in this period. The transportation master plan, developed in 1955-1957, includes the construction of the coastal road between Altınyol (Ekspres Road) and Konak-İnciraltı, the road construction between Eşrefpaşa Market and Cumaovası (Menderes) and the coastal arrangement of Karşıyaka. Following the Ege University Campus competition in 1958, Bornova settlement accelerated the urban development process (Biçer, 2013).

4.1.3.1.2 Spatial Structure between 1950 and 1970. In the 1960s, trade axes developed in four different parts of the city. Mezarlıkbaşı-Eşrefpaşa and Basmane-Tepecik-Kemer line developed for trade with low income. In the First Cord-Second Cord axis around Cumhuriyet Square, agricultural goods were traded. Commercial and service areas for the middle- and high-income groups are developed to be on the Konak-Güzelyalı axis. High income groups are located in Alsancak, Göztepe, Güzelyalı, and Karşıyaka regions while the middle-income group is located in the old districts of Karşıyaka and Hatay. It has adopted. The low-income groups remained in the city center. Later, in 1964, due to the Law of Ownership, the existence of adjacent high-rise buildings began to be seen in the coastal area of İzmir. Alsancak Port, Halkapınar, Mersinli and partly around Bayraklı industrial areas have spread to Karabağlar, Kemalpaşa and Çiğli regions. Ankara-Bornova-Manisa, Karşıyaka-Manisa-Çanakkale, Çeşme Motorways, Basmane-Balikesir-Bandirma, Basmane-Menemen-Afyon, and Alsancak-Aydin Railways have been constructed for the road transport connecting Izmir and its surroundings. Passport Passenger Port and Alsancak Freight Port were completed for sea transportation and military airports in Gaziemir and Çiğli were established (Güner, 2006).

4.1.3.1.3 Spatial Structure between 1970 and 2000. Between the years of 1970 and 2000, as a result of the studies carried out by the Izmir Metropolitan Area Master Plan Bureau, which was established in 1965, the first high-scale plan 1 / 25000 scale Izmir Metropolitan Area Master Plan was prepared. For the industrial areas to be developed in the city, the Şemikler-Aliağa axis in the north and the Karabağlar-Cumaovası (Menderes) axis in the south were proposed. Upon the establishment of the Aliağa Refinery in 1969, the organized industrial zones concentrated on the northern axis. In the 1973 approved Master Plan, studies were carried out with the aim of 1985, and 1197000 population projections were made for the Greater City, which covers 13 municipalities and 31 villages in and around İzmir. Over time, there have been significant deviations from the decisions of the Master Plan, and the plan has lost its effectiveness due to unforeseen urban developments in the plan. It was revised in 1989 due to the problems experienced in the Master Plan which was approved in 1973. The target population was determined as 4200000 and the plan was arranged to cover 37,926 hectares of land. While 24,442 hectares of the plan consists of urban uses, the

remaining areas consist of forests, agriculture and non-residential areas. It is aimed to establish a continuous vehicle pattern along the coast by connecting the north road from Çanakkale direction to the Aydın Road in the south and to the Çeşme Motorway to the west axis of the İstanbul-Manisa artery in the east. For this purpose, the construction of the Çeşme Motorway, which will lead the development of the city to the west, began in 1989 (Tekeli, 2015).

4.1.3.1.4 Spatial Structure in 2000 and After. Prior to the Metropolitan Municipality Law No. 5216, Izmir was defined with 9 districts, while the boundaries of the metropolitan municipality were enlarged to include the remaining areas within the 50 km radius of the city center. The 1/25000 Izmir Urban Area Master Plan approved in 2007 was foreseeing that urban transformation would take place in the areas facing the gulf and the renewal works were to be undertaken. A green belt is defined that surrounds the central city and limits its uncontrolled extension. The areas of development have been determined to cover Aliağa, Torbalı, Kemalpaşa and Urla districts (Tekeli, 2015).

1/100000 Scale Manisa-Kütahya-İzmir Planning Region Environmental Layout Plan, which was approved in 2009, has the highest scale physical decisions covering the areas within the boundaries of İzmir. The main objective is to eliminate the problems caused by rapid and uncontrolled urbanization, and remove problems caused by fragmentation and sectoral planning. Besides, it is determined to provide a restrained development of urbanization and industrialization, and to keep developments sustainable. It is also determined to prevent the effects that will disrupt the ecological balance, and to direct land use pattern in a way that protects cultural and natural values. Considering the decisions made in the plan, it was decided to increase the settlements around the Aliağa-Menderes İzban Suburban Line and to provide integration and acceleration of tourism on the Selçuk-Bergama line. Forming green belts by afforesting the areas under the risk of illegal construction near the big settlements in İzmir was determined.

According to the spatial division of the plan, it is seen that development axes are formed in direction of north-south and east-west considering the geographical location

of the city of İzmir. It is also seen that the area around the gulf, which is the heart of the city, emerges as the traditional center.

In the plan, the trade function is graded as Central Business Areas (1st degree), 2nd and 3rd Degree Centers. In this context, Central Business Area usage decisions have been made for Kemeraltı-Alsancak-Salhane region. The trade function of the central city also includes the tourism function. While the traditional city center of Kemeraltı region continues to function, it is envisaged to shift the city center to Alsancak Harbor Behind-Salhane-Turan region. Within the scope of this plan, Halkapınar-Yenişehir region that is integrated with Alsancak region, Salhane region that is integrated with Alsancak region and Altındağ-Çamdibi region are planned as 2nd and 3rd degree centers (İzmir Çevre Düzeni Raporu, 2013).

4.1.3.2 Current Land Use Structure

In the 1/100.000 scale Environmental Plan; land use study was grouped as Urban and Rural Settlements, Agricultural Areas and Other Areas. Accordingly, there are 30082 ha of urban resident area and 10330 ha of rural resident area within the provincial borders. When the agricultural areas are examined, irrigated agricultural areas have the largest share with 165230 ha, while the forest areas with 44128 ha occupy the largest area among the other areas.

Table 4.2 İzmir municipal boundary land use type according to law no. 5216 (Çevre ve Şehircilik Bakanlığı, 2010)

Land Use Type	**Area Size (ha)**	**Ratio in Total (%)**	**Land Use Type**	**Area Size (h)**	**Ratio in Total (%)**
Urban and Rural Settlement Areas			**Technical Infrastructure Areas**	435	0.04
Urban Settelements Area	30082	2.52	**Farming Areas**		
Rural Settlements Area	10330	0.86	**Irrigated Agricultural Area**	165230	13.82
Business Area	341	0.03	**Dry Agricultural Areas**	85844	7.18
Organized Industrial Zones	2550	0.21	**Citrus fields**	4561	0.38
Small Industrial Sites	524	0.04	**Other Orchards**	26491	2.22
Industrial and Storage Areas	5353	0.45	**Vineyard Fields**	8261	0.69
Free Zone	197	0.02	**Olive Fields**	97278	8.14
Mining Extraction Areas	978	0.08	**Other Areas**		
Tourism Facility Areas	5640	0.47	**Forest Areas**	444128	37.16
University Campuses	776	0.06	**Pasture Areas**	113668	9.51
Urban Large Green Areas	812	0.07	**Maquis Shrubland and Moor Areas**	167749	14.04
Major Archaeological Sites	132	0.01	**Stony Rocky Areas**	547	0.05
Coastal Use Beaches	4990	0.42	**Reeds in the Marsh**	3103	0.26
Military Areas	8585	0.72	**Lake Dam and Stream Deposits**	4397	0.37
Airports	2113	0.18	**Totals**	**1195095**	**100**

Within the definition of urban settlement areas; urban settlements that includes many urban functions, industrial types, central business areas, large public areas take place. As a result of the planning studies carried out until today, the linear development of the city, which is trapped around the Gulf, has been supported along the transportation axes. Although the general trend has continued in this direction, some developments have caused deterioration in this macroform. These developments, which were not taken into account when determining the macroform, caused changes in the physical development tendencies of the city. İzmir province ends with agricultural areas that existed after Menemen in the north and ends with forest areas that create a threshold between Bornova and Kemalpaşa in the east. Supporting the developments within Kemalpaşa district boundaries with the decision of Organized Industrial Zone has led İzmir city to advance by making leaps on agricultural areas in the east direction. In the north, the forest areas in Karsiyaka and Bornova districts and the city center are limited, while in the south it is limited to the agricultural areas within the Tahtali Dam and the Dam Basin. Developments in the south have crossed the Tahtali Dam Basin and started to merge with Torbali. This has increased the pressure on the areas that need to be protected from an agricultural point of view. In addition, residential areas around Torbalı Ayrancılar have concentrated and developed in a disconnected way from the residential area in İzmir. In the western part of the city, it has not created disconnect with the city in terms of the structure seen in the coastal area between Güzelbahçe and Urla districts. However, the fact that the settlement was a secondary residence led to the separation of Urla and İzmir from each other. Looking at the urban settlement areas in the northern direction of İzmir province, Ayrancılar, Yazıbaşı and Pancar settlements located in Ulucak, İzmir-Torbalı axis adjacent to Kemalpaşa Organized Industrial Zone are the areas where significant housing developments are observed as a result of industrial developments. The secondary housing constructions in Foça in the northwest part of the city, Seferihisar in the southwest and Urla in the west have entered into important settlement areas of İzmir city. Bayındır and Selçuk districts in İzmir are spatial and settlement areas with limited development dynamics with İzmir City Center.

4.1.4 Existing Transportation System

İzmir ranks third behind Istanbul and Ankara in terms of transportation infrastructure. In terms of highway value, İzmir has the possibility of direct connection with the neighboring provinces, İzmir ring road, İzmir-Çeşme, and İzmir-Aydın motorways. The motorway route that will connect Izmir to Bursa via Manisa is designed in the direction of Kemalpaşa-Turgutlu from the east of the city. The fact that the first railroad is located within the borders of İzmir is important in terms of providing transportation by neighboring provinces and railways. Furthermore, İzmir has high potential in terms of accessibility by sea.

When İzmir is examined in terms of urban transportation; it includes highway, rail systems, sea road, bicycle and pedestrian tracks. In this section, the information about usage infrastructure will be given by examining the city of İzmir and the transportation infrastructure of İzmir.

4.1.4.1 Road Infrastructure

Freight and passenger transportation in road traffic share in Turkey appeared to be higher when compared with EU countries. Although the share of freight on highways in the EU countries is 45% and the share of passenger transportation is 79%, it is determined that the share of freight transportation in 2011 is 92% and the share of passenger transport is 96% in our country.

When the transportation infrastructure of İzmir province is examined, it is seen that the province has all the necessary infrastructure facilities in terms of road and the facilities are located in a usable and accessible manner. The road infrastructure of İzmir consists of the roads starting from the city center and connecting to Çanakkale in the north, Balıkesir, Bursa and İstanbul via Manisa in the northwest, Uşak, Ankara through Afyon in the east and Denizli and Muğla in the south. In addition to these connections, the road infrastructure of the province has improved in terms of the roads connecting the districts with the districts.

Within the boundaries of İzmir province, 1,295 km of the total road network of 5,903 km is state and provincial road, 213 km is motorway and 4,395 km are village

road. Total road network, road network in Turkey Aegean Region has a share of 10.9%. The road network of İzmir province has a share of 14.6% in the Aegean Region road network. In terms of length of province and state road, İzmir province is the fifth among all provinces and the first among the Aegean Region provinces (İzmir Kalkınma Ajansı, 2013).

4.1.4.2 Maritime Line İnfrastructure

İzmir has a great potential in terms of national and international maritime transportation with its coastline. Five of the 12 port offices operating under the İzmir Regional Directorate of the Undersecretariat of Maritime Affairs are within the borders of İzmir province. They are located in İzmir, Çeşme, Dikili, Foça and Aliağa. The ports in İzmir Port, Çeşme Port, Aliağa-Nemrut and Dikili districts are important points for sea transportation. Çeşme and İzmir ports are also active in passenger transport. Sea transportation in Izmir has an important place in urban transportation.

Two new piers are planned to be constructed for the construction of an independent cruise port that will separate the passenger port of Izmir Port from Izmir Port. In the existing port, a new generation of two cruisers can dock between 150-220 meters, while a new pier and a new generation of five cruise ships are planned to be built at the same time. The new port will be the largest, most modern cruise port of the Mediterranean is intended to be.

4.1.4.3 Railway İnfrastructure

The city of İzmir is the place where the first line of national scale railway network was established on 23.08.1856 with Aydın-İzmir line. The city is located on important routes in the rail transportation network as well as in the road transportation network. The Izmir-Ankara line connects to the Ankara-Istanbul high-speed train line and connects the city to Istanbul and Ankara, two important centers of the country. There are also train services to İzmir, Konya, Uşak, Denizli, Manisa, Balıkesir, and Bandırma, Nazilli, Söke, Ödemiş, Tire, and Alaşehir districts.

While Izmir in the Aegean Region network shares of 19.5%, the share of the provincial network in Turkey is 3.4%. The province of İzmir ranks sixth among 81

provinces in terms of railway length. Passenger, bulk cargo, containers and other cargo can be transported by rail (İzmir Kalkınma Ajansı, 2013).

The High-Speed Train (YHT) project, which plans to reduce the 824 km distance between İzmir and Ankara from 16 hours to 3 hours and 30 minutes, will have 663 kilometers if İzmir is reached via Manisa. If it is done over Kemalpaşa, it will have a length of 624 kilometers. Construction works started in June 2012 in Polatlı-Afyonkarahisar part of the project. İzmir-İstanbul YHT project has not been included in the investment program yet and its studies are continuing.

4.1.4.4 Airway Infrastructure

The level of accessibility of a province by air is defined as the relationship between the duration of access to the nearest airport of the province, the flight traffic of the airport and the number of connections established with other airports. In terms of accessibility, İzmir ranks fourth after İstanbul, Ankara and Antalya. Adnan Menderes Airport, which is one of the airports in Izmir, is located in Gaziemir district. Selcuk Airport, which is another airport, is located in Selçuk district and Çiğli-Kaklıç military airport is within the borders of Çiğli district.

State Airports Authority (DHMİ) Adnan Menderes Airport, which was been opened in 1987, is the most important point of air traffic in İzmir and the region. Over the last four years, the number of domestic and international arrivals and departures has increased by more than 50%. In 2012, there was an increase of 13.4% in domestic flights and 0.52% in international flights, and the total number of passengers exceeded 9.3 million (İzmir Kalkınma Ajansı, 2013).

Selçuk Airport, which was built in 1990, is the second civil airport of İzmir and is used for tourism and education by Turkish Aeronautical Association (THK). It is on the İzmir-Selcuk- Kuşadası highway, 3 km away from Selçuk district and 1 km away from the ancient city of Ephesus.

4.1.4.5 Urban Transportation

According to the information obtained within the scope of Transportation Master Plan in İzmir city, 50% of daily trips are made by public transport, 38% by pedestrian and 12% by private vehicles.

Table 4.3 Distribution of daily trips in İzmir city (Çevre Koruma ve Kontrol Dairesi Başkanlığı Sağlıklı Kentler ve Temiz Enerji Şube Müdürülüğü, Mart 2016)

Public Transport	**Pedestrian**	**Private Car**	**Total Transit Trip**	**Total Trip**
50%	38%	12%	62%	100%
0.72 trip/person	0.55 trip/person	0.18 trip/person	0.90 trip/person	1.45 trip/person

4.1.4.5.1 Public Transportation Systems. In İzmir, urban public transportation systems are provided with rubber wheeled, rail systems (Light Rail Transport, Suburban Rail Transport and Tram Transport), sea and cable transport systems. In addition to these systems, passenger transportation is carried out by various cooperatives and authorized persons (M License Plate, GIB, D4 Certified Vehicles). With the introduction of subway and suburban systems in urban public transport, the share of access by road has started to decrease (Çevre Koruma ve Kontrol Dairesi Başkanlığı Sağlıklı Kentler ve Temiz Enerji Şube Müdürlüğü, 2016).

Public transportation systems in İzmir are boarded by the use of electronic cards. According to the data obtained from electronic card boarding systems, average 1,522,029 passengers are transported daily in İzmir. When evaluated according to the types, it was been found that the largest wheeled public transport system with 62% (Çevre Koruma ve Kontrol Dairesi Başkanlığı Sağlıklı Kentler ve Temiz Enerji Şube Müdürlüğü, 2016).

Table 4.4 Daily public transport numbers by type of transport

Daily Numbers	**Bus Transport**	**Light Rail Transport**	**Suburban Railyway Transport**	**Maritime Transport**	**Total**
Weekday	5,373,191	1,616,198	1,330,341	205,978	8,525,708
Weekend	1,418,757	432,513	412,684	74,541	2,338,495
Total	6,791,948	2,048,711	1,743,025	280,519	10,864,203
Daily Average	970,278	292,673	249,004	40,074	1,522,029

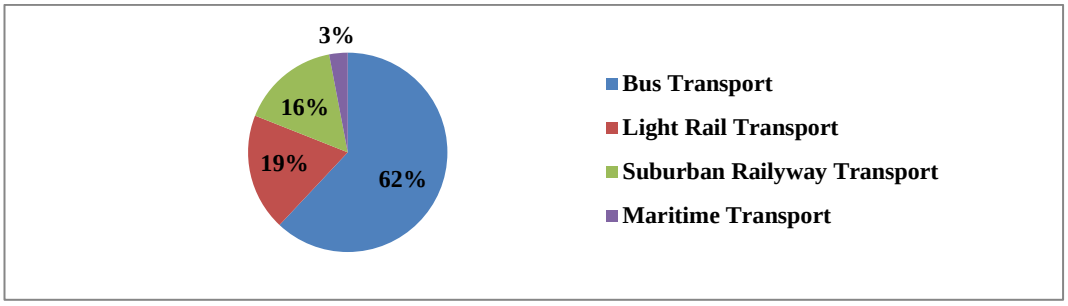


Figure 4.3 Daily public transport rates by type of transport

Rubber Wheel Systems; it provides service on 320 public transportation lines with a fleet of 1,763 vehicles in total in İzmir. Vehicle models are between 1998 and 2015, with a total capacity of 57 passengers to 158 passengers.

While the age of the fleet with rubber wheels varies between 0 and 17, it is seen that 23% of the fleet consists of 2013 model vehicles. In addition, it was found that 40% of the fleet was composed of vehicles less than 5 years of age.

There are three rail system lines in the city of İzmir, which provide public transportation services: light rail line, commuter line and İzmir Tramway. İzmir Metro operates between Fahrettin Altay and Evka 3 in both directions. The length of the route is approximately 20 km and there are 17 stations on the line. İzban A.Ş. suburban line in the north-south direction of Izmir between Aliaga and Cumaovası settlements serves. Aliağa-Halkapınar is the northern part and Halkapınar-Cumaovası is the southern part of the line. The line, which was put into service with 31 stations when it was opened, operates with 32 stations with the Hilal station being put into service. As of 2013, the existing transportation infrastructure consists of motorways, divided roads, undivided roads, and İzban (İzmir Suburban) lines used between district centers within the boundaries of İzmir province. Within the framework of the plan decisions in force, it is expected that the İzmir-Çanakkale highway will be completed in the north direction in 2023 and the İzban line, which has become an important part of the urban transportation system, will be extended to Bergama and Selçuk.

Izmir Tram, which is an investment of Izmir Metropolitan Municipality, consists of two lines; Karsiyaka Tram and Konak Tram. Currently, Tram has a total length of 23 kilometers and operates integrated to the subway and suburban system of İzmir.

Karsiyaka Tramway serves with a total of 14 stops between 8.7 km and Atasehir-Alaybey. Konak Tramway operates between Fahrettin Altay and Halkpinar. The line, which has a total length of 12.6 km, serves with 18 stations.

There are total of 11 routes in the Gulf along with the Foça and Yassıcaada lines that operate periodically. Bostanlı-Üçkuyular/Üçkuyular-Bostanlı line is both passenger and vehicle transportation lines. The route with the highest number of services is the Karşıyaka - Konak line. In the Gulf, total of 222 service per day.

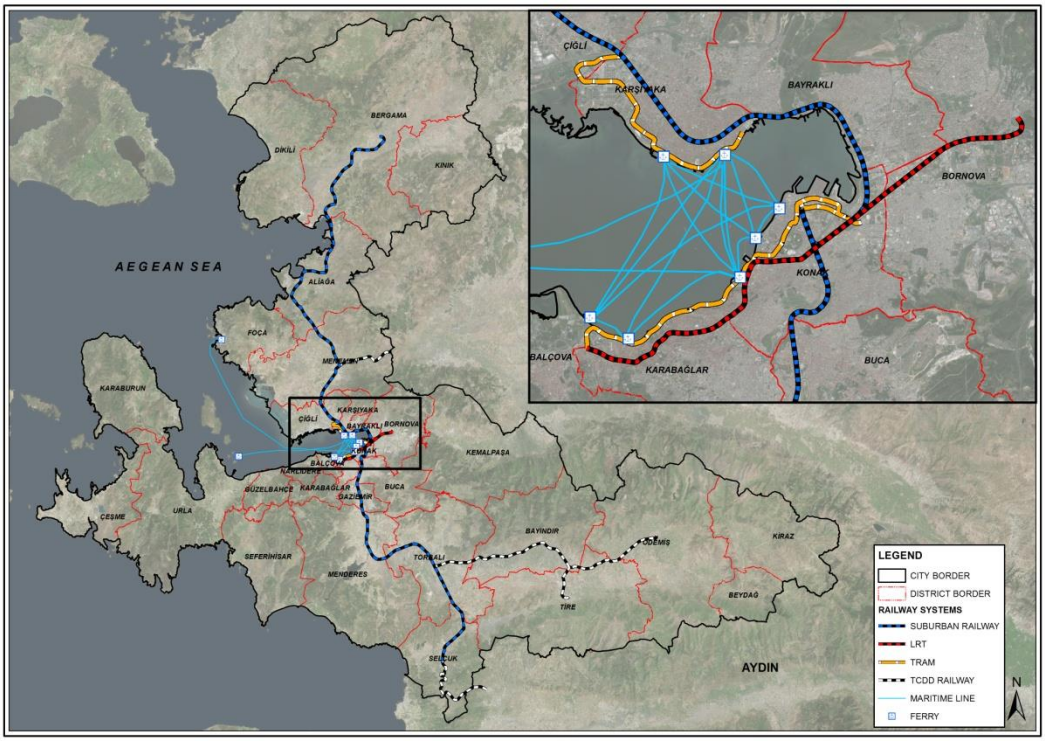


Figure 4.4 Izmir city rail system lines (via Arcmap program)

4.1.4.5.2 Paratransit Transportation Systems. Paratransit public transportation operations in İzmir are provided by "Services", "Taxis", "Taxi-Dolmuş" and "Minibuses". There are 1,117 minibuses with M plates serving in İzmir province. These minibuses depart from 64 different routes and there are 46 stops in total. The total number of daily services was 17,831. 1,117 vehicles in minibus lines carry an average of 300 people per vehicle per day.

Minibuses working in the districts operating outside the nine districts around the Gulf (Aliağa, Foça, Menemen, Kemalpaşa, Bayındır, Torbalı, Selçuk, Menderes,

Seferihisar, Urla, Bergama, Beydağ, Çeşme, Dikili, Karaburun, Kınık, Cherry, Ödemiş, and Tire) has a route permit or a D4 certificate.

There are 135 taxi-dolmuş in İzmir. These taxi minibuses carry an average of 14,000 passengers per day. 135 taxis are served in 6 lines in the city.

4.1.4.5.3 Private Vehicles. The number of vehicles in İzmir is increasing day by day. Automobiles account for more than half of the vehicles in İzmir. According to TUIK data, there are 1,172,549 vehicles in İzmir as of the end of May 2015. Since 2013, the increase is 6%. 54% of these vehicles are private vehicles. 36% of motor vehicles in the Aegean Region with 6% of the motor vehicles comprise motor vehicles in Turkey in Izmir.

In 2015, the number of automobiles per thousand people was determined as 164 according to household survey data by İzmir Metropolitan Municipality. According to the İzmir Transportation Master Plan for the whole city, it is foreseen that the population of the city will be doubled. Accordingly, it was calculated that the number of cars per thousand people will be 233 (İzmir Büyükşehir Belediyesi, 2015).

4.1.4.5.4 Bicycle and Pedestrian Transportation. The existing cycling routes in İzmir are concentrated around the Gulf and extend from Karşıyaka to Sasalı, from Konak to Alsancak Harbor and Üçkuyular. In addition, there are bicycle routes in Foça, Menemen, Gaziemir and Çeşme districts.

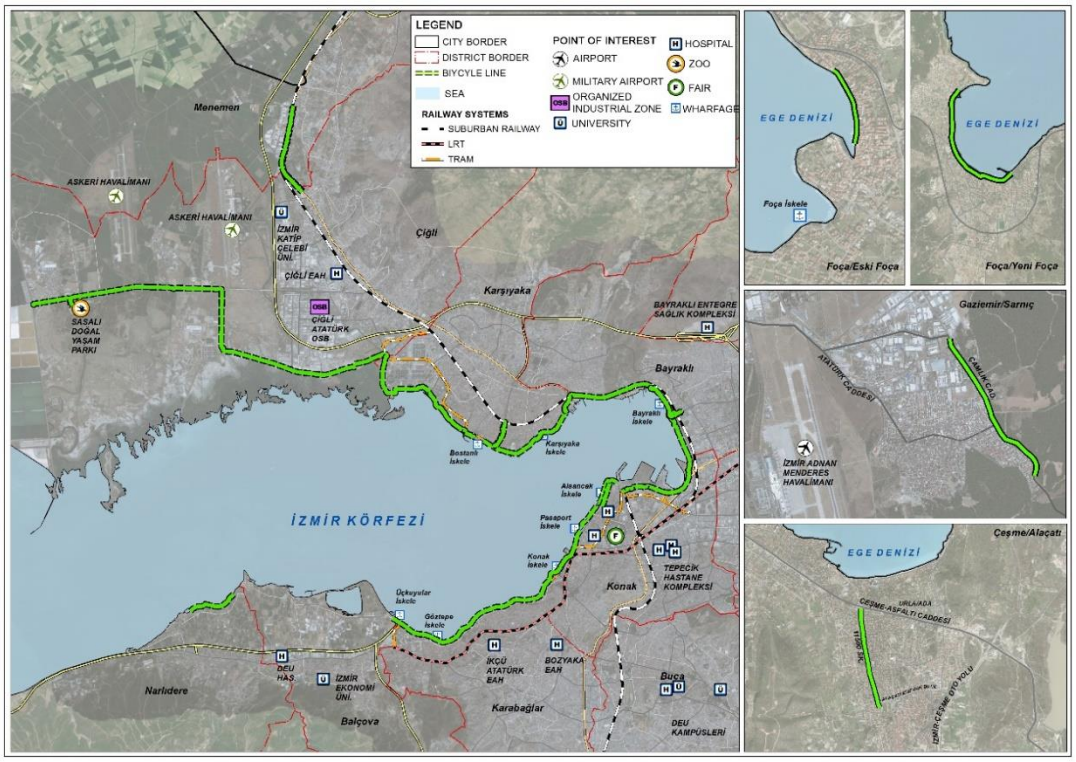


Figure 4.5 Exitisting bicycle roads (via Arcmap program)

There are approximately 66 km of cycling paths throughout İzmir city. When the distribution of the existing bicycle paths according to the types of coating is examined, it is determined that 90% is asphalt, 4% is metal and 3% is concrete and stone.

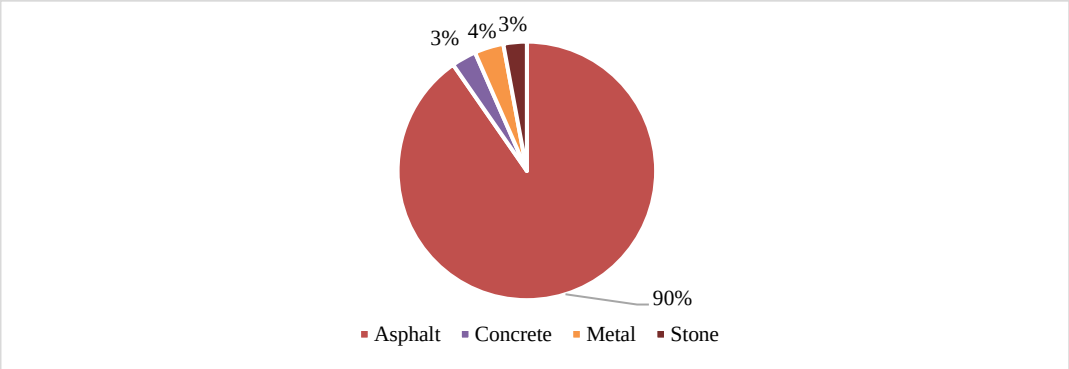


Figure 4.6 Proportional distribution of bicycle road coating types (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Bicycle parking areas have been proposed for the use and expansion of the biscuit network developed in İzmir. These areas show clustering in Konak, Karşıyaka and

Bornova districts in the city center. In addition, there are bicycle parking areas in Urla, Seferihisar and Torbalı districts.

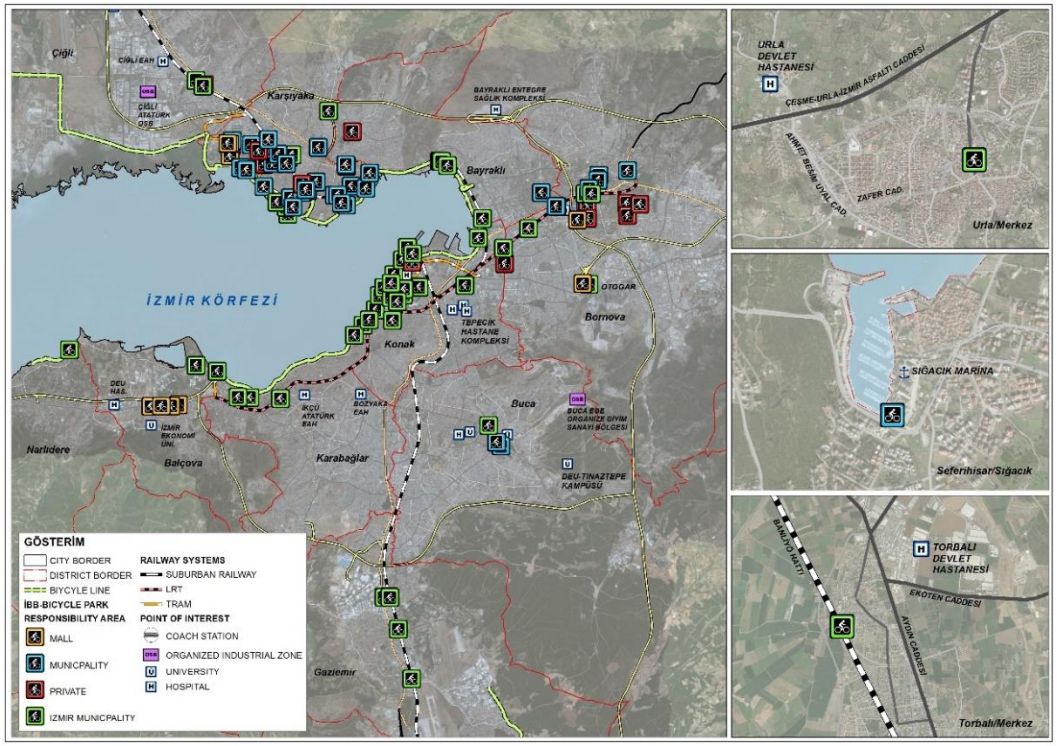


Figure 4.7 Bicycle parking areas in İzmir province (via Arcmap program)

There are 127 parking spaces in the city and has a total capacity of 1664. The number of these existing parking areas vary according to the the institutions in charge. 1000 of the bicycle parking areas in the city have been arranged by Izmir Metropolitan Municipality. Other parking areas are left under the responsibility of other institutions such as district municipalities and shopping malls.

Table 4.5 Bicycle parking areas and responsible institutions (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Responsible Institution	**Bicycle Parking Area**
Private	126
Shopping Mall	126
District Municipalities	435
Izmir Metropolitan Municipality	977
Total	1,664

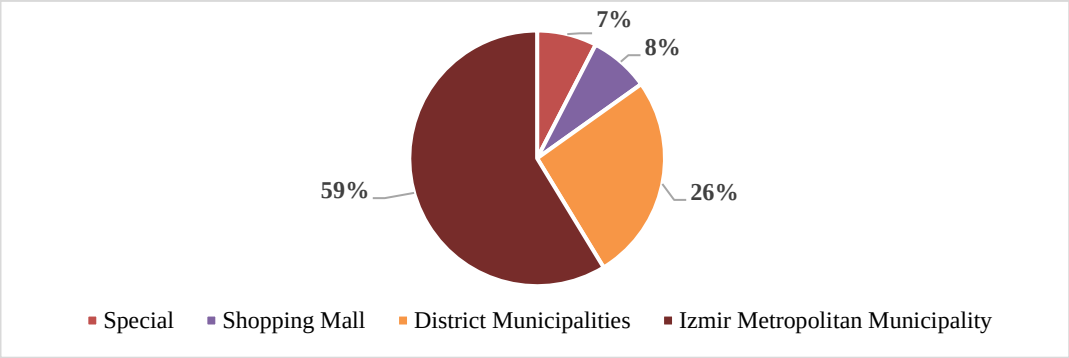


Figure 4.8 Distribution of bicycle parking areas according to the responsible institution (Bisikletli ve Yaya Erişimi Şefliği, 2018)

There is a structure in İzmir, which provides services related to smart bicycle transportation. Since 2014, this structuring where been carried out by İzulaş A.Ş. has been established under the name of Bisim. Bisim has 34 bicycle rental stops along 46 km of Izmir coastal coastline. The number of parks in these rental stops is 600 and there are 400 bicycles. Between January 2014 and October 2015, the number of Bisim card and credit card members reached 108 thousand.

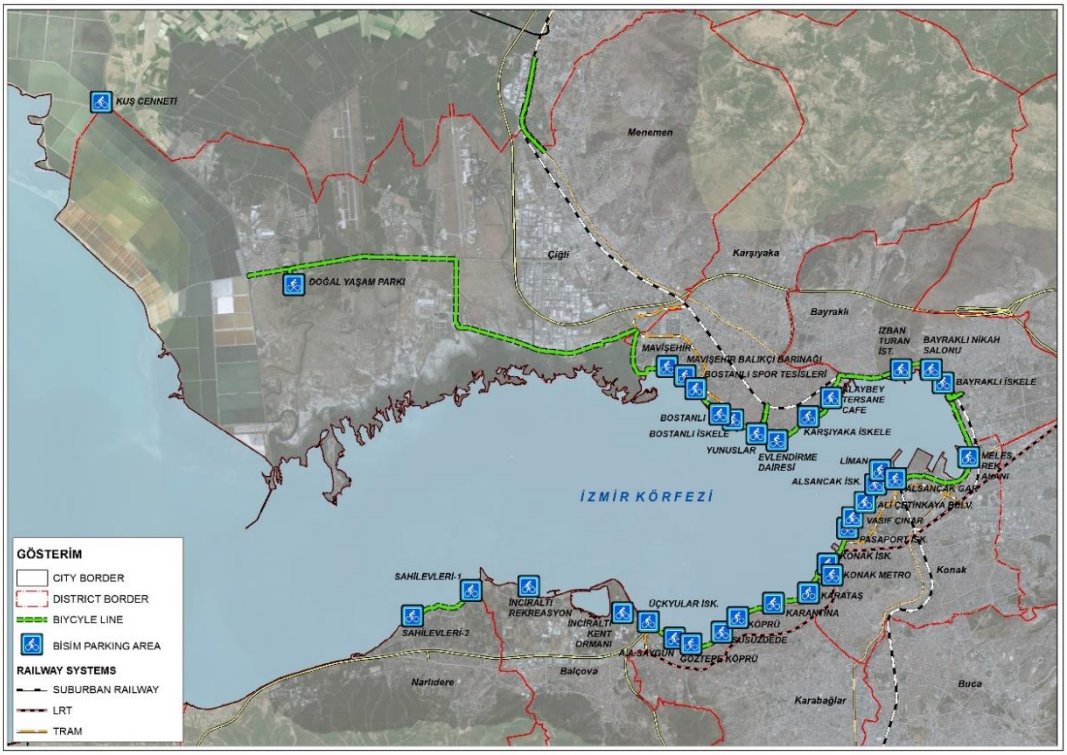


Figure 4.9 Bisim bike path and Bisim park area (via Arcmap program)

Within the scope of the Transportation Master Plan conducted in 2009, 38% of the journeys in the city were made on foot. This value is an important indicator of pedestrian potential in the city. The main pedestrian centers in İzmir are Kemeraltı Region, Cyprus Martyrs Street and Kordon. In addition, there are recreation areas and squares in the city as a pedestrian focus. Recreation areas are used by pedestrians intensively especially in spring and summer months as the geographical and climatic characteristics of İzmir province require.

4.2 Bicycle Road Studies Developed in İzmir up to Date

Participation in many national and international studies is carried out in İzmir with the aim of improving cycling and raising awareness. The most important pillar of this process is EuroVelo (the European cycle route network). The EuroVelo European network of bicycle routes is a sustainable cycling tourism project managed by the European Cyclists Federation. The aim of the EuroVelo project is to promote and coordinate the creation, promotion and operation of a sustainable Trans-European Transport Network across the European Continent. EuroVelo's contribution to cycling tourism is listed below.

- In Europe, 2.3 billion cycling tours in yearly and 20.4 million cycling tours are organized.
- The average daily spending is more than 15 Euros, and the accommodation is 57 Euros per day.
- While the economic return of cycling in Europe is 44 billion euros annually, the share of the EuroVelo network is 7 billion euros annually (Taşkın Erten, 2016).

As a result of the studies carried out in İzmir, İzmir Metropolitan Municipality has applied to the European Cycling Tourism Network which ended its current bicycle tourism potential in Athens (Greece). The routes applied were selected in connection with the Eastern European Route 11 and the Mediterranean Route 8. The EuroVelo Route 11 is a non-active 5,984 km route, starting in the North Cape of Norway and

ending in Athens, Greece. The route passes through Norway, Estonia, Latvia, Lithuania, Poland, Slovakia and Serbia.

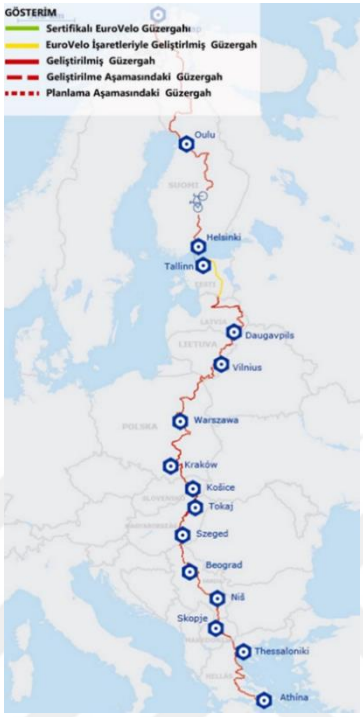


Figure 4.10 EuroVelo 11th route (Taşkın Erten, 2016)

EuroVelo Mediterranean Route 8 is a route that begins in the Spanish city of Cádiz, passing through 11 different European countries with two separate endpoints in Athens, Greece and Cyprus. There are 23 world heritage sites on the route. The active length of the EuroVelo route, which runs in the East-West direction, is 5,888 km.

Figure 4.11 EuroVelo 8th route (Taşkın Erten, 2016)

The proposed routes for the EuroVelo process of Izmir were established in order to ensure the participation of Izmir to EuroVelo by sea connection. These connections were established as two different lines from Athens to Chios, to Çeşme and to Mytilene Road and Dikili.

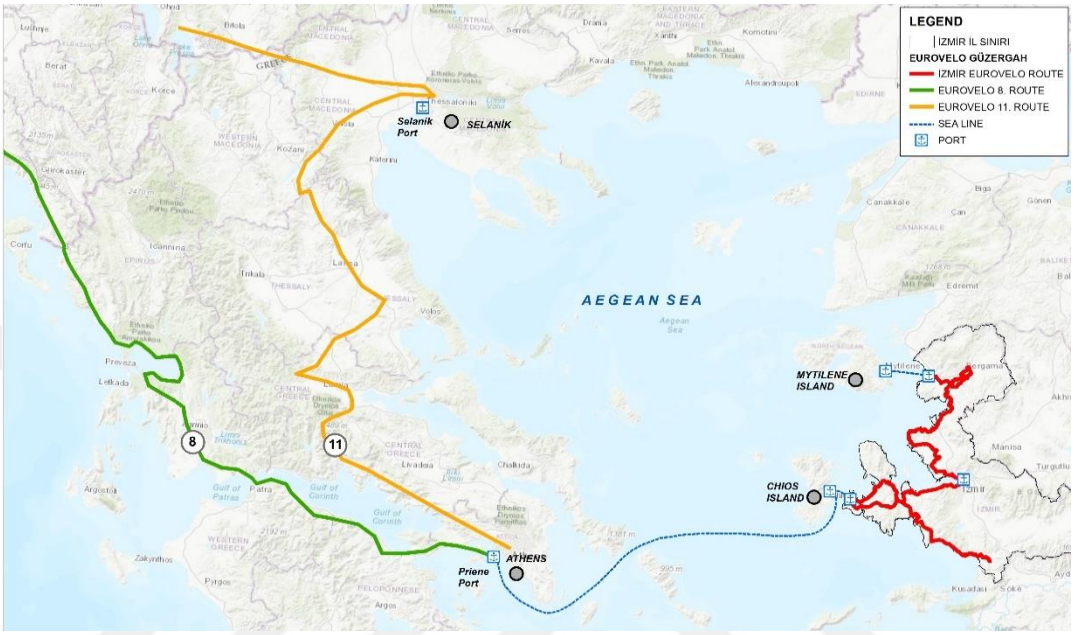


Figure 4.12 EuroVelo 8th and 11th routes Izmir connection (Taşkın Erten, 2016)

The route, which was planned to be extended to the EuroVelo 11th route and developed for it, has been associated with many attractive points of İzmir. It is thought that the route will also contribute to the future national economic tourism corridor. Cyclists who will visit Izmir offer services to meet their needs such as many gastronomic and accommodation alternatives, shopping, bicycle repair and equipment purchase while passing through different centers on the route between Dikili and Selçuk. It is aimed to place the inventory on maps and brochures in order to provide better information and guidance to tourists, and to provide all necessary information to the visitors through printed and digital media in cooperation with local business owners. The EuroVelo Izmir route is approximately 500 km long and consists of 9 sections. The route is a structure that connects ancient cities and allows cultural, natural and local values to be experienced by the users of the route.

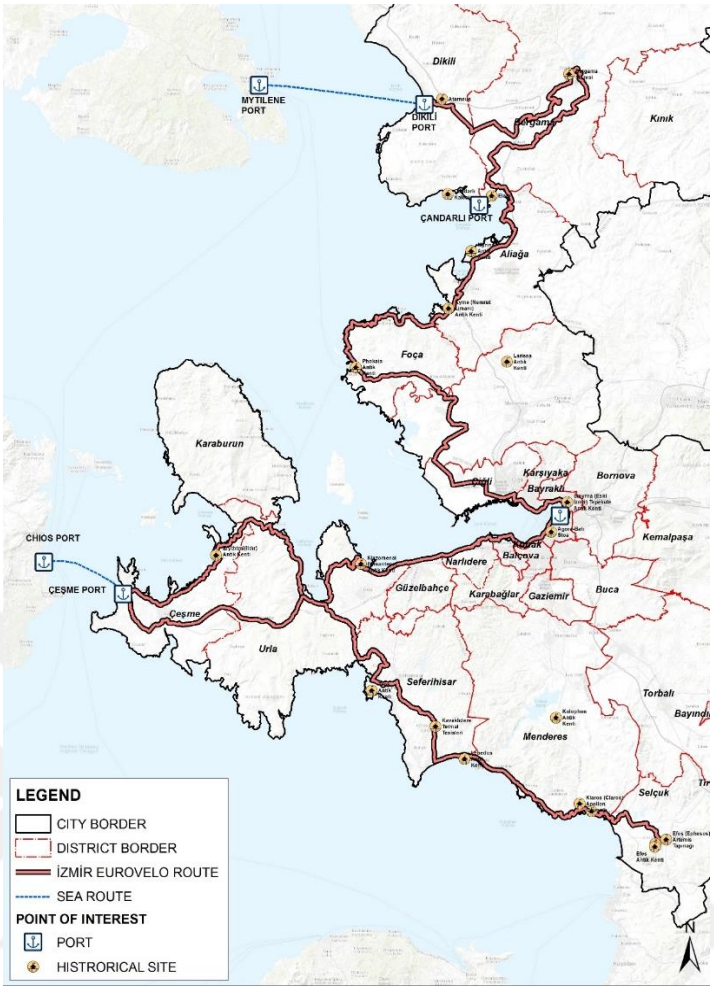


Figure 4.13 Izmir EuroVelo route (Taşkın Erten, 2016)

Another study for the city of İzmir in terms of cycling tourism is the travel routes created within the scope of the Peninsula (Yarımada) Project. There are sub-routes of different concepts on the tour route created between Karaburun and Mimas-Selçuk.

- The walking route starts in front of the Temple of Artemis in Ephesus and ends in Karaburun, whose mythological name is Mimas. The route consists of 55 tracks with a length of 687 km.

- The Olive Route coincides with the 190 km cycling route between Çeşme Harbor and the Temple of Artemis, which complies with EuroVelo standards.

- The Bike Route consists of a total of 762 km between Çeşme Port and the Temple of Artemis. 190 km of the route meets EuroVelo standards.

- Bağ Yolu Route includes Selçuk, Seferihisar, Menderes, Urla, Karaburun and Çeşme districts. The route consists of 151 km.

The Ephesus (Selçuk) - Mimas (Karaburun) Road passing through Selçuk, Menderes, Seferihisar, Güzelbahçe, Urla, Çeşme, and Karaburun counties includes all natural, historical and cultural accumulation on this route. The routes were created by the voluntary efforts of professional mountaineers and hikers, cyclists, olives and vineyards organized by Izmir Metropolitan Municipality. Maps of these routes, transportation facilities, geographical data, accommodation, break, and camping areas, health facilities, historical, and natural values, bearing points were processed. Road signs are also placed on the routes marked in accordance with international standards (İzmir Büyükşehir Belediyesi, 2015).

Figure 4.14 İzmir Efes-Mimas route (İzmir Büyükşehir Belediyesi, 2015)

In order to strengthen its efforts to become a bicycle city of Izmir, the Metropolitan Municipality of Izmir applied to the European Cycling Competition, which is supported by the European Commission on May 1-31 each year. After the application process was approved, 52 cities and 46000 participants from 18 European countries participated in the European Cycling Competition in 2016 and more than 4 million kilometers of cycling were performed. In 2017, the European Cycling Competition

was held in France, 4 cities from Portugal, 8 cities from Italy, 2 cities from Switzerland, 9 cities from Poland and Sweden, 5 cities from Ireland, 2 cities from England, 4 cities from Lithuania, in total 52 cities and 38,602 participants from 13 European countries including one from the TRNC, Croatia, Hungary and Spain took part in the competition and bicycles were used for more than 4 million km. In the city of Izmir, bicycles were used for 855,000 km, and Izmir won the competition (İzmir Büyükşehir Belediyesi, 2016).

Figure 4.15 Izmir European bicycle competition presentations (İzmir Büyükşehir Belediyesi, 2016)

There are many organizations actively involved in activities such as assessing the current status of cycling in Izmir, promoting awareness-raising activities for cycling, organizing activities for cycling. Cycling organizations in the city are in coordination with IBB Cycling and Pedestrian Access Chief.

Table 4.6 Bicycle user organizations

No	Bicycle Organizations	No	Bicycle Organizations
1	Ege Üniversitesi Bisiklet Topluluğu	16	Celal Bayar Üniversitesi
2	Karşıyaka Bisiklet Derneği	17	Pedalhane
3	Gaziemir Aktif Pedal	18	İzmir Görme Engelliler Derneği
4	Çarşamba Akşamı Bisikletçileri	19	İzmirli Pedalperest Kadınlar
5	Karşı Bisiklet	20	İzmir Bisikletli Kadınlar
6	Perşembe Akşamı Bisikletçileri	21	VELO KSK
7	BUGEP	22	Bisikletli Kültür Turları
8	BİSİM	23	Özgür Pedallar
9	Gaziemir Doğa Gezerler Bisiklet Grubu	24	BIKE İzmir
10	İzmir'de Ulaşımını Bisikletle Sağlayanlar	25	CAT Bisiklet Spor Kulübü
11	Eş Pedal	26	Bisiklet Kooperatifi
12	Pedal 35	27	KARBİS
13	Ege Pedal	28	Az Bilinen Antik Kentler Turu
14	Kemalpaşa Bisiklet Topluluğu	29	Federasyon
15	Süslü Kadınlar		

CHAPTER FIVE
ASSESSMENT OF THE USE OF BICYCLE IN URBAN TRANSPORTATION IN İZMİR

In this section, the existing bicycle routes in İzmir will be examined on a spatial scale and geographic inquiries will be made on the integration structure with other means of public transport. In addition, the results of the survey conducted within the scope of Preparation of Action Plans for the Recommendations of İzmir Metropolitan Municipality Main Transportation Plan (UPİ 2030) will be evaluated. In addition to the studies, the results of the counting process will be evaluated with the camera imaging method for the use of bicycles.

5.1 Evaluation on Spatial Scale

The widespread use of bicycle transportation in the city and the increase in use in terms of transportation are related to its spatial location in the city. Geographical factors such as population, slope, and climatic characteristics of the city are effective in the spatial positioning of the bicycle path and determining the routes. In addition, network integrity of proposed routes and access to the city center and other sub-centers are also effective factors in spatial evaluation.

5.1.1 Population Interaction

Examining of the existing cycling route of İzmir indicates that it is a network structure surrounding İzmir Gulf. This existing network constitutes a total of 49 km of cycling path. When the completed bicycle network in İzmir is evaluated across 30 districts, this value reaches 66 km.

The cycling mileage value per 1,000 inhabitants can be assessed in relation to the population that bicycle network is capable of giving service. When the bicycle network per 1000 people is examined in İzmir, the total length of the bicycle network remains low, although the population of İzmir is higher than the cities compared. In Melbourne, bicycle network kilometers per 1,000 people is 0.89, while in Izmir, this value is only 0.013. In the calculations carried out considering the district populations around the

Gulf, this ratio is 0.017. As a result, the analysis is an important indicator that the bicycle network in Izmir should be expanded.

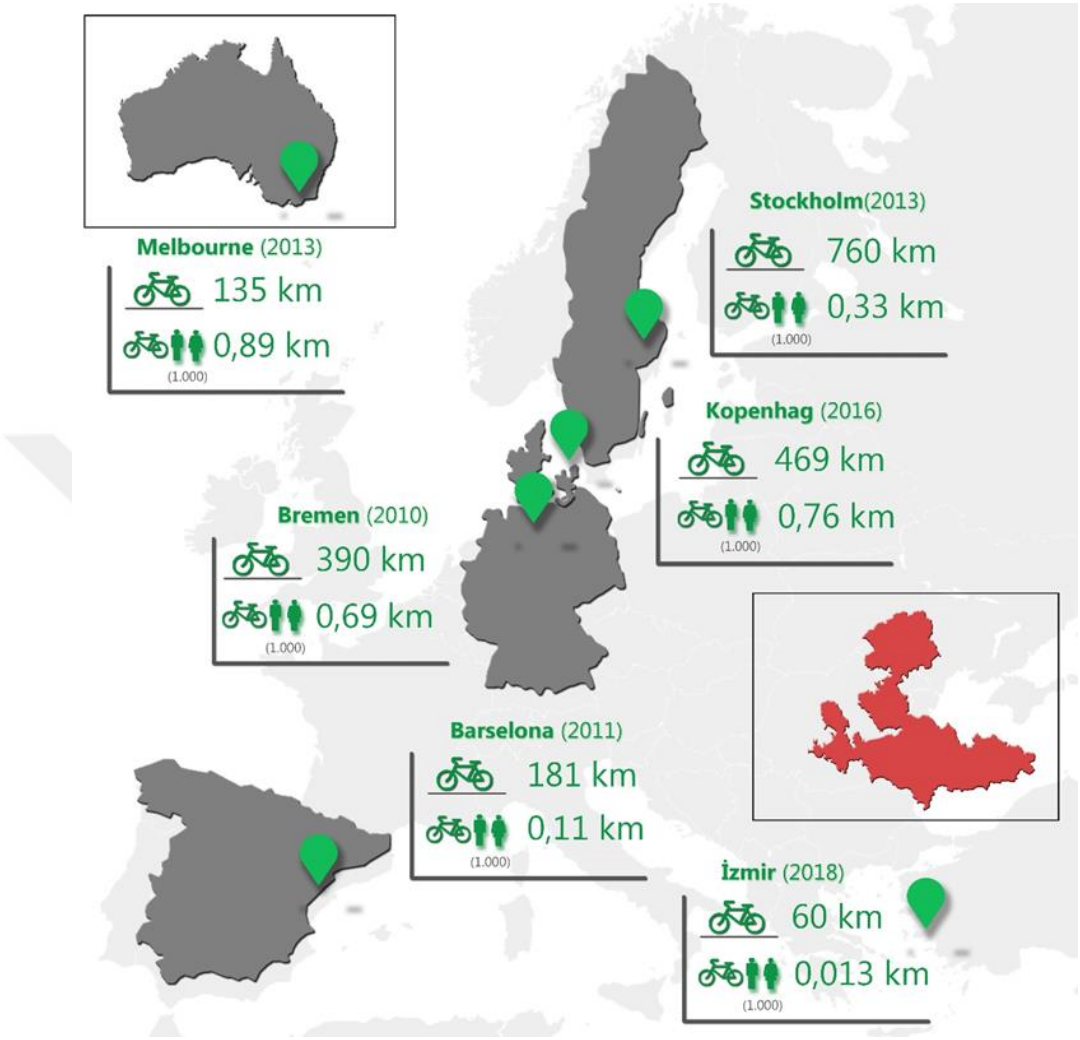


Figure 5.1 Bicycle network by cities

In the study conducted with the existing bicycle network along the coastline of İzmir city, 13.68% of the population of 11 central districts remains within the bicycle transportation network service area as 5.06% of the population in the 30 districts remains within the bicycle transportation network service area. Currently, it is seen that the proportion of the population within the scope of the bicycle population is quite low.

On the other hand, when the bicycle parking areas and Bisim parking areas in İzmir are evaluated, it is calculated that 32.47% of the population provides access to bicycle

parking areas in 11 districts while Bisim parking areas serve only 8.18% of the population.

Table 5.1 Evaluation of the impact areas of bicycle network and parking areas

Year 2018		Populaton of İzmir	Population in Bike Impact Area		Population outside the Bike Impact Area	
			Person	%	Person	%
Bicycle Line	**11 District**	2,299,555	314,511	13.68%	1,985,044	86.32%
	30 Distrcit	6,701,154	339,283	5.06%	6,361,871	94.94%
Bicycle Paring Area	**11 District**	2,299,555	746,654	32.47%	1,552,901	67.53%
	30 Distrcit	6,701,154	771,444	11.51%	5,929,710	88.49%
BİSİM Parking Area	**11 District**	2,299,555	188,182	8.18%	2,111,373	91.82%
	30 Distrcit	6,701,154	188,182	2.81%	6,512,972	97.19%

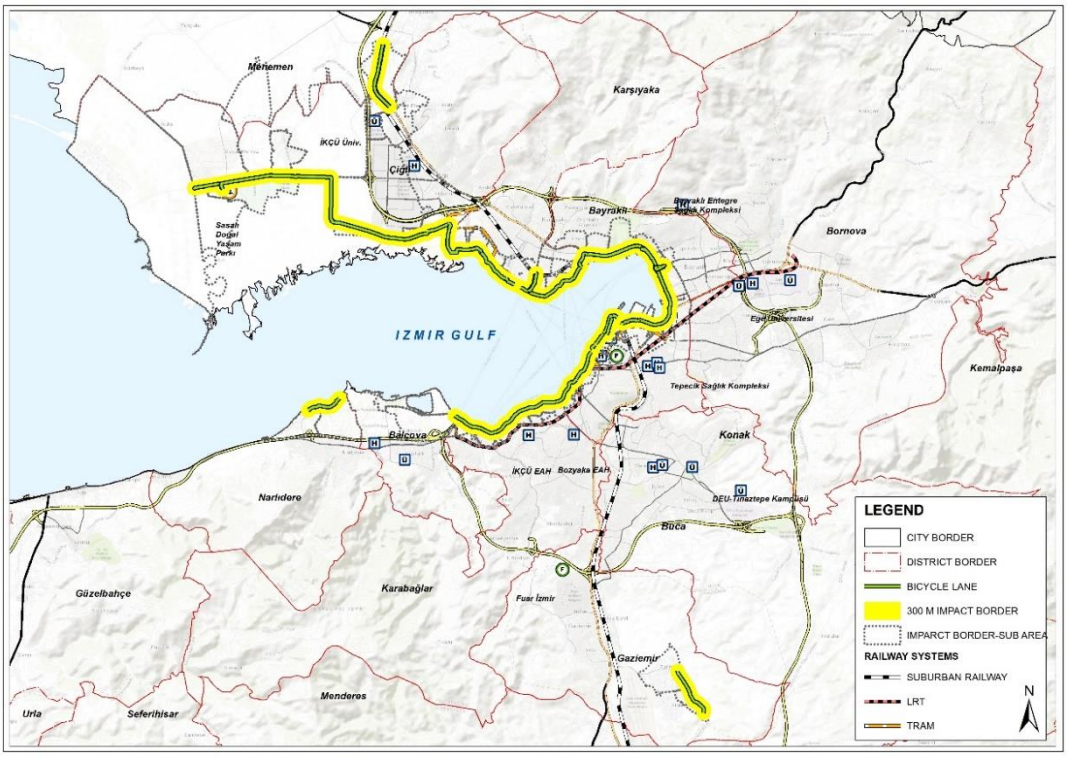


Figure 5.2 Cycling paths and impact area (via Arcmap program)

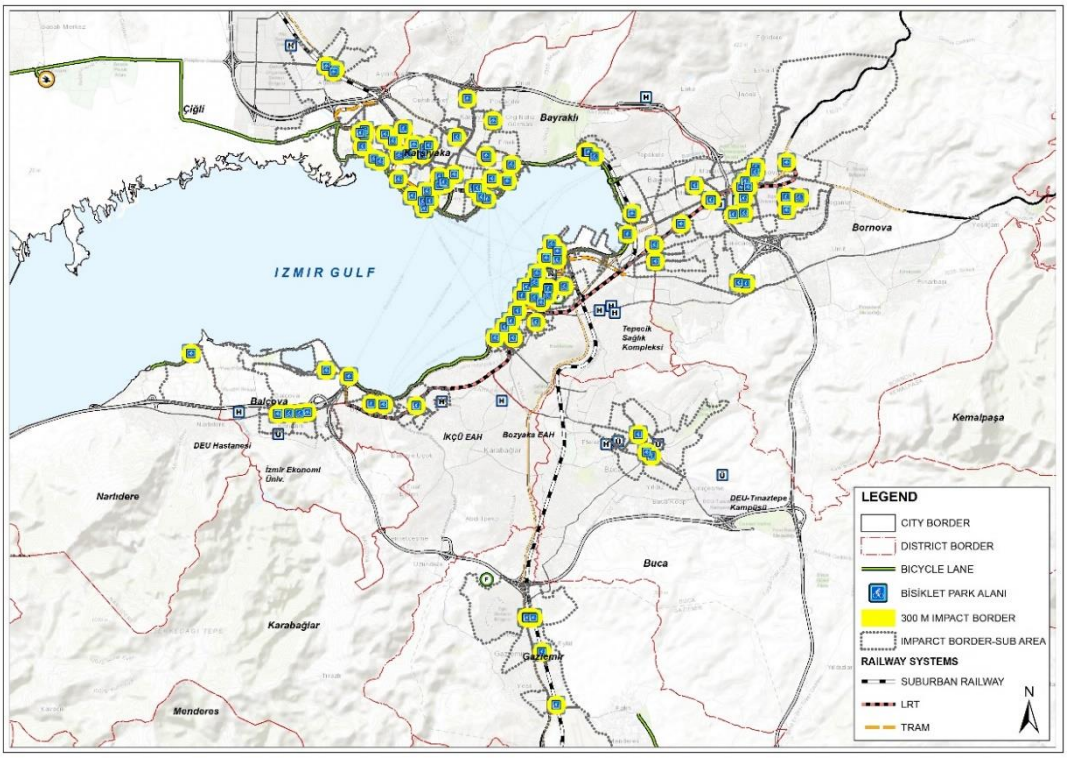


Figure 5.3 Bicycle park areas and impact area (via Arcmap program)

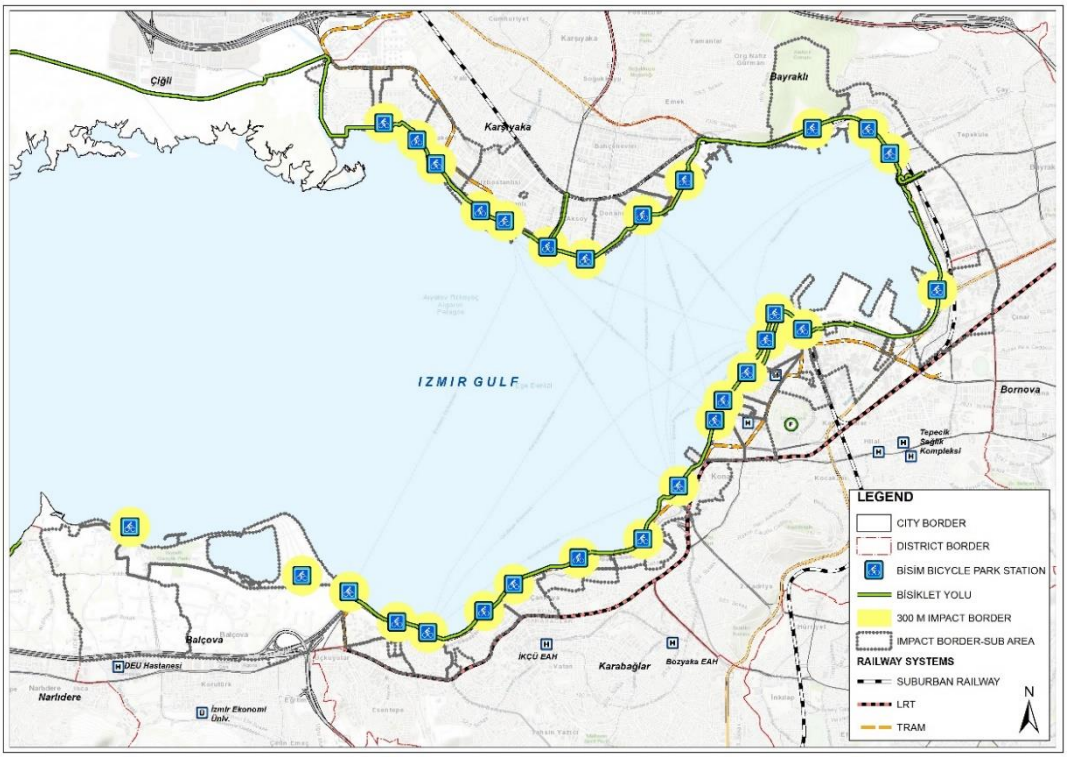


Figure 5.4 Bisim parkng areas and impact area (via Arcmap program)

5.1.2 Network Integrity

The existing bicycle network in İzmir concentrates around the Gulf and extends from Karşıyaka to Sasalı, from Konak to Alsancak Harbor and Üçkuyular. Inner Gulf Coastline Bike route follows the existing bike path from Sasalı Wildlife Park to Mavişehir Fisherman's Shelter and from there reaches the Alaybey shipyard with a course to be rehabilitated within the recreation area of Karşıyaka coast. The cycling route to be established between the suburban line and Altınyol from Alaybey shipyard to Bayraklı descends to the coastal recreation area before the Bayraklı Wedding Office. The route, which covers the Bayraklı Ferry Port and Turgut Özal Recreation Areas, rises to Kordon after Alsancak Port and reaches the F. Altay Ferry Port with an uninterrupted track following M. Kemal Sahil Boulevard. However, the cycling network is not able to maintain its continuity along this line due to the fact that bicycle routes are located in the gulf band throughout the city. Currently, the cycling routes are interrupted at the back of Zafer Payzın Junction and Alsancak Harbor. In addition, the presence of segmented bicycle paths in regions such as İnciraltı, Ulukent and Cistern is the biggest indicator of the lack of network integrity.

Figure 5.5 Points of interruption of bicycle transportation network (via Arcmap program)

5.1.3 Accessibility

The bicycle transport network is connected to the main residential areas, public transport system and activity centers such as public buildings, hospitals, schools, business centers, bazaars and shopping centers. These connections are one of the most important factors in increasing the bicycle's potential for transportation.

When the existing bicycle network in İzmir is examined, it is seen that the city does not have access to the potential uses for bicycle use such as central business areas, schools, university areas, residential areas. The cycling routes along the Gulf line are interrupted at the back of Alsancak harbor. Bike paths in the coastal line are interrupted in the Natural Life Park, Girne Boulevard, Alsancak Harbor area, Üçkuyular Pier and İnciraltı area and the network operates in three parts. Karşıyaka-Çiğli region, Bayraklı region, Bornova District Ege University, hospital districts and residential areas were not integrated with the bicycle path. In the city center of Izmir, the central business area and the Kemeralтı region are seen as areas where there is no direct access to the bicycle paths.

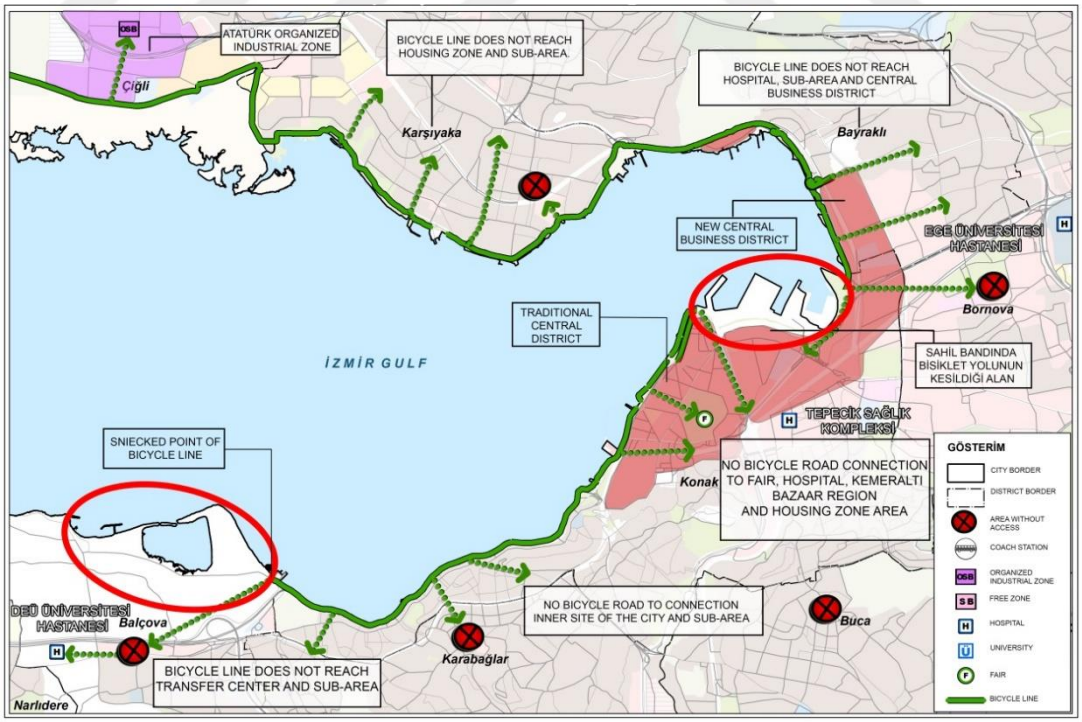


Figure 5.6 Access analysis of bicycle paths (via Arcmap program)

5.1.4 Slope

Since the use of bicycles depends on manpower, the slope of the topography makes cycling difficult. The incline up to 4% is the ideal incline for a smooth and comfortable ride. As the incline increases, cycling becomes more difficult and the preferred rate of the decisive route decreases.

When the slope map of İzmir central region is examined, it can be said that the city has a difficult topography in terms of bicycle transportation. When the bicycle paths located in the Gulf band are examined, it is located in the region between 0% and 3% slope. While Menemen district has the same slope, it is observed that there is a slope close to 4% in Gaziemir district. However, it can be said that the suggested bicycle paths can provide comfortable driving and are the correct routes in terms of comfort. According to the slope map, the most suitable cycling route routes can be made in new city center in Bayraklı, district densely populated residential areas in Bornova, Atatürk Organized Industrial Zone in Çiğli, İnciraltı Region and Buca district. However, central areas, important transport foci and appropriately inclined residential areas should not be ignored in terms of bicycle access.

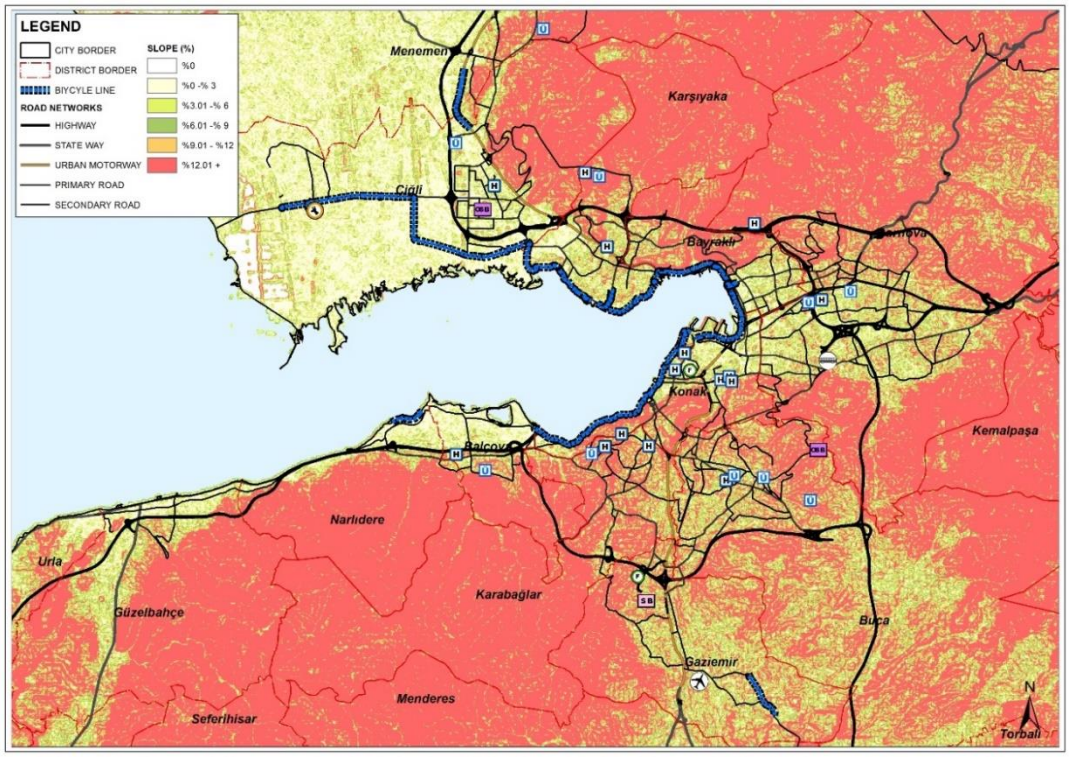


Figure 5.7 Izmir slope analysis (via Arcmap program)

5.1.5 Structure of Bicycle Lane

In addition to the fact that the road transport network is handled in terms of non-motorized transport network, the bicycle transport network must be graded according to its functions, physical characteristics and the characteristics of the region it provides access to. This is necessary in order to promote, promote and plan safe transportation of motorless transport.

The most important element in bicycle transportation is driving safety. When safety is insufficient, the rate of bicycle use in the city decreases. The production of bicycle paths free of vehicle traffic ensures driving safety. However, the lack of sufficient width for the bicycle path in the road sections leads to the lack of high safety driving routes. For this reason, a separate cycle path can be built on some routes. In addition, vehicles and bicycles share the same road surface in some routes due to insufficient road width.

When the road profiles of the existing bicycle paths in İzmir are examined, there are three different types as bicycle path, bicycle lane and pedestrian shared bicycle path. Bike path and bicycle lane are used in the bicycle road profile in the Gulf band, while pedestrian shared bicycle path is used in the areas where the bicycle path is interrupted.

5.1.5.1 Seperated Bicycle Lane

They are two-way or one-way routes, which are insulated from pedestrian and all types of motor vehicles by using protection lane and reserved for the use of bicyclists only. Bike paths can be constructed on one or both sides of the road with these construction conditions. These roads; motor vehicle roads, paving stones, horizontal signs, lawns, roads which are separated by physical obstacles such as concrete barriers.

In Izmir, Mustafa Kemal Sahil Boulevard section, Passport section and Alsancak Port section were separated from vehicle traffic completely and bicycle path was used. In the examination of the bicycle tracks, it was found that the width of the bicycle lanes was not the same in all sections and that asphalt was used as the material of bicycle road. The 2-meter wide bicycle path was used in the Mustafa Kemal Sahil Boulevard

section. Green paint was applied to distinguish vehicle traffic and bicycle path. When the Passport section was examined, it was found that a 2-meter wide bicycle path was built. In this section, the separation of bicycle path from vehicle traffic was solved by the application of a barrier. When examining the bicycle path application in Alsancak Port section, there is a total of 2.4-meter-wide bicycle path to separation of bicycle linefrom traffic line. The distinction of the cyclist from the vehicle traffic was found to be the same as that applied in the Passport section.

Figure 5.8 Göztepe pier bicycle road (Personel archive, 2019)

Figure 5.9 Göztepe pier cycling road section (via Streetmix)

Figure 5.10 Pasaport-Konak bicycle road (Personel archive, 2019)

Figure 5.11 Pasaport-Konak bicycle road section (via Streetmix)

Figure 5.12 Alsancak Port bicycle road (Personel archive, 2019)

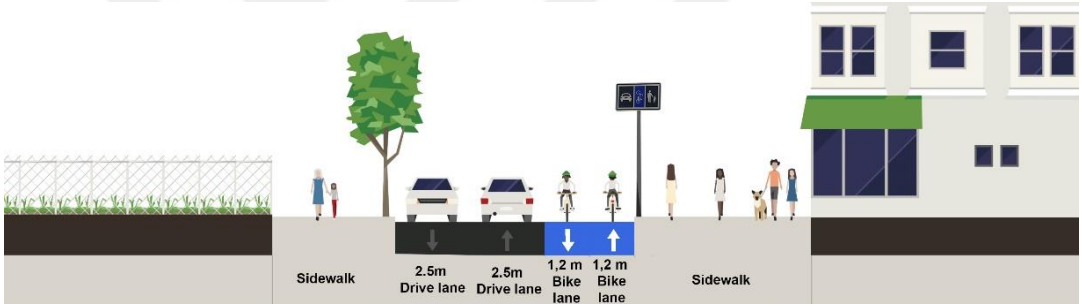


Figure 5.13 Alsancak Port bicycle road (via Streetmix)

5.1.5.2 Bike Lane

A type of two-way or one-way bicycle path where all priorities are given to bicycles and separated by lane markings of a section of the road platform or pedestrian areas. This area consists of a sheltered area separated by traffic signs and signs for cyclists.

An example of the bicycle lane is the bicycle path at the Bostanlı Pier section. The bike lane, which is separated from the vehicle traffic by painting on the road, is also partially separated by the Karşıyaka Tram line. When we look at the width of the bike lane, it was found that a 2.4-meter bike path was built in order to use the road effectively.

Figure 5.14 Bostanli Iskele tram station and Hasan Ali Yucel Boulevard (Personel archive, 2019)

Figure 5.15 Bostanlı İskele tram station and H. Ali Yücel Boulevard bicycle section (via Streetmix)

5.1.5.3 Pedestrian Shared Bike Lane

In cases where network integrity cannot be ensured, it is the type of line that will be applied on the pedestrian path or sidewalks when connecting the start-to-finish route by the shortest path or when an alternative route cannot be determined. This type of bicycle path should be used when making information with horizontal and vertical signs.

Alsancak Port section and Melez Recreation Area can be given as an example for this application which is made at the points where the bicycle path is cut on the coast line in İzmir. The heavy traffic on the Harbor Street in Alsancak Port and the presence of multi-storey junctions connected by Altınyol constitute an obstacle to the application of the bicycle path. In addition, the existing road structure is not suitable for the construction of a bicycle lane or seperated bicycle lane can be cited. However, as seen in figure 5.17, it is observed that the pedestrian shared bicycle lane applied is

below the standards and constitutes an uncomfortable transition area for both pedestrians and cyclists.

Figure 5.16 Alsancak Port in-park road and Alsancak train station (Personel archive, 2019)

Figure 5.17 Harbor Street side road and Port C gate entrance (Personel archive, 2019)

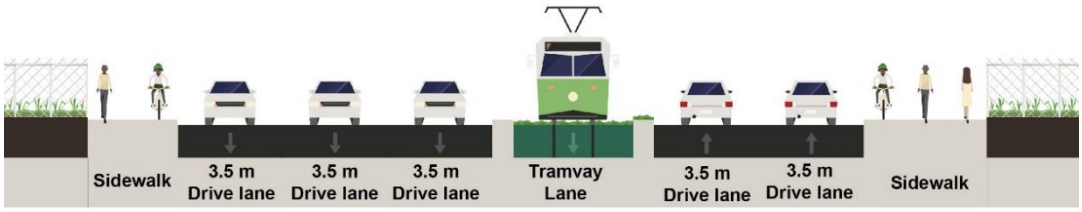


Figure 5.18 Liman Street pedestrian shared bicycle road section (via Streetmix)

5.1.6 Investigation of Highway Hierarchy and Bicycle Path Hierarchy

In networks where the bicycle is used for transportation, a hierarchical approach to the road network is also required. There are no practices such as speed-limiting zones and shared zones developed in İzmir as a hierarchical approach to bicycle transportation. A classification for bicycle paths is directly related to many topics such as accessibility, safety, integration, as well as the planning of non-motorized transport networks.

The speed limit applicable in the road transport network, including all local roads, is officially defined as 50 km h. Depending on the structure of the region; lower speed limits may also be applied in some regions such as center and sub-center. However, it is not seen that such applications are sufficiently applied for the whole city. Considering the importance of a new approach to the road network in terms of safety, speed limits need to be evaluated differently in areas where pedestrian movements are intense. 50 km/h, which is the maximum speed limit envisaged by the General Directorate of Highways on urban roads, is very dangerous for pedestrian and bicycle safety. Again, it is seen that the road perceptions are very limited even if the drivers follow the official speed limits in regions where pedestrian mobility is intense.

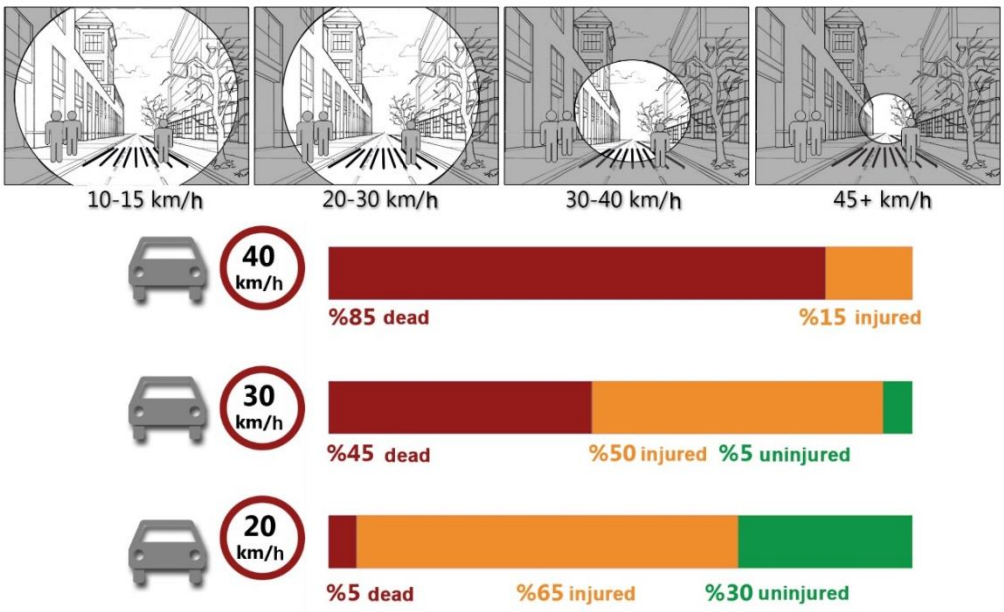


Figure 5.19 Speed and pedestrian safety interaction (Lindake, 2015)

When the bicycle routes in İzmir are examined in terms of highway and bicycle hierarchy, there is no approach and progress in terms of promoting non-motorized transportation. The creation of shared zones for pedestrians, cyclists and disabled people in highway implementation is an important factor for the promotion and safety of cyclists.

5.2 Integration Assessment

The widespread use of bicycles in the city and the increase in use are available through integration with other types of public transport. Integration is possible with both spatial and wage collection systems. In this section, the bicycle routes in İzmir will be examined in terms of spatial and ticket integration with the public transportation system in the city.

5.2.1 Spatial examination by public transport

In order to provide bicycle integration in spatial terms, bicycle parking spaces should be available in transfer centers, rail system stations, public transport stops with rubber wheels, scaffolding, central business areas, pedestrianized roads.

Buses, trams, ferries, HRS lines, and suburban lines, which are the public transportation system available in İzmir, can be taken by bicycle or travel. This application is important for the integration of bicycles and public transport. When examining the bicycle parking areas at the existing rail system stations and the piers of the sea road, it was found that the tram lines serving on the coast line are integrated with the bicycle parking areas. When the HRS and suburban lines were examined, it was found that bicycle parking areas were limited. It was found that the pier points on the ferry lines were designed more efficiently than other types in terms of bicycle integration.

Table 5.2 Bicycle park areas in railway stations

Statıon Name	**Raılway System Name**	**Yes/ No**	**Statıon Name**	**Raılway System Name**	**Yes/ No**	**Statıon Name**	**Raılway System Name**	**Yes/ No**
Çiğli	Suburban	**Yes**	Cumaovası	Suburban Raılway	**No**	Vilayet Evi	Karsıyaka Tram	**Yes**
Mavişehir	Suburban	**Yes**	Develi	Suburban Raılway	**No**	Atakent	Karsıyaka Tram	**Yes**
Şemikler	Suburban	**Yes**	Tekeli	Suburban Raılway	**No**	Bilim Müzesi	Karsıyaka Tram	**Yes**
Demirköprü	Suburban	**Yes**	Pancar	Suburban	**No**	M.Kemal Atatürk	Karsıyaka Tram	**Yes**
Nergiz	Suburban	**Yes**	Kuşçuburun	Suburban	**No**	Alaybey	Karsıyaka Tram	**Yes**
Karşıyaka	Suburban	**Yes**	Tepeköy	Suburban	**No**	Bostanlı İskele	Karsıyaka Tram	**Yes**
Alaybey	Suburban	**Yes**	Selçuk	Suburban	**No**	Bostanlı Çarşı	Karsıyaka Tram	**No**
Naldöken	Suburban	**Yes**	Ulukent Sanayi	Suburban	**No**	Selçuk Yaşar	Karsıyaka Tram	**No**
Turan	Suburban	**Yes**	Selçuk-Sanayi	Suburban	**No**	Mavişehir	Karsıyaka Tram	**No**
Bayraklı	Suburban	**Yes**	Katip Çelebi	Suburban	**No**	Çevreyolu	Karsıyaka Tram	**No**
Salhane	Suburban	**Yes**	Menemen Cumhuriyet	Suburban	**No**	Ataşehir	Karsıyaka Tram	**No**
Alsancak	Suburban	**Yes**	Menemen Zeytinlik	Suburban	**No**	Mavişehir	Karsıyaka Tram	**No**
Esbaş	Suburban	**Yes**	Halkapınar	LRT	**Yes**	Sadıkbey	Konak Tram	**Yes**
Gaziemir	Suburban	**Yes**	Bornova	LRT	**Yes**	Üçkuyular İskele	Konak Tram	**Yes**
Sarnıç	Suburban	**Yes**	Bölge	LRT	**Yes**	Aassm	Konak Tram	**Yes**
Torbalı	Suburban	**Yes**	Ege Üniversitesi	LRT	**Yes**	Güzelyalı	Konak Tram	**Yes**
Şırınyer	Suburban	**Yes**	Evka3	LRT	**Yes**	Göztepe	Konak Tram	**Yes**
Hilal	Suburban	**No**	Göztepe	LRT	**Yes**	Köprü	Konak Tram	**Yes**
Aliağa	Suburban	**No**	Sanayı	LRT	**Yes**	Karantina	Konak Tram	**Yes**
Biçerova	Suburban	**No**	Stadyum	LRT	**Yes**	Karataş	Konak Tram	**Yes**
Hatundere	Suburban	**No**	Basmane	LRT	**No**	Alsancak Gar	Konak Tram	**Yes**
Menemen	Suburban	**No**	Hatay	LRT	**No**	Halkapınar	Konak Tram	**Yes**
Egekent 2	Suburban	**No**	Hılal	LRT	**No**	Fuar-Kültürpark	Konak Tram	**Yes**
Ulukent	Suburban	**No**	Polıgon	LRT	**No**	Konak İskele	Konak Tram	**Yes**
Egekent	Suburban	**No**	Çankaya	LRT	**No**	Gazi Bulvarı	Konak Tram	**No**
Ata Sanayi	Suburban	**No**	Üçyol	LRT	**No**	Hocazade Cami	Konak Tram	**No**
Kemer	Suburban	**No**	İzmirspor	LRT	**No**	Alsancak Cami	Konak Tram	**No**
Koşu	Suburban	**No**	Konak	LRT	**No**	Alsancak Stadyumu	Konak Tram	**No**
İnkılap	Suburban	**No**	Karşıyaka İskele	Karsıyaka Tram	**Yes**	Üniversite	Konak Tram	**No**
Semt Garajı	Suburban	**No**	Nikah Salonu	Karsıyaka Tram	**Yes**	Havagazı	Konak Tram	**No**
Adnan Menderes	Suburban	**No**	Yunuslar	Karsıyaka Tram	**Yes**	Fahrettin Altay	Konak Tram	**No**

Table 5.3 Biycle park areas in ferries

Station Name	System Name	Yes/No
Üçkuyular İskele	Wharfage	**Yes**
Pasaport İskele	Wharfage	**Yes**
Konak İskele	Wharfage	**Yes**
Karşıyaka İskele	Wharfage	**Yes**
Karantina Iskele	Wharfage	**Yes**
Göztepe İskele	Wharfage	**Yes**
Bostanlı İskele	Wharfage	**Yes**
Bayraklı İskele	Wharfage	**Yes**
Alsancak İskele	Wharfage	**Yes**

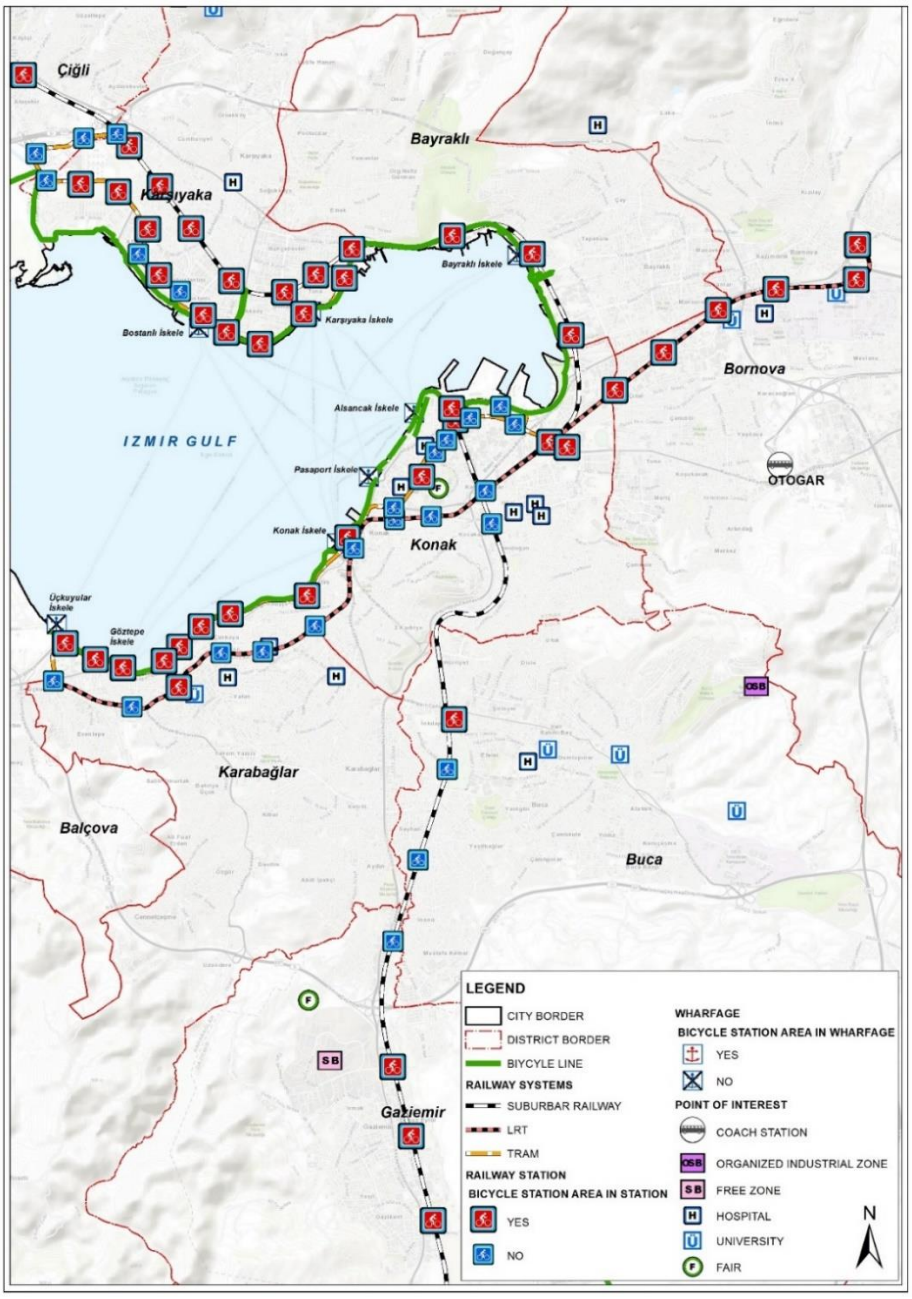


Figure 5.20 Integration of railway stations and piers with bicycle parking areas (via Arcmap program)

Another factor in achieving spatial integration in bicycle transportation is the encouragement of transfer trips and minimization of transfer problems. According to the household data realized within the scope of İzmir Transportation Master Plan Work (UPİ 2030), the distributions of passenger movements according to their types were examined. According to the data obtained, it is determined that the daily bicycle trips in İzmir are 34,144. The ratio of cycling to all trips in the city is calculated as 0.52%.

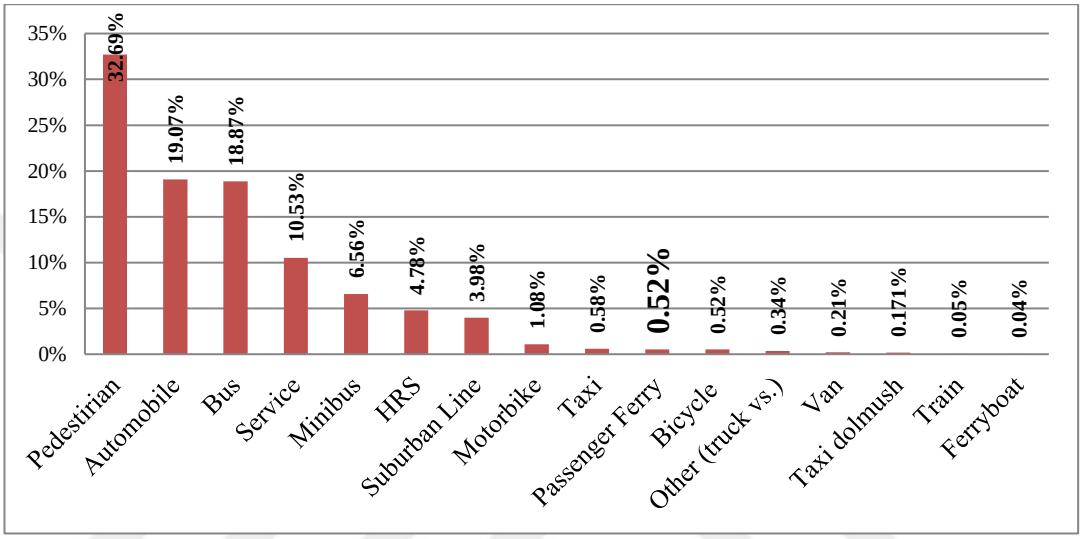


Figure 5.21 Distribution of all passenger movements by vehicle type (İzmir Büyükşehir Belediyesi, 2015)

In the scope of the UPI (2030) study, the relationship between cycling passengers and other types of public transport was investigated. 80.3% of the connecting trips were used by sea.

Table 5.4 The Relation between bicycle transportation and transfer travel on public transport (İzmir Büyükşehir Belediyesi, 2015)

Bicycle-Public Transport Transfer Matris	**Bicycle**	**Bus Transport**	**Railway Transport**	**Maritime Line Trasnport**
Bicycle	-	0%	**19.70%**	**80.30%**
Bus Transport	0.01%			
Railway Transport	0%			
Maritime Line Trasnport	2.20%			

Within the scope of EPİ Bike User Surveys Field Study 2018, monthly cycling passenger data for rail and tram systems were obtained. According to the data between September 2017 and March 2018, there are 200 to 400 bicycles per month on the Karşıyaka tram line. This number ranges from about 3,000 to 5,000 for the light rail system. On the other hand, the highest bike boarding was made for the Karşıyaka tram in March. In light rail system, the highest boarding was determined in November.

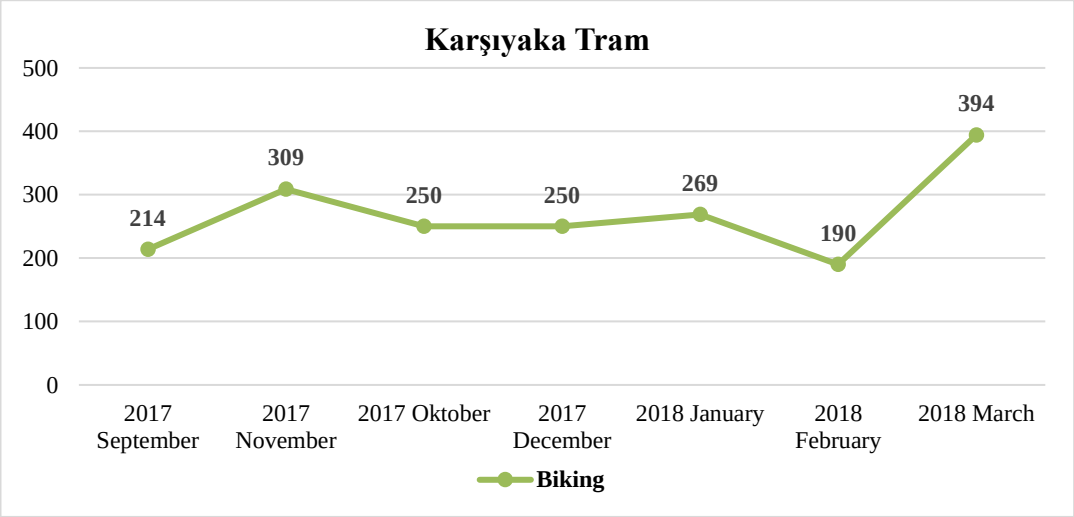


Figure 5.22 Karşıyaka tram monthly boarding bicycle passengers (Bisikletli ve Yaya Erişimi Şefliği, 2018)

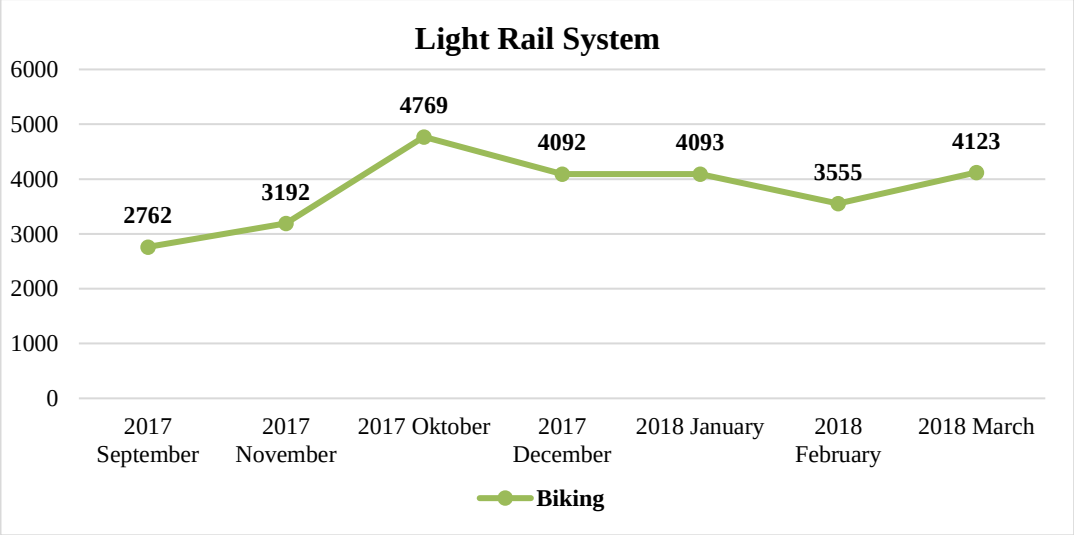


Figure 5.23 LRT Systems monthly boarding biycycle passengers (Bisikletli ve Yaya Erişimi Şefliği, 2018)

The results of the bicycle user survey conducted within the scope of the Cycling and Pedestrian Transport Action Plan were evaluated in terms of public transport integration. According to the results of the survey, 49% of summer users and 42% of autumn users had problems in terms of integration.

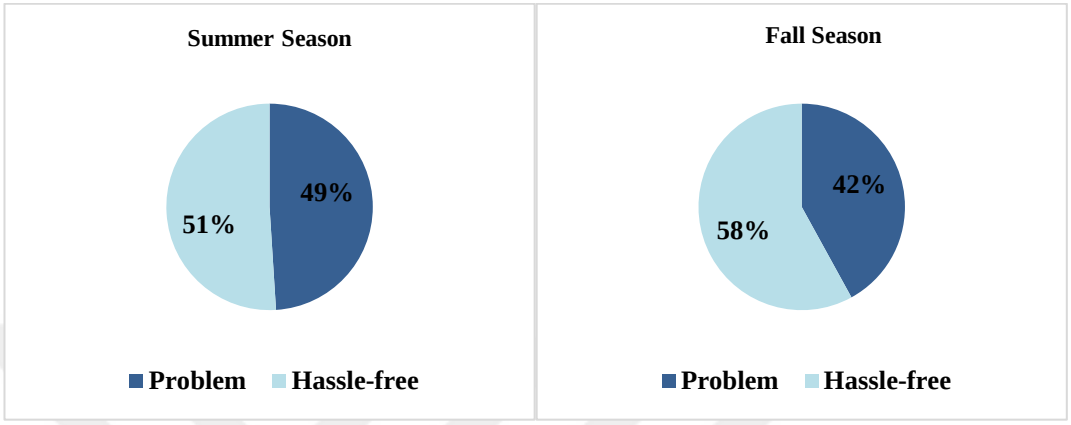


Figure 5.24 Bike user's problem withh public transport integration (Bisikletli ve Yaya Erişimi Şefliği, 2018)

In the summer and fall cycling user surveys, the question was asked about the types of public transport the cyclists had problems with. In line with the answers given, it was found that they had problems with HRS line at a rate of 36%. While the problem with the suburban system was determined as 24%, the tram was determined least non-problematic type of public transport. The cause of these problems are as follows.

- Buses are not allowed to ride with bicycles
- Not enough bicycle transport apparatus
- No cycling during peak hours
- In the suburban and HRS, the ride on the bike is limited to wo persons.

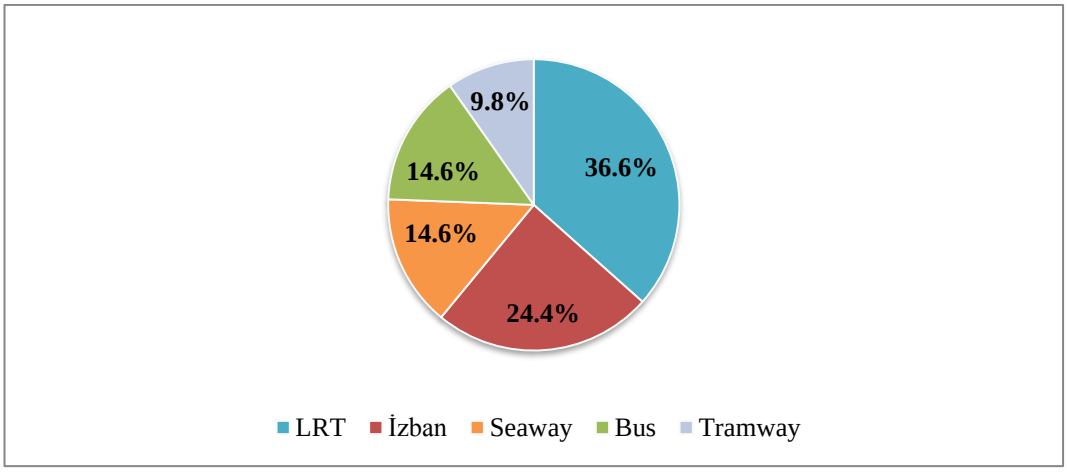


Figure 5.25 Rate of problems in terms of transportation types (Bisikletli ve Yaya Erişimi Şefliği, 2018)

The ability to transport bicycles in public transport is the most basic application that enables the integration of bicycle and public transport systems. There are apparatuses for transporting bicycles in a section of the bus vehicles that provide public transportation services in İzmir. Bike transport apparatus is standard and only has two bicycles. Bicycles to be transported must have a tire diameter of less than 16 inches. According to the results obtained from the web application of the public transport system with rubber wheels, there are only 32-line bicycle transport apparatus throughout the city. In order to ensure integration for the public transport system, more even bicycle transport apparatus is required.

Table 5.5 Bus lines with bicycle transport apparatus (Eshot Genel Müdürlüğü, 2016)

Number	**Line Number**	**The name of the line with bicycle carrying apparatus**	**Daily total bike number**	**Daily Total two-way trip number**
1	17	F.Altay Akt. - Uzundere Toplu	28	106
2	20	Konak - Kooperatif Evleri	40	156
3	25	F.Altay Akt. - Oyunlar Köyü	86	92
4	53	Altındağ - H.Pınar Metro	44	210
5	82	F.Altay Akt. - Güzelbahçe	16	90
6	114	Evka 3 Metro - Evka-3	54	180
7	125	Halkapınar Metro 2 - Mustafa K	48	122
8	247	Çiğli Akt.Mrk - Evka 6	58	75
9	277	Otogar - Tınaztepe	20	44
10	342	Çiğli Akt.Mrk - Egekent	72	134
11	346	Egekent Akt.Mrk - Evka.5	132	151
12	428	Bostanlı İsk.Aktr.Mr. - Egeken	37	108
13	429	Bostanlı İsk.Aktr.Mr. - Güzelt	48	76
14	443	Bostanlı İsk.Aktr.Mr. - Egeken	20	119
15	445	Bostanlı İsk.Aktr.Mr. - Evka 2	74	107

Table 5.5 continues

Number	Line Number	The name of the line with bicycle carrying apparatus	Daily total bike number	Daily Total two-way trip number
16	447	Bostanlı İsk.Aktr.Mr. - Evka 6	18	65
17	480	İnciraltı - Üçkuyular İskele	56	79
18	524	Cennetçeşme - Üçyol Metro	18	104
19	565	Bornova Metro - Evka 4	26	277
20	568	Bornova Metro - Evka 4	36	161
21	585	Bornova Metro - Evka 4	18	172
22	587	Konak - Limontepe	36	158
23	676	Şirinyer Akt. - Tınaztepe	42	131
24	827	Bostanlı İskele-Ulukent Aktarm	38	62
25	871	İşçievleri - Şirinyer Akt.	56	91
26	874	İzkent - Şirinyer Akt.	52	83
27	875	Evka 1 - Şirinyer Akt.	42	93
28	876	Şirinkapı - Şirinyer Akt.	32	65
29	879	G. Semt Garajı - Yeşilyurt	28	102
30	891	Evka 7 - Gaziemir Semt Garajı	60	70
31	945	Esentepe - F.Altay Akt.	106	125
32	971	F.Altay Akt. - Narbel	82	165

When the spatial distribution of the rubber wheeled public transport system, which operates the buses with bicycle transport apparatus, was observed, it had limited access to all parts of the city. In addition, it was found that this service could not be provided in the major attraction centers, which are the central and sub-centers of the city.

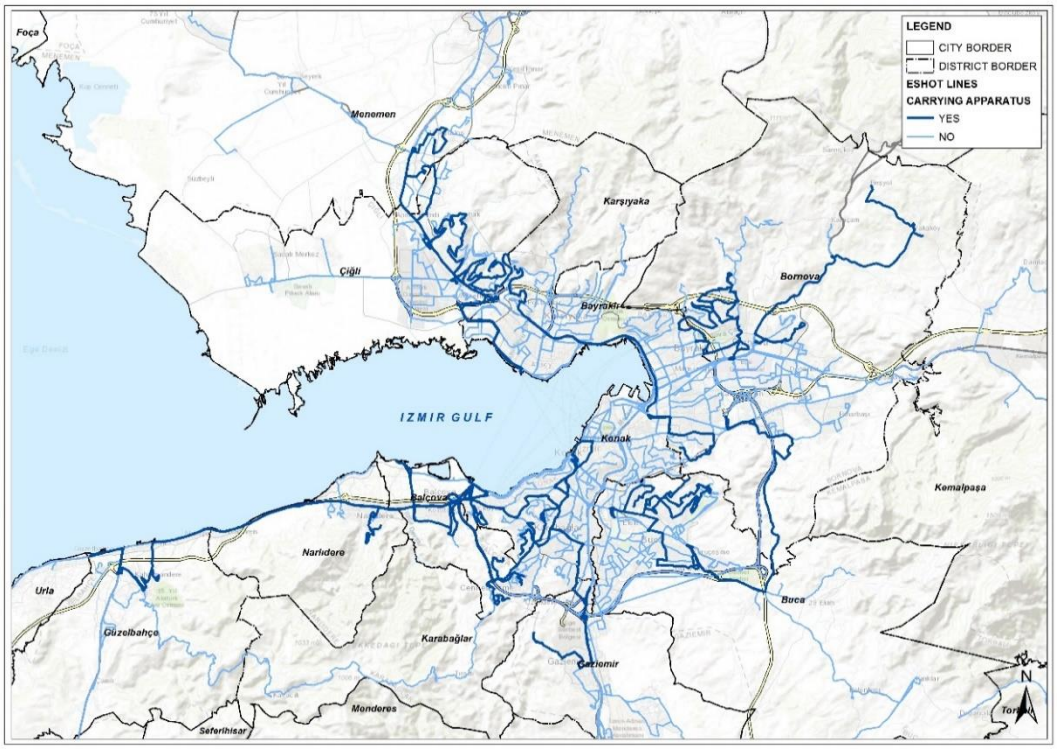


Figure 5.26 Lines where buses with bicycle apparatus are operated (via Arcmapp rogram)

5.2.2 Examination of Ticket Integration by Public Transport

Bike rental system in Izmir can be rented by credit card or member card. Furthermore, although the member card is not integrated with İzmirimKart, which is used in public transportation in the city, İzmirimKart cannot be used in bicycle rental system. The free transfer system within 90 minutes of the public transportation system cannot be used in bike rental due to non-compliance with İzmirimKart and Bisim, and the use of bicycles is not included in the transfer system and the bike rental application serves for recreational purposes.

Applications that allow the transportation of bicycles in public transportation systems contribute to the development of bicycle transportation. Although some types of public transport in İzmir are allowed to carry bicycles under certain conditions, the development of this practice is important for the promotion of bicycle use.

5.2.3 Examination of Public Transport, Automobile and Bicycle Integration (Park & Ride)

There are various policies in the world that encourage the transition from private vehicle to public transportation. One of these policies is the Park and Ride system (P&R - Park and Ride). With the Park-and-Ride system, passengers traveling to the city center can continue their journey by public transport using the car parks near public transportation stations. These areas are also used as transfer centers.

Points P&R are usually chosen near rail stations, bus stops and piers. Thus, those who travel by private vehicle can continue their journey by public transportation by parking their vehicles in P&R areas without entering the cities busy traffic corridors. Integration with other species is provided with bicycle parking areas created in these areas.

Currently, there are no parking and resume points in Izmir. However, public transport, private vehicles and bicycles are used together as transfer center areas. These areas are potential for the Park & Ride system.

5.3 Evalution of Surveys

In this section, the work on the Action Plans of İzmir Transportation Master Plan Recommendations Action Plans, which has not been published yet but has already completed the current analysis studies, was utilized. The study was compiled from the reports prepared by the Bogazici Proje and from the database of the Department of Transportation of Izmir Metropolitan Municipality.

Within the scope of this study, bicycle routes, cycling routes, focal points and integration centers were taken into consideration. For this purpose, questionnaires were carried out to collect the data that will provide the trip objectives, starting and ending points of trip of the cyclists and the duration of trip and the creation of a bicycle model. Cycling user surveys were obtained through face-to-face interviews with a randomly selected sampling method among cyclists at designated points in the field.

The survey was conducted at 44 points throughout the city. Taking into consideration the tendency of bicycle routes to concentrate in the city center, it has caused the selection of survey points in the central region. Also, outside the city center; Surveys have been carried out since Seferihisar, Çeşme, Foça, Aliağa and Menemen districts have the potential to use bicycles.

It is assumed that the number of cycling users may change seasonally and it is decided to conduct two separate studies for the periods when schools are open and closed. In line with this decision, two separate surveys were conducted as summer and fall.

5.3.1 Summer Semester Cycling User Survey Results

This section will include the results of the summer surveys of bicycle user surveys. Demographic and socioeconomic information, bicycle travel information and satisfaction status of the interviewees were evaluated in bicycle user surveys.

The distribution of the surveys according to the cross-sectional point is shown in the table below. The highest cross-sectional points for the bicycle user survey were

Karşıyaka, Göztepe, Bostanlı, and Alsancak piers respectively. The Atatürk Stadium is the cross-section that can be negotiated with the minimum number of bicycle users.

Table 5.6 Corss-sectional Distribution of cycling user serveys (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Section Code	Section Name	Number of Surveys	Percentage (%)
B-2A	Konak Metro Giriş1	13	1.5%
B-2B	Konak Metro Giriş2	8	0.9%
B-01	Konak İskele	41	4.9%
B-03	Alsancak Liman Bağlantısı	13	1.5%
B-04	Alsancak Gar-1	11	1.3%
B-05	Alsancak İskele	51	6.0%
B-06	Pasaport İskele	36	4.3%
B-08	Göztepe İskele	84	9.9%
B-09	Üçkuyular İskele	10	1.2%
B-10	Stadyum İstasyonu	16	1.9%
B-11	Atatürk Stadyumu	5	0.6%
B-12	Âşık Veysel Rekreasyon Alanı	10	1.2%
B-13	Adnan Kahveci Kavşağı	8	0.9%
B-14	Turan	9	1.1%
B-15	Karşıyaka İskele	148	17.5%
B-16	Bostanlı İskele	58	6.9%
B-17	Mavişehir Caher Dudayev Bul.	18	2.1%
B-18	Buca Menderes Cad.	10	1.2%
B-19	Sarnıç	14	1.7%
B-20	Seferihisar Sığacık	8	0.9%
B-21	Urla İskele	33	3.9%
B-22	Çeşme	9	1.1%
B-23	Yeni Foça	37	4.4%
B-24	Aliağa	12	1.4%
B-25	Yeni Girne Cad.	18	2.1%
B-26	Ankara Cad. Yan Yolu	13	1.5%
B-27	Çamdibi Kamil Tunca Bulvarı	6	0.7%
B-28	Ulukent İzban	7	0.8%
B-29	Buca Cemil Şeboy Cad.	9	1.1%
B-31	Ege Üniversitesi Cad.	11	1.3%
B-32	Girne Cad. İzban	17	2.0%
B-33	Narlıdere AKM Kavşak	22	2.6%
B-34	Güzelbahçe İskele	16	1.9%
B-35	Bornova Sakarya Cad.	17	2.0%
B-36	EVKA3 Sanayi Kavşak	8	0.9%
B-37	Menemen İnkılap Cad.	14	1.7%
B-38	Eski Foça	25	3.0%
Total		**845**	**100%**

The main demographic characteristics, age and gender of the participants were evaluated. When the gender of the bicycle users participating in the survey is evaluated, 78% is male and 22% is female.

Table 5.7 Gender distribution of bicycle users (Summer Semester)(Bisikletli ve Yaya Erişimi Şefliği, 2018)

	Gender			
	Male		Female	
	N	%	N	%
Bicycle User	648	78%	187	22%

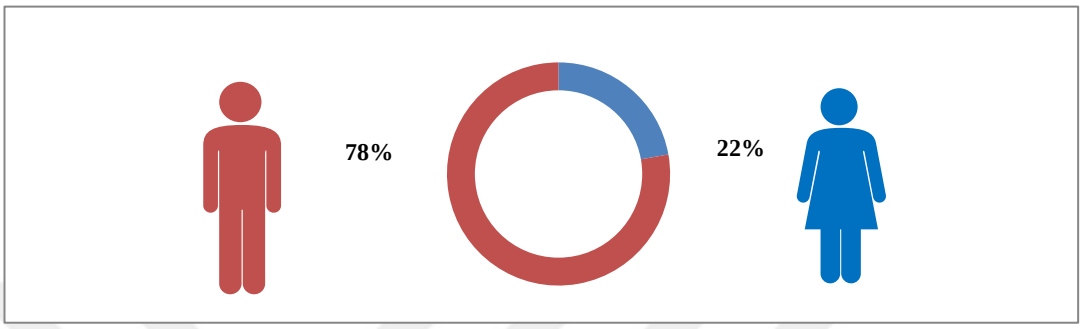


Figure 5.27 Gender distribution of bicycle users (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

According to the results of the bicycle user survey, bicycles are used by all age groups in İzmir. When the age profile of the interviewees was examined, 26.8% of the users were from the 10-19 age group, 24.8% from the 20-29 age group, 17.8% from the 30-39 age group, 12.8% 40-49 age group. The proportion of users over the age of 50 is 17.8%. According to the survey results, bicycle use decreases with age.

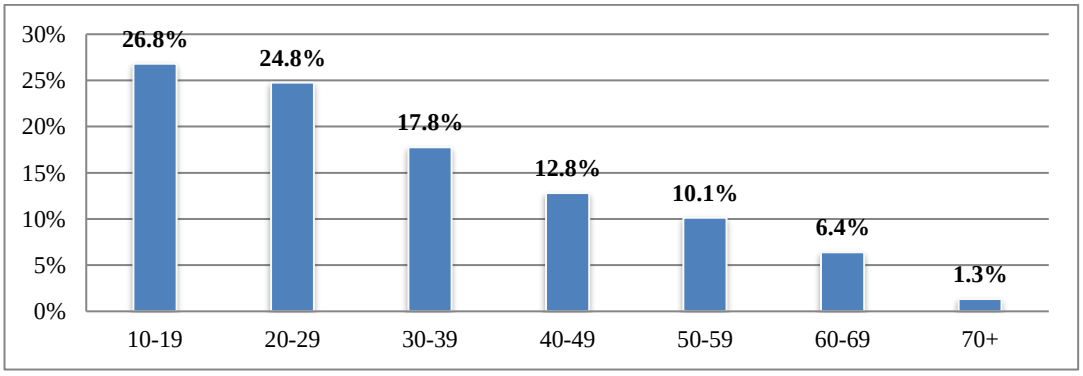


Figure 5.28 Distribution of bicycle users by age group (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

When the age and gender distribution of the interviewees is examined, it is the age range where the most users are in the 10-19 age group in males and 20-29 age group in women. 26.5% of male users are in the 10-19 age group and 36.6% of women are

in the 20-29 age group. When the users under the age of 30 are examined, it is seen that the rate of women is higher. The highest number of bicycle users was detected in the 10-19 age groups among all users. This shows that the young population is more aware of cycling.

Table 5.8 Distribution of bicycle users by age and gender groups (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Age	Male		Female		Total	
	N	Percentage (%)	N	Percentage (%)	N	Percentage (%)
10-19	169	**26.5%**	51	27.9%	220	26.8%
20-29	134	21.0%	67	**36.6%**	201	24.5%
30-39	117	18.4%	30	16.4%	147	17.9%
40-49	82	12.9%	23	12.6%	105	12.8%
50-59	76	11.9%	8	4.4%	84	10.2%
60-69	48	7.5%	4	2.2%	52	6.3%
70+	11	1.7%	0	0.0%	11	1.3%
Total	**637**	**100.0%**	**183**	**100.0%**	**820**	**100.0%**

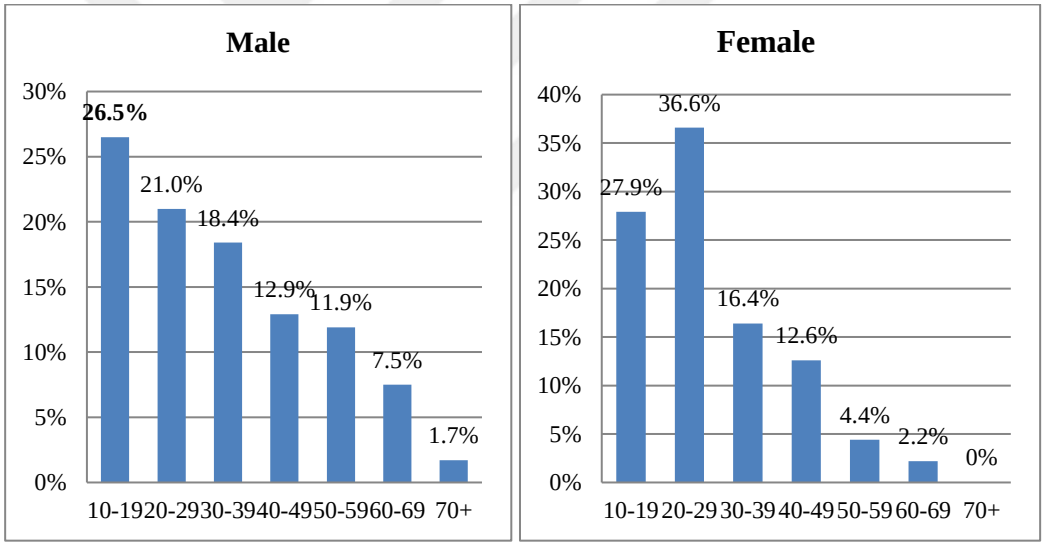


Figure 5.29 Distribution of bicycle users by age and gender groups (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

It was also got information whether the surveyed bicycle users had motor vehicles belonging to their households. According to the figure, 51.95% of bicycle users do not have motor vehicles belonging to their households, while 48.05% have motor vehicles. The respondents prefer to use bicycles although they have motor vehicles belonging to their households.

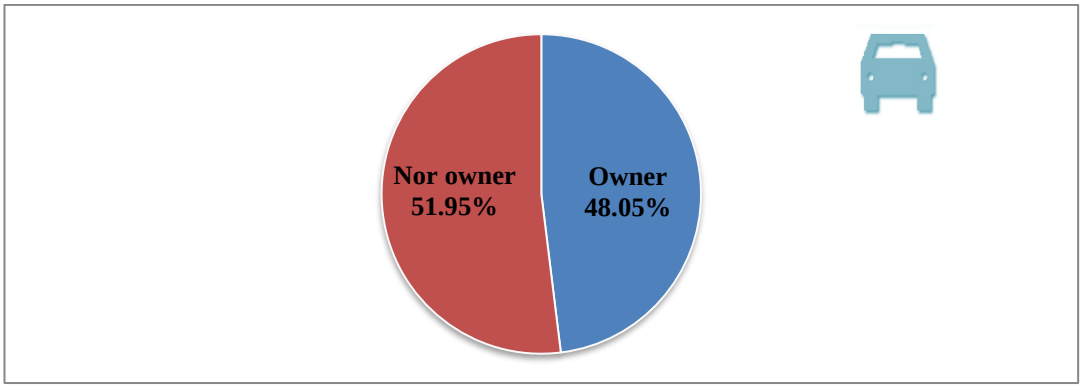


Figure 5.30 Household motor vehicle of bike users (%) (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

An important indicator of the promotion of non-motorized transport is the ownership of bicycle. In line with the bicycle user surveys, 93% of the interviewees are bicycle owners.

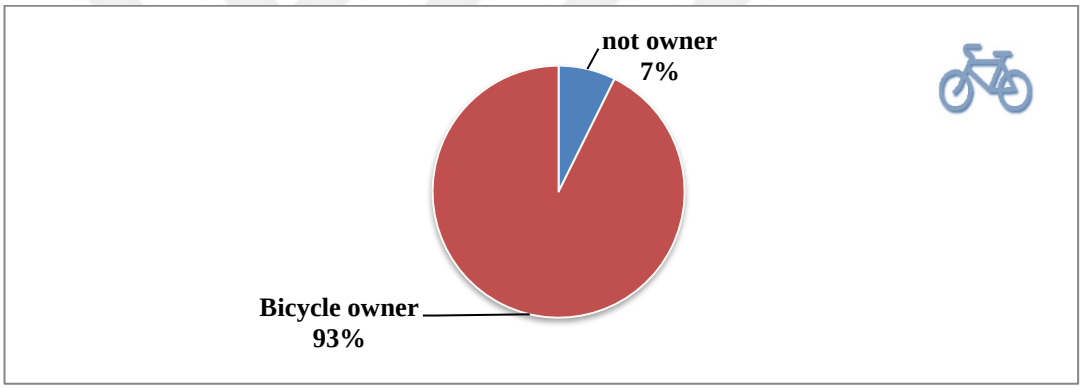


Figure 5.31 Bicycle ownership of bicycle users (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

According to their own and other motorized and non-motor vehicle ownership status, 58.2% of the participants have their own bicycles. When the passenger status of bicycle users is evaluated, it is seen that 11% of the users and 18.4% of the other individuals in the households are passenger cars. Despite the ownership of passenger cars, cycling is an important finding to promote non-motorized transport.

Table 5.9 Vehicle ownership status of bike users (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Motorized and Non-Motorized Vehicle Ownership		Total	N	Percentage %
His own	Vehicle	1	138	11.00%
		1+	7	0.60%
	Motocycles	1	43	3.40%
		1+	1	0.10%
	Bicycle	1	729	58.20%
		1+	22	1.80%
Other person in household	Vehicle	1	230	18.40%
		1+	21	1.70%
	Motocycles	1	12	1.00%
		1+	1	0.10%
	Bicycle	1	44	3.50%
		1+	5	0.40%
Total			1,253	100.0%

According to the results of the data obtained from the bicycle user surveys on the ownership status of the bicycles they use, 88% travel on their own bicycles. 67% of the 12% user segment, which states that the bicycle they use does not belong to them, travels with the sharing bicycle system (Bisim). 10% of the users, who do not own a bicycle, ride on rental bikes. When the other option for bicycle ownership is considered, it is found that 39% of the bicycles belong to another person in the household, 33% belong to work place and 28% belong to friend.

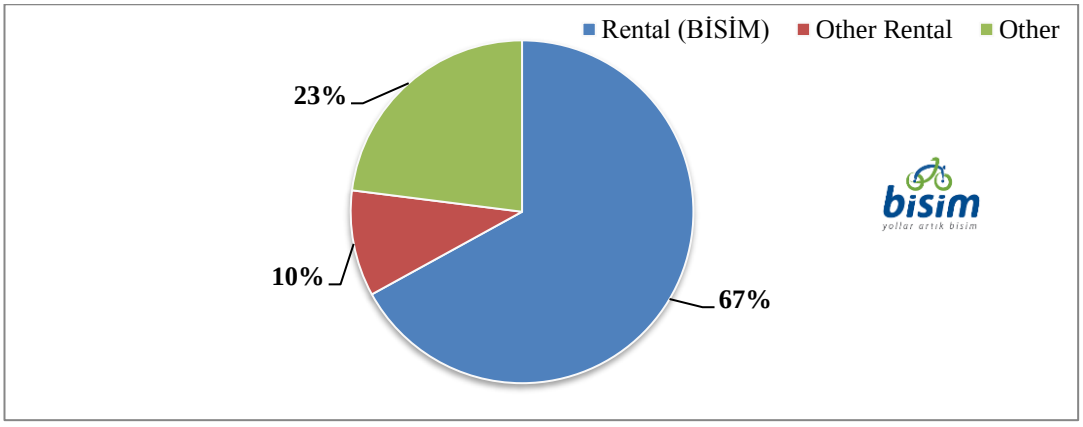


Figure 5.32 Distribution of availability of bicycles for bicycle users (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Cycling user surveys were asked how often they used the bike during their journey. According to the information obtained, 27.7% of the interviewers use bicycles every day and 27.6% use bicycles twice or three times a week. While 16.8% of the users

provide transportation by bicycle four or five times a week, the rate of those using bicycles less than once a week corresponds to approximately 28%.

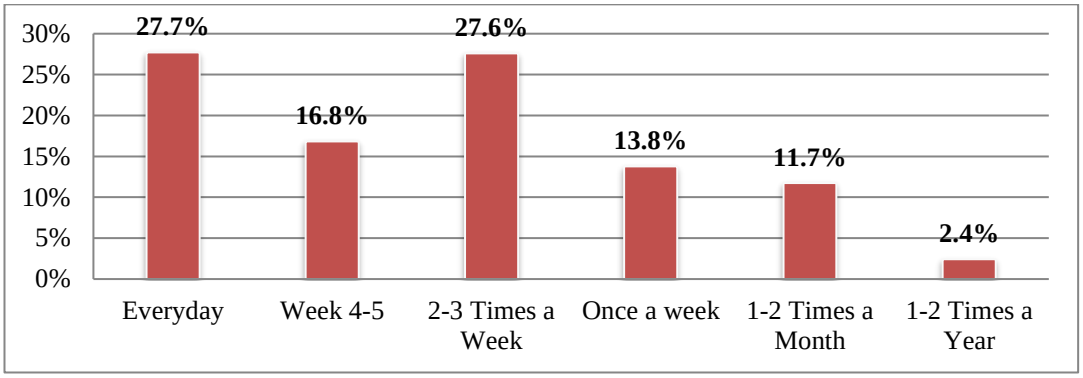


Figure 5.33 Frequency of bicycle use (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

When the information about the purpose of the journey is evaluated, it is stated that the purpose of using the bicycle is sports and recreational activity by approximately 70% of the surveyed bicycle users. The rate of cycling on regular trips, such as business and school trips, is around 16%. When the distribution among the people who use the bicycle for other purposes is evaluated, it is found that 80% of them are used for fishing, 6.7% of them are used for family visits or meeting with friends.

Table 5.10 Distribution of bicycle trip according to trip objectives (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Trip Objectives	**N**	**%**
Business	125	15.0%
Doing Business (Delivery / Transport)	14	1.7%
School Purpose	7	0.8%
Business Tracking	19	2.3%
Sports / Recreational	575	69.2%
Shopping	69	8.3%
Other	22	2.6%
Total	**831**	**100.0%**

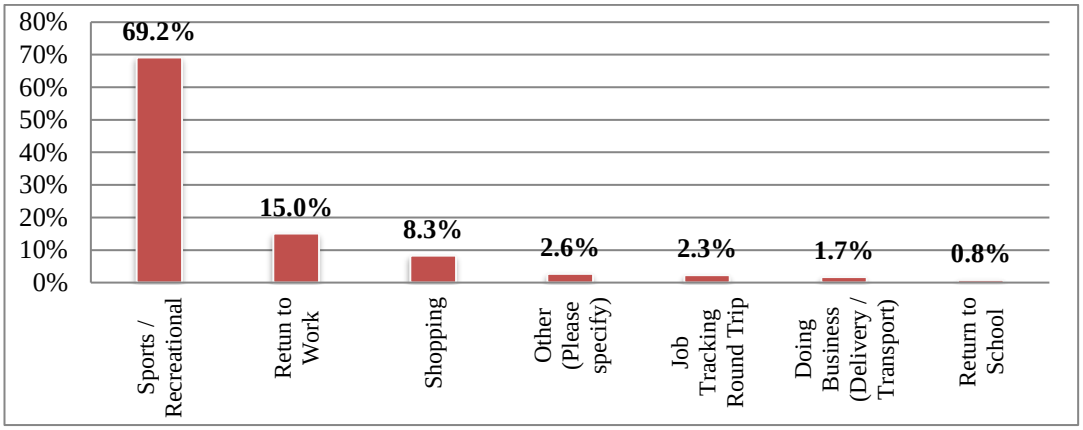


Figure 5.34 Distribution of bicycle journeys by trip objective (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Separated bicycle paths in İzmir are limited to the coastline. Therefore, bicycle users are obliged to use bicycles in areas where there is no defined bicycle path. In this case, the preferred road segments of the users are shown in the figure below. The following figure shows the type of road section that bicycle users prefer in places where there is no bicycle path (see Figure 5.35). According to the figure, the right lane with 40% traffic, the pedestrian road or sidewalk with 37%, and the safety lane with 18.7% traffic are preferred by cyclists. This is important for revealing users' perspective in order to create shared paths. In addition, 3.8% do not prefer cycling where there is no bicycle path.

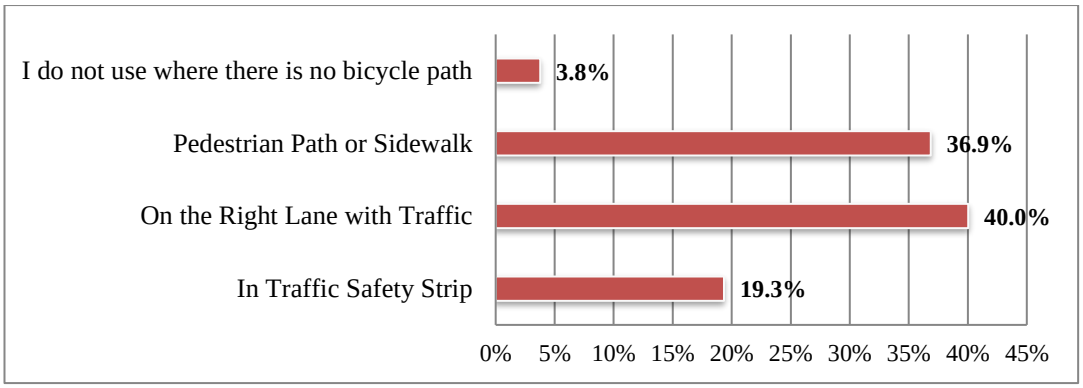


Figure 5.35 The Cross sections preferred by bicycle users on non-bicycle roads (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

An important issue that needs to be addressed for bicycle transport is accident statistics. It is possible to determine the regions and issues to be developed with the help of spatial evaluation of accidents and examination of their causes. Within the

scope of bicycle user surveys, whether the users had an accident and the reasons for the accident were examined. As can be seen from the figure below, it was found that 21% of bicycle users had an accident.

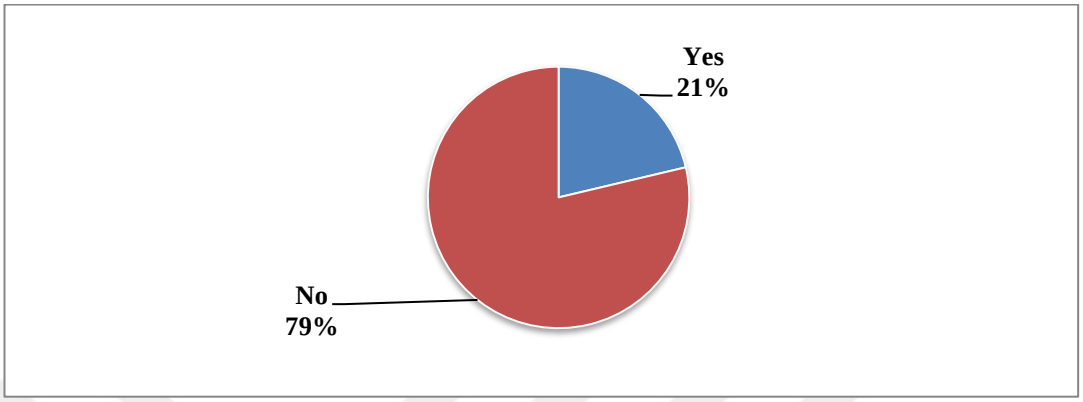


Figure 5.36 Accident with bike (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

When the causes of the accident are examined, it is seen that this is mainly caused by the user. Causes of the accident were distraction of thought and carelessness with 31.5% and speed with 11.8%. When the problems related to bicycle transportation infrastructure are examined, it is seen that this rate is 10.6%. In addition, the rate of car crashes and bicycle tires entering the grids was 25%.

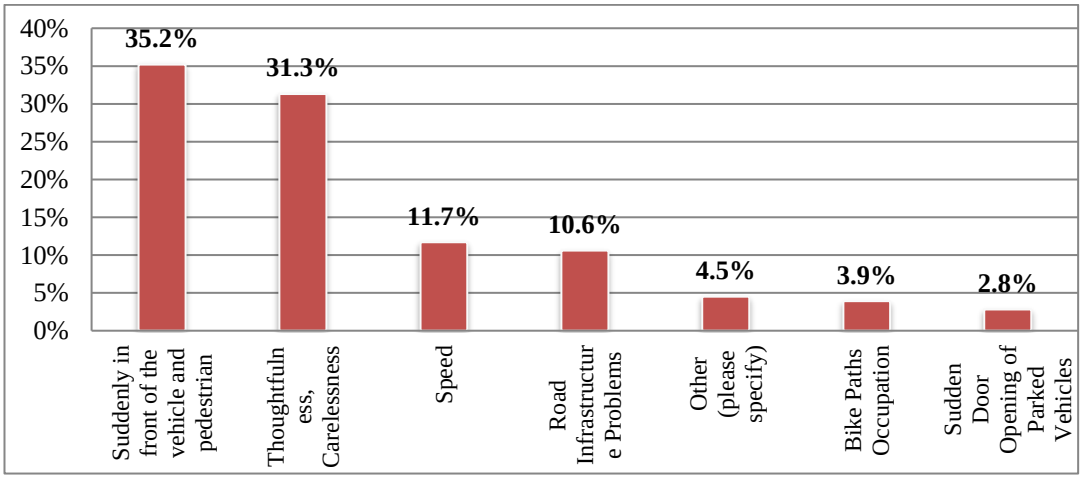


Figure 5.37 Causes of accident with bicycle (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Cycling users who feel that bicycle transport is not safe are asked what they can do to make bicycle transport safer. According to the answers, 24.4% of bicycle users

maintain the bicycle path, 17.2% develop the bicycle infrastructure, 12.5% of existing roads increase maintenance and repair, 12.1% increase horizontal and vertical signs.

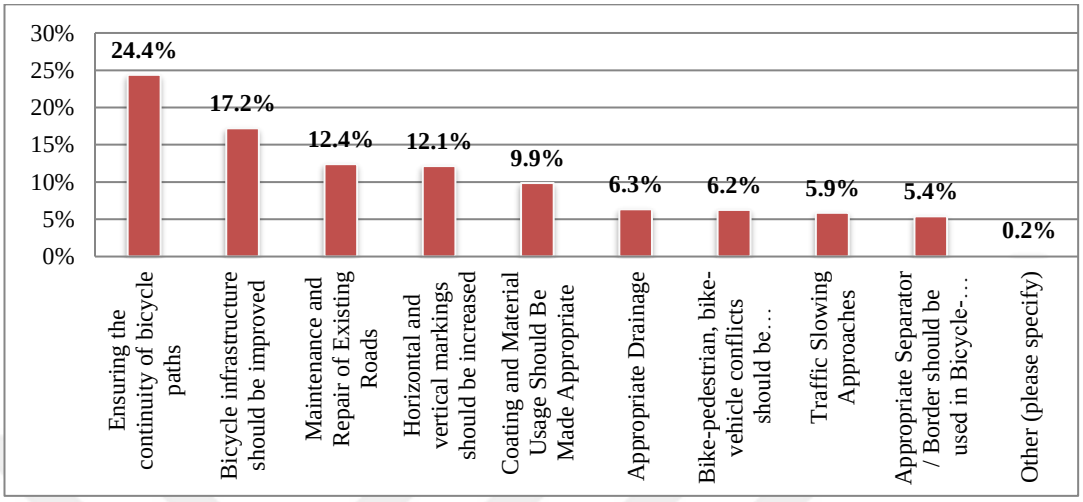


Figure 5.38 Recommendatons for making bicycle trasnportation safe (Summer Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

5.3.2 Fall Semester Cycling User Survey Results

In this section, bicycle user surveys fall semester study results will be included. A total of 1.137 questionnaires were conducted in 24 sections in the fall semester. The highest cross-sectional points of the bicycle user survey were; Konak İskele, Ege University, Bostanlı Pier, and Göztepe Pier. The cistern is the cross-sectional point that can be negotiated with the minimum number of bicycle users.

Table 5.11 Corss-sectional Distribution of cycling user serveys (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Section Code	Section Name	Number of Surveys	Percentage (%)
B-01	Konak İskele	343	**30.20%**
B-01-A	Konak Metro Giriş 1	20	1.80%
B-01-B	Konak Metro Giriş 2	21	1.80%
B-02	Şair Eşref Bulvarı	23	2.00%
B-03	Alsancak Gar	20	1.80%
B-04	Alsancak Liman Bağlantısı	14	1.20%
B-05	Karataş Lisesi	27	2.40%
B-06	Göztepe İskele	89	**7.80%**
B-07	Stadyum İstasyonu	65	5.70%
B-08	Çamdibi Kamil Tunca Bulvarı	22	1.90%
B-09	Ankara Yan Yol	19	1.70%
B-11	Sakarya Caddesi	17	1.50%
B-12	Ege Üniversitesi	113	**9.90%**
B-13	Girne İzban	25	2.20%
B-14	Mavişehir	33	2.90%

Table 5.11 continues

Section Code	Section Name	Number of Surveys	Percentage (%)
B-15	Buca Menderes Caddesi Forbes Sokak	21	1.80%
B-16	Sarnıç	5	**0.40%**
B-17	Narlıdere Akm Kavşağı	13	1.10%
B-18	Güzelbahçe İskele	11	1.00%
B-19	Urla İskele	25	2.20%
B-20	Torbalı	22	1.90%
B-21	Ödemiş	11	1.00%
B-22	Karşıyaka İskele	81	7.10%
B-23	Bostanlı İskele	97	**8.50%**
Total		**1.137**	**100.00%**

When the age and gender characteristics of the surveys conducted in the fall semester are examined, 78% of the users contributing to the survey are men and 22% are women. It is seen that bicycle users are the majority of male users.

Table 5.12 Gender distribution of bicycle users (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

	Gender			
	Male		**Male**	
	N	**%**	**N**	**%**
Bicycle User	845	76.9%	254	23.1%

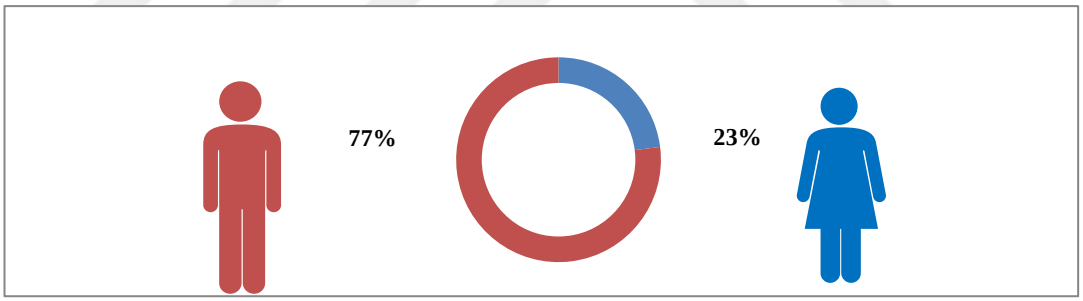


Figure 5.39 Gender distribution of bicycle users (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

According to the results of the cycling user survey in the fall term, cycling is used by almost every age group in İzmir. When the age profile of the surveyed people is examined, it is seen that the age group which is the most user is the 30% of the 20-29 age group. Then, the age range of 10-19 and 30-39 is followed by 19%. Users over the age of 50 make up 21% of all users.

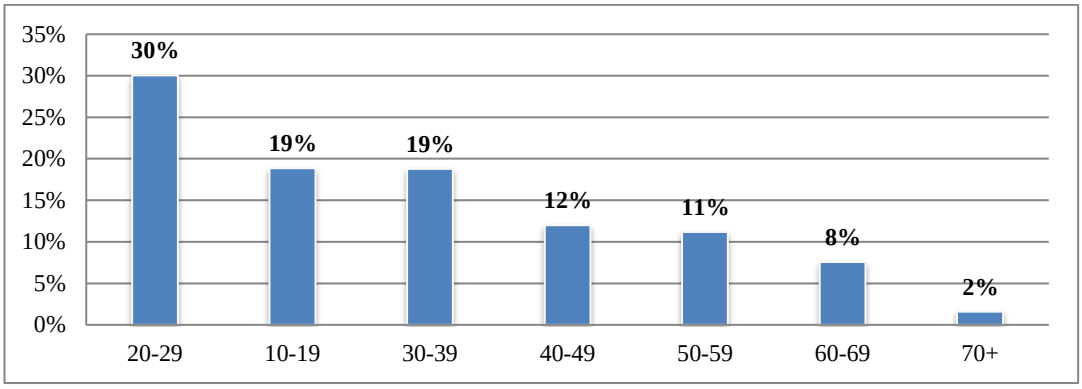


Figure 5.40 Distribution of bicycle users by age groups (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Looking at the table and figure showing the age and gender distribution of bicycle users in the fall term, 26.4% of male users and 42.5% of female users are in the 20-29 age groups. While there are no users over 70 years of age among female users, this age group has the lowest rate of 1.7% among male users.

Table 5.13 Distribution of bicycle users by age and gender groups (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Age	Male		Female		Total	
	N	Percentage (%)	N	Percentage (%)	N	Percentage (%)
10-19	147	17.4%	62	24.4%	209	19%
20-29	223	**26.4%**	108	**42.5%**	331	**30.1%**
30-39	153	18.1%	51	20.1%	204	18.6%
40-49	113	13.4%	20	7.9%	133	12.1%
50-59	109	12.9%	13	5.1%	122	11.1%
60-69	86	10.2%	0	0%	86	7.8%
70+	14	1.7%	0	0%	14	1.3%
Total	100	100%	254	100%	1099	100%

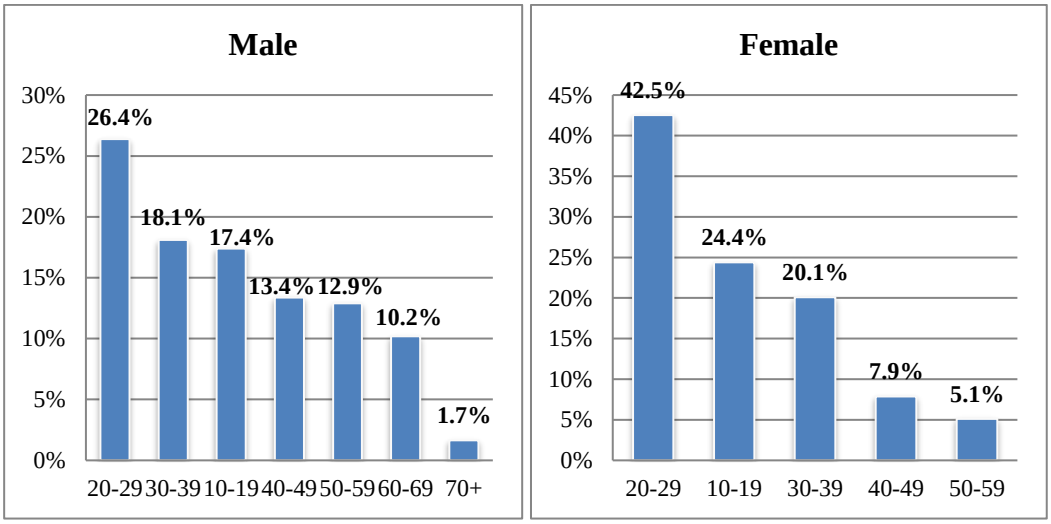


Figure 5.41 Distribution of bicycle users by age and gender groups (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

It was also obtained whether the participants of the bicycle survey had motor vehicles belonging to their households. According to the figure, 48.6% of bicycle users do not have motor vehicles belonging to their households, while 51.4% of them have motor vehicles belonging to households.

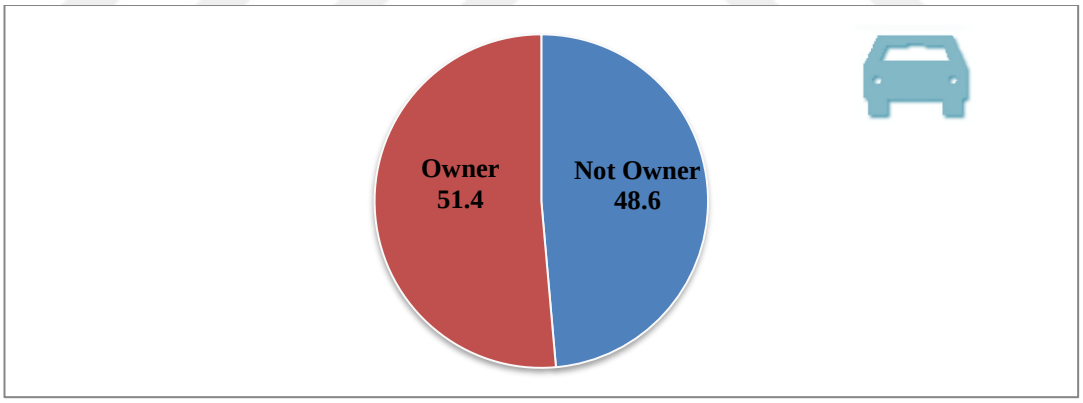


Figure 5.42 Household motor vehicle of bike users (%) (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

In the figure of the bicycle ownership ratio of the interviewees, 73% of the people have bicycles and 27% do not have bicycles.

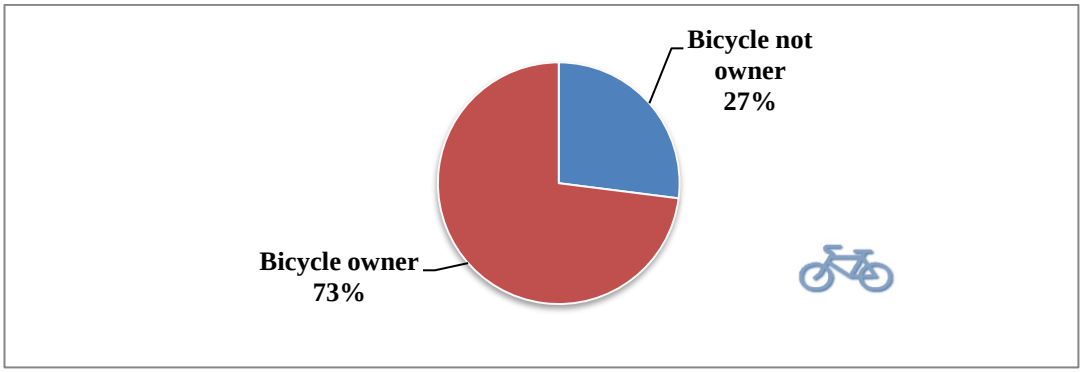


Figure 5.43 Bicycle ownership of bicycle users (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

In the table of ownership of motorized and non-motorized vehicles of bicycle users and other individuals in their households, it was found that 17.5% of the participants had a vehicle of their own and 16.9% was a passenger of the household. In the case of bicycle ownership, 44.6% had their own bike, while 3.5% had their own bike.

Table 5.14 Owners of motorized and non-motorized vehicles for cyclists (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Motorized and Non-Motorized Vehicle Ownership		**Total**	**N**	**Percentage (%)**
His won	**Vehicle**	**1**	271	17.50%
		1+	12	0.80%
	Motocycles	**1**	46	3.00%
		1+	2	0.10%
	Bicycle	**1**	690	**44.60%**
		1+	59	3.80%
	Other	**1**	1	0.10%
Other person in household	**Vehicle**	**1**	261	16.90%
		1+	31	2.00%
	Motocycles	**1**	34	2.20%
		1+	2	0.10%
	Bicycle	**1**	82	5.30%
		1+	54	3.50%
	Other	**1**	1	0.10%
Total			**1,546**	**100.00%**

According to autumn cycling user surveys, 77% of bicycle users ride their own bikes. When the 23% segment in the other category is examined, it is seen that 82 of them travel with the common bicycle system (BİSİM). 9.2% of the users who do not own bicycles were found to ride bicycle rental. Considering another option for bicycle ownership, it was found that 47% of the bikes belong to someone else at home, 32% belong to the workplace and 21% belong to a friend.

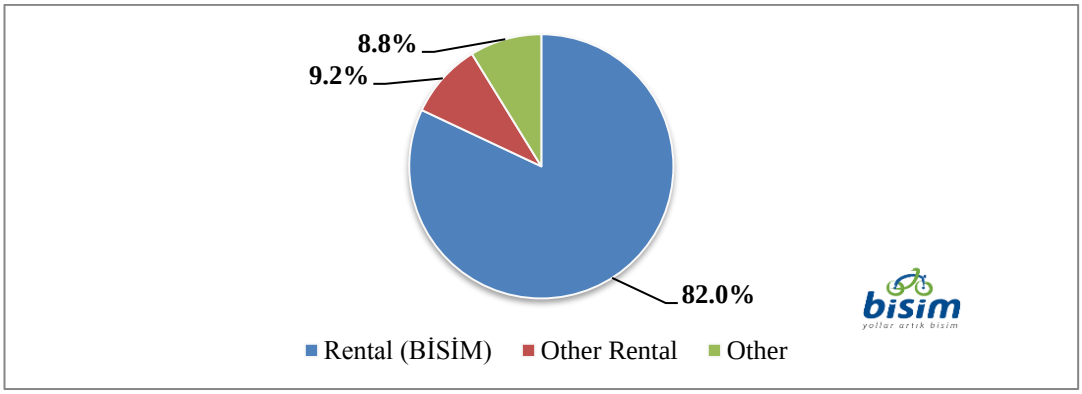


Figure 5.44 Distribution of availability of bicycles for bicycle users (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

In the cycling user surveys in the fall term, the figure showing how often the respondents used the bicycle was found to be 35.1% of daily passengers. The rate of those who use 1-2 times a year is 3.4%.

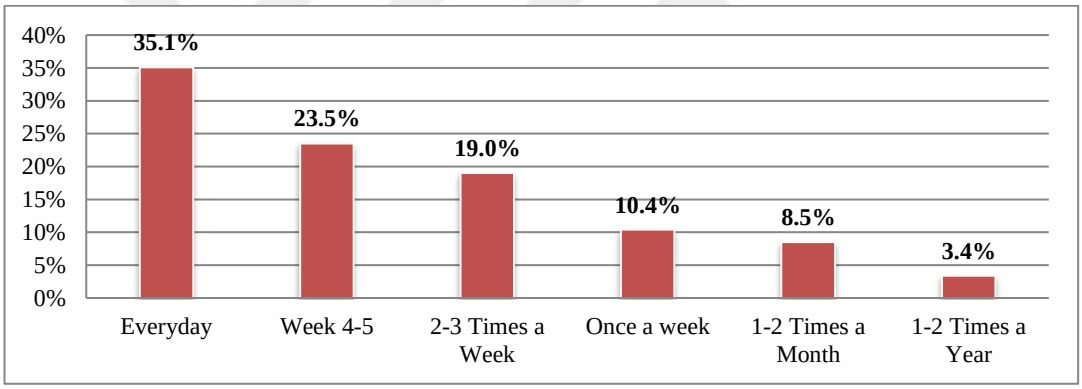


Figure 5.45 Frequency of bicycle use (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

When we examine the distribution of the travel purposes of the bicycle users, 57.1% of them contain recreational purposes while 16.3% contain business purposes. The ratio of school trips by bicycle is 12.3%.

Table 5.15 Distribution of bicycle journeys by trip objective (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Trip Objective	**N**	**%**
Business	184	16.3%
Doing Business (Delivery / Transport)	53	4.7%
School Purpose	139	12.3%
Business Tracking	42	3.7%
Sports / Recreational	644	57.1%
Shopping	42	3.7%
Other	24	2.1%
Total	**1,128**	**100.0%**

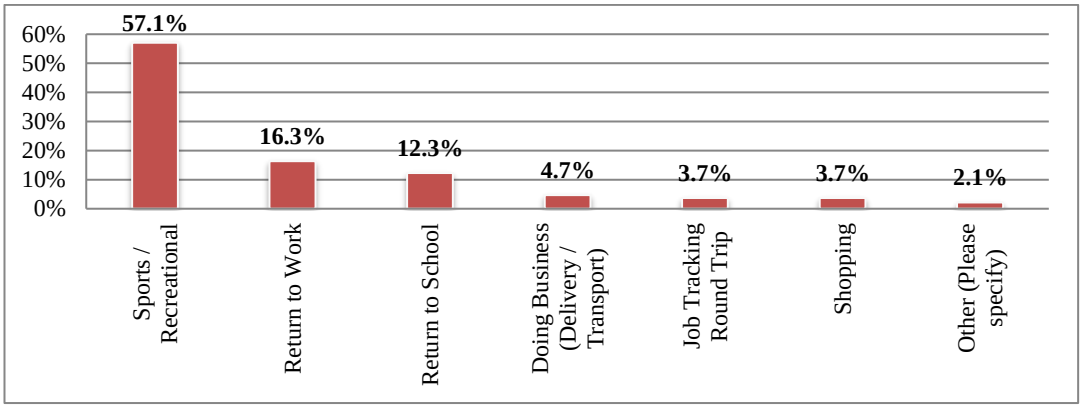


Figure 5.46 Distribution of bicycle journeys by trip objective (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Separated bicycle paths in İzmir are limited to coastline and bicycle users can use undefined bicycle paths when necessary. The figure below shows the road sections that bicycle users prefer in places that do not have a bicycle path. According to the figure, the proportion for use of pedestrians and sidewalks by cyclists is 32% while the percentage is 31% for using right lane of traffic and 27% for using emergency lane. In addition, 10% do not prefer cycling where there is no bicycle path.

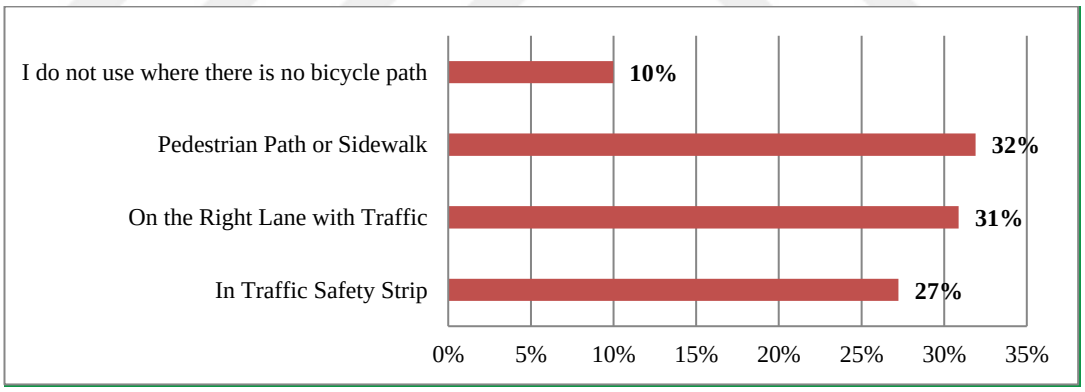


Figure 5.47 The Cross sections preferred by bicycle users on non-bicycle roads (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

Spatial identification of cycling accidents and investigation of their causes are guiding in the planning of region-based solution proposals in the future. Within the scope of bicycle user surveys, whether the users had an accident and the reasons for the accident were examined. As can be seen from the figure below, it was found that approximately 27% of bicycle users had an accident.

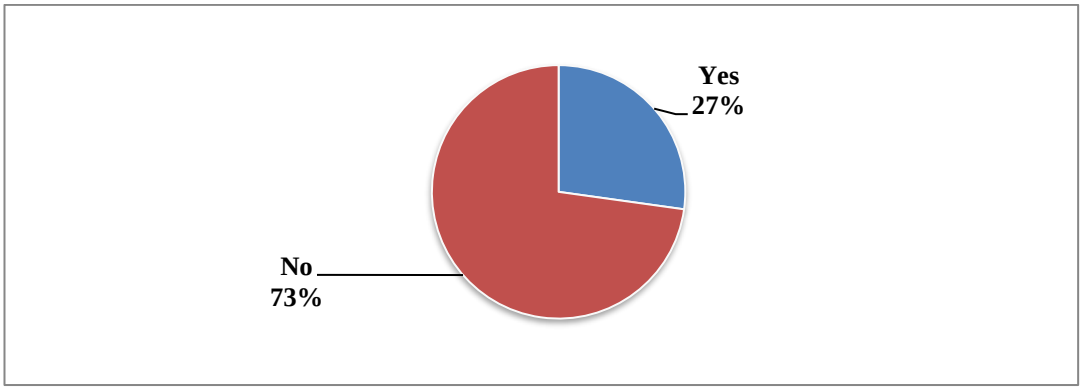


Figure 5.48 Accident with bike (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

When the reasons of accidents by bicycle users participating in the survey were examined, it was found that 35% of the accidents caused by the vehicles and pedestrians suddenly appeared in front of the cyclist and 27% of them were caused because of distract of thought or carelessness. In addition, the accidents caused by bicycle transportation network infrastructure problem are at 13%.

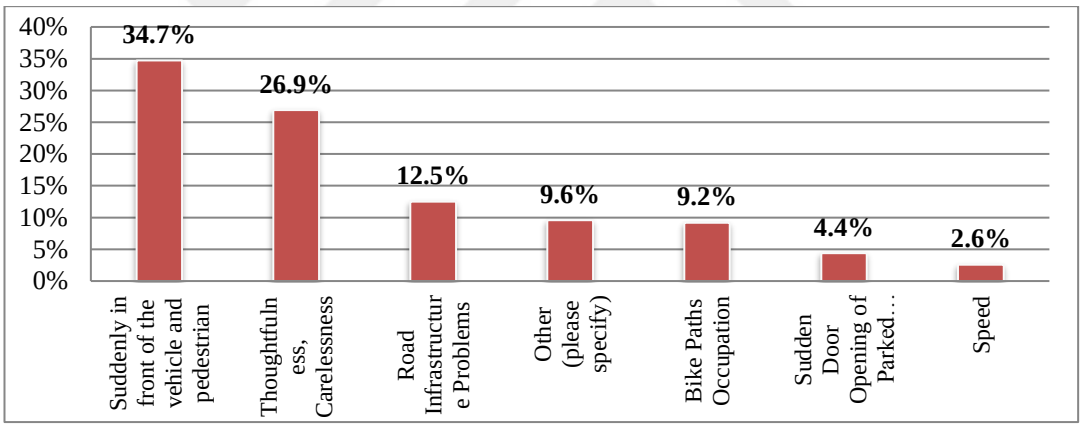


Figure 5.49 Causes of accident with bicycle (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

The figure below illustrates suggestions by users (30.4%) who do not find bike use in transportation safe, and their suggestion to make it more secured. 22.8% of bicycle users stated that bicycle infrastructure should be improved, and 21.7% of them suggested that bicycle paths provide continuity while 12.9% demanded horizontal and vertical marking to be more common. The maintenance and repair of existing roads and the use of suitable materials are in the category of other recommendations.

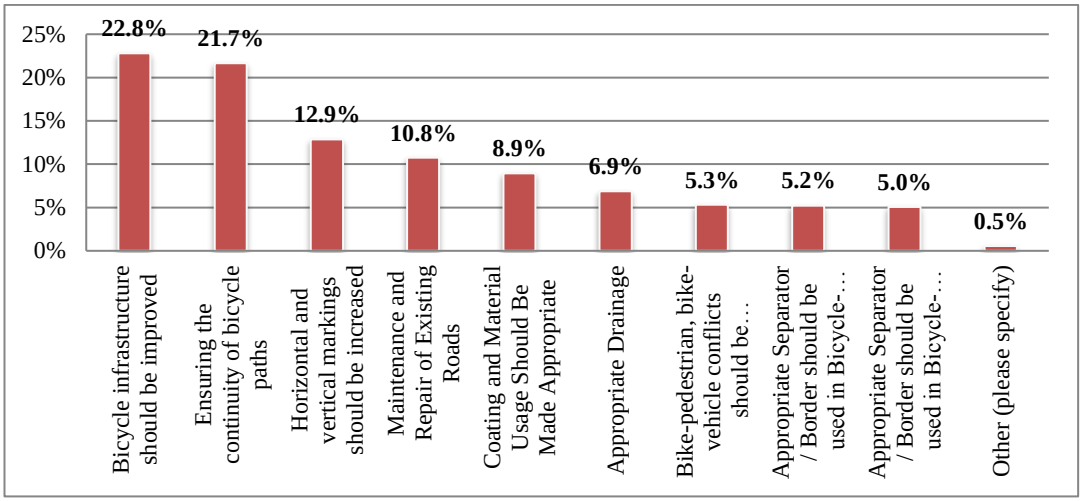


Figure 5.50 Recommendatons for making bicycle trasnportation safe (Fall Semester) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

5.3.3 Evaluation of Survey Results

İzmir Transportation Master Plan (UPİ 2030) Recommendations as a result of the work prepared by Boğaziçi Project and conducted by the Department of Transportation of İzmir Metropolitan Municipality within the scope of the Action Plans construction, a total of 1,982 surveys were conducted in 845 summer and 1,137 surveys in the fall semester. When the sociodemographic structure of the survey results was examined, it was found that 77% were male users.

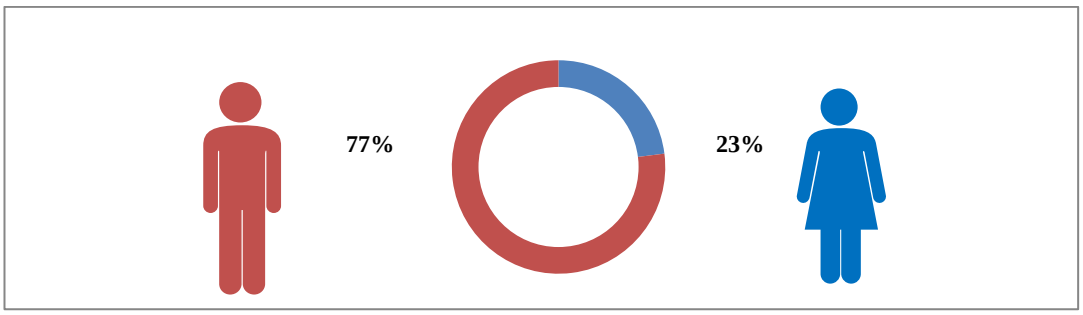


Figure 5.51 Gender distribution of bicycle users (Total) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

All cycling user surveys have reached almost all age groups. When the distribution of questionnaires according to age groups is examined, it is seen that the age group with the highest number of users in the 20-29 age range is approximately 29%. Then, the rate of those in the 10-19 age group was 22.1%, while the rate of those in the 30-

39 age group was 18%. It is determined that users over the age of 50 make up 19.4% of all users.

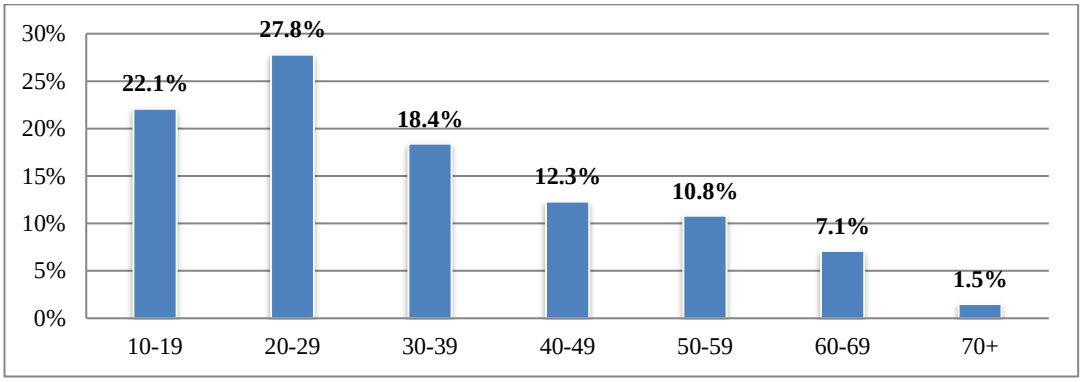


Figure 5.52 Distribution of bicycle users by age groups (Total) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

When the motor vehicle and bicycle ownership information of the households of the participants of the bicycle survey were evaluated for both periods, it was found that 49.9% of the bicycle users had a vehicle and 81% had a bicycle. In this case, despite the fact that almost half of the users have motor vehicles, they prefer to use bicycles.

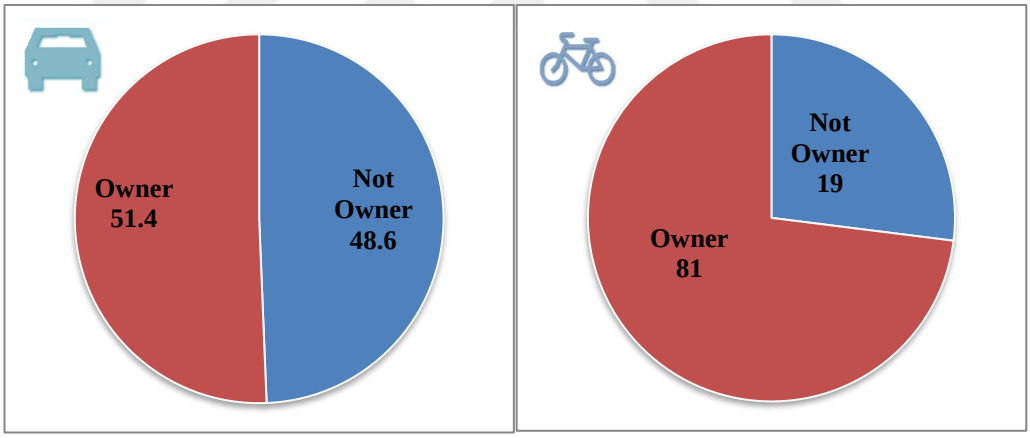


Figure 5.53 Household motor vehicle and bike owner distribution by bike users (%) (Total) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

When the travel objectives of the bicycle users surveyed were examined, it was found that 62.2% used the bicycle for recreational purposes. The percentage of those using bicycles for transportation is 37.8%.

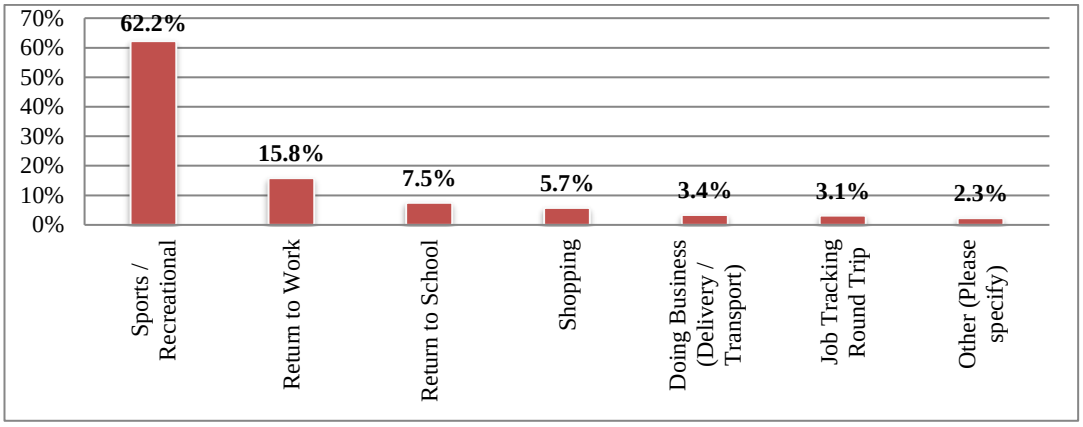


Figure 5.54 Distribution of bicycle trip by trip objectives (Total) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

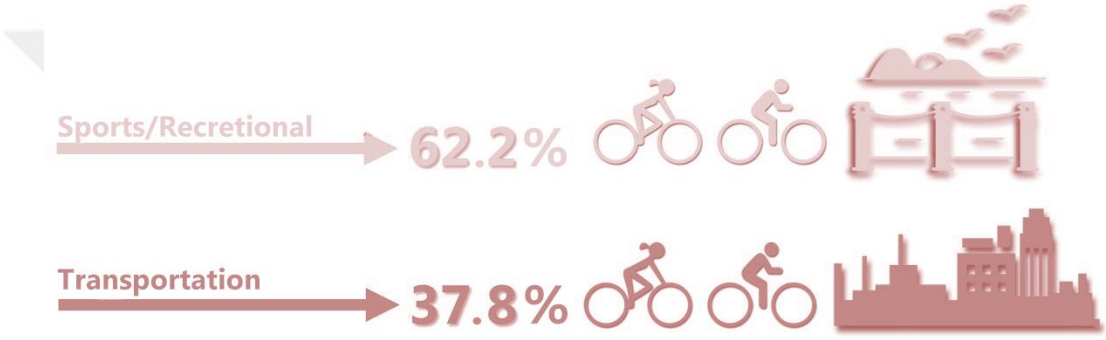


Figure 5.55 Comparison of bicycle journeys for recreational and transportation (Total)

Surveys showed that 16% of bicycle users prefer to use bicycles because they are more economical. Bike transport is attractive, as 14.8% of users travel short distances. 18.2% of those who use sports/exercise and recreational bicycles prefer cycling because it is fun.

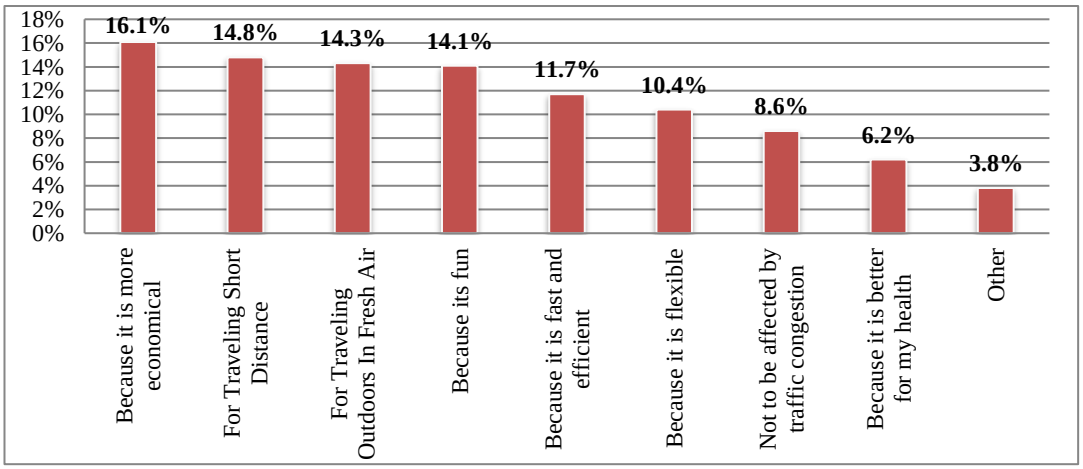


Figure 5.56 Reasons of use of bicycle in urban transportation by bike users (Total) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

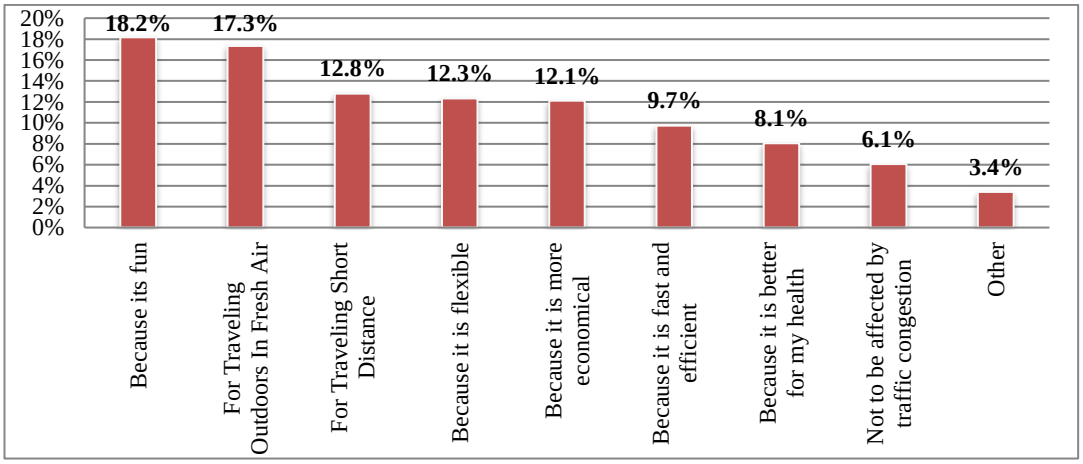


Figure 5.57 Reasons of choosing bike by recreational users (Total) (Bisikletli ve Yaya Erişimi Şefliği, 2018)

In the bicycle user surveys, the rate of people using the bicycle for daily transportation was found to be 41.3%. The use of bicycles for sports/exercise and entertainment purposes were 26.2%. When the frequency of use is greater than at least 1 per week, 87% of the use of bicycles is for transportation and 67% is for recreation and sports/exercise purposes. In this case, it is important to increase this ratio by making efforts to increase the bicycle for transportation purposes in İzmir.

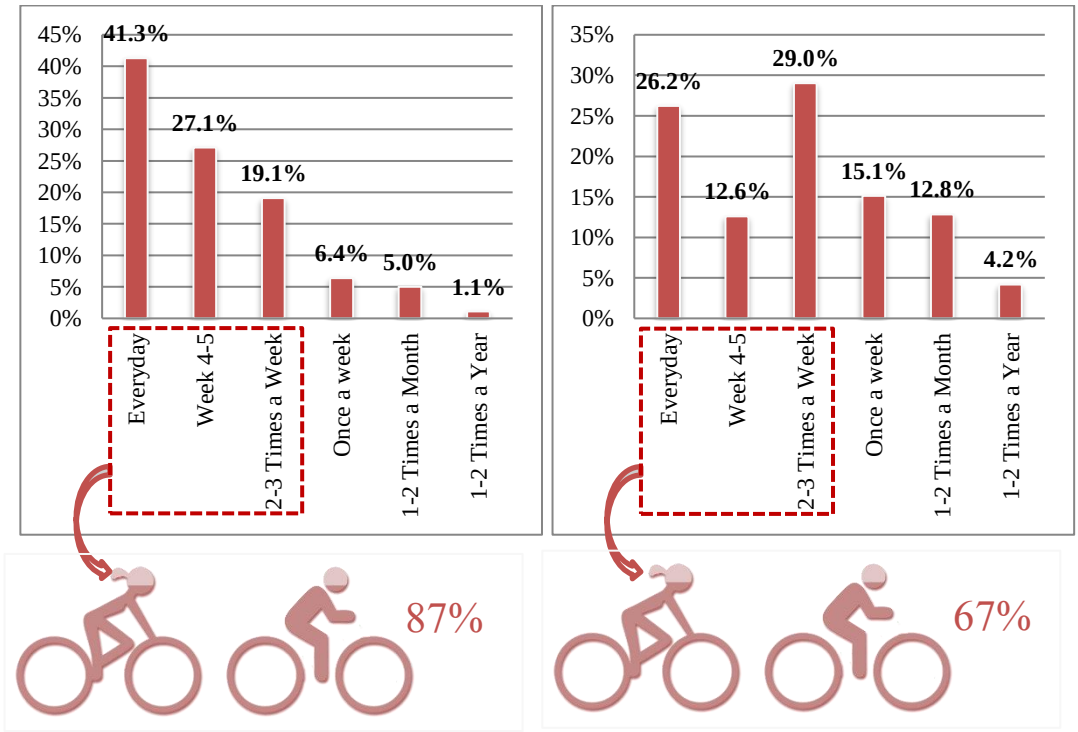


Figure 5.58 Frequency of use of bicycle transportation and sports/exercise and recreational (Bisikletli ve Yaya Erişimi Şefliği, 2018)

As a result of surveys conducted during the Summer and Fall semesters, one in every four cycling users in İzmir find bicycle paths insecure. In addition, although the bicycle lanes are separate from motor traffic, one out of every four bicycle users has been found to have had an accident. When the reasons of the users to make an accident are examined, it is seen that accidents caused mainly by the occupation of the bicycle path.

Figure 5.59 Accident rate of bicycle users

Lastly, although the existing bicycle path in the city of İzmir is in the central area and it is clearly defined in these areas, it is found that 30.3% of the bicycle users are unaware of the bicycle paths. In addition, 25% of bicycle users declared that the existing cycling paths were unsafe. This situation can be evaluated in many ways related to the lack of promotion for bicycle transportation, lack of sufficient information about bicycle transportation, lack of prevalence of bicycle culture and lack of sufficient horizontal and vertical markings.

5.4 Cycling User Counts and Evaluation

In this section, video recordings were taken in order to determine the profile of the use of bicycles and to observe the safety precautions taken by the users while cycling. In order to make the results of cycling significant, a typical working day was selected on weekdays and a 12-hour image recording was obtained between 07.00-08.00 in the morning and 20.00-21.00 in the evening. The points that were taken with the camera were decoded and the results were obtained.

Camera counting images were obtained from four different points in İzmir. Working points Karşıyaka, Bornova, Konak Kemeraltı and Alsancak regions were selected (Topaloğlu & Aydoğan, 2019).

5.4.1 Karşıyaka Pier Region

Karşıyaka Pier Region and its environs is the sub-center for Karşıyaka district. The presence of various commercial functions, such as shops, cafes, serving the local people, enhances the functionality of the region. The central region of Cemal Gürsel Street was determined in Karsiyaka Pier and the number of users with bicycles was determined and counting was performed on this center.

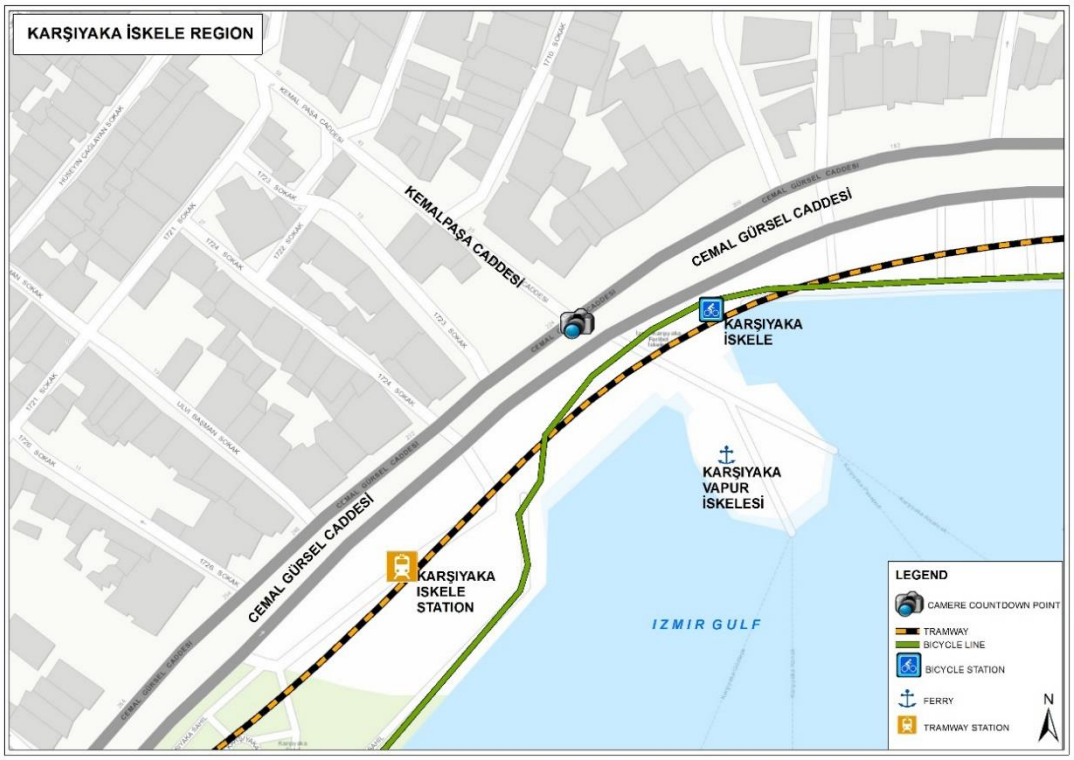


Figure 5.60 Karşıyaka pier counting point (Topaloğlu & Aydoğan, 2019)

According to the counting results, a total of 445 cyclists were found, including 414 male users and 31 female users during the 12-hour period. According to the results, only 7% of bicycle users are women.

Table 5.16 Bike user gender distribution in Karşıyaka (Topaloğlu & Aydoğan, 2019)

	Gender			
	Male		**Female**	
	N	%	N	%
Bicycle User	414	93%	31	7%

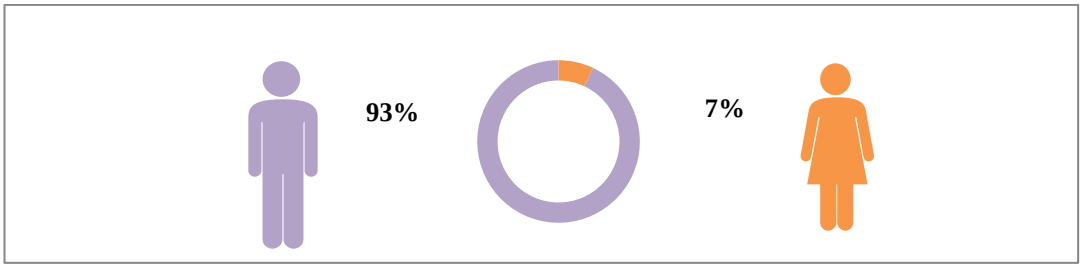
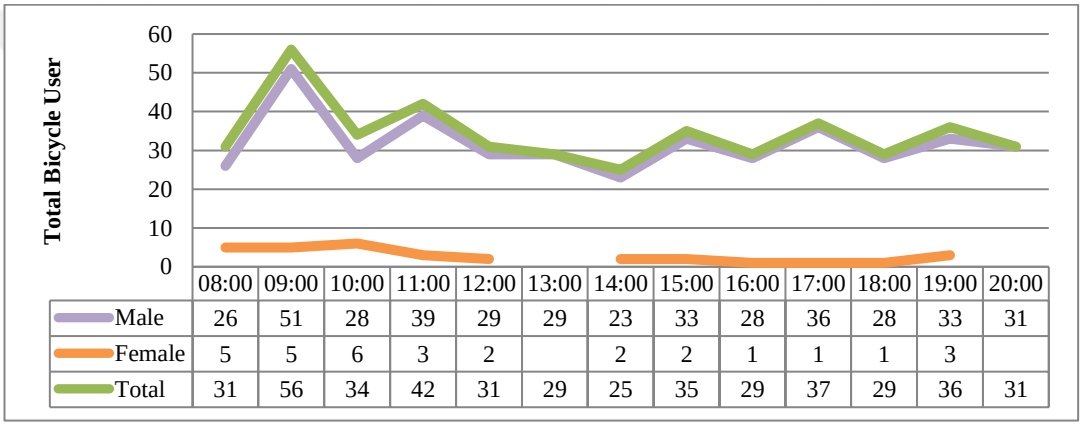


Figure 5.61 Bike user gender distribution in Karşıyaka (Topaloğlu & Aydoğan, 2019)

When the hourly bicycle volume of Karşıyaka pier section is evaluated, total bicycle user volume varies during the day. While the highest user volume was reached at 09:00 hours, similar volume values were observed throughout the day.



	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Male	26	51	28	39	29	29	23	33	28	36	28	33	31
Female	5	5	6	3	2		2	2	1	1	1	3	
Total	31	56	34	42	31	29	25	35	29	37	29	36	31

Figure 5.62 Hourly cycling user values in Karşıyaka Pier region (Topaloğlu & Aydoğan, 2019)

In terms of both comfort and safety when using a bicycle, users may need to use some equipment. In the video recordings, the use of helmets, which is the most important situation for bicycle users in terms of safety while cycling, was examined. According to the results obtained for Karşıyaka region, the overall helmet use rate was found to be only 13%.

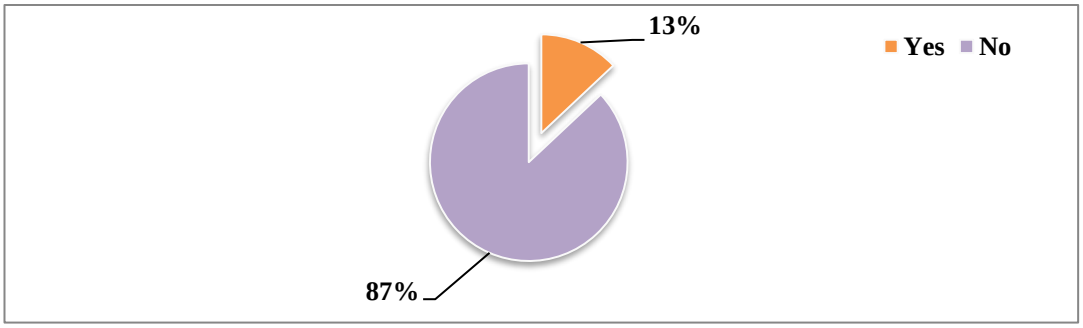


Figure 5.63 Helmet use rates in Karşıyaka (Topaloğlu & Aydoğan, 2019)

Considering the 13% helmet use rate among female and male use, 29% of female users use helmets and 12% of male users. According to the obtained results, it can be said that for bicycle riders in Karsiyaka Pier, women use more helmets than men.

Table 5.17 Helmets use rates by gender in Karşıyaka (Topaloğlu & Aydoğan, 2019)

	Headguard Use			
Gender	**Yes**	**%**	**No**	**%**
Male	49	12%	365	88%
Female	9	29%	22	71%

Figure 5.64 Helmets use rates by gender in Karşıyaka (Topaloğlu & Aydoğan, 2019)

5.4.2 Alsancak Region

Alsancak Region functions as the central business area and the region where commercial and social activities are carried out in İzmir. Various commercial activities such as office, café etc. take place within the area, and it plays a role as a gathering and entertainment center for the people of the region and the people in İzmir. For this reason, Alsancak is considered to have intense use of bicycles, and Talatpaşa Boulevard was accepted as the central point to perform counting operations by cameras.

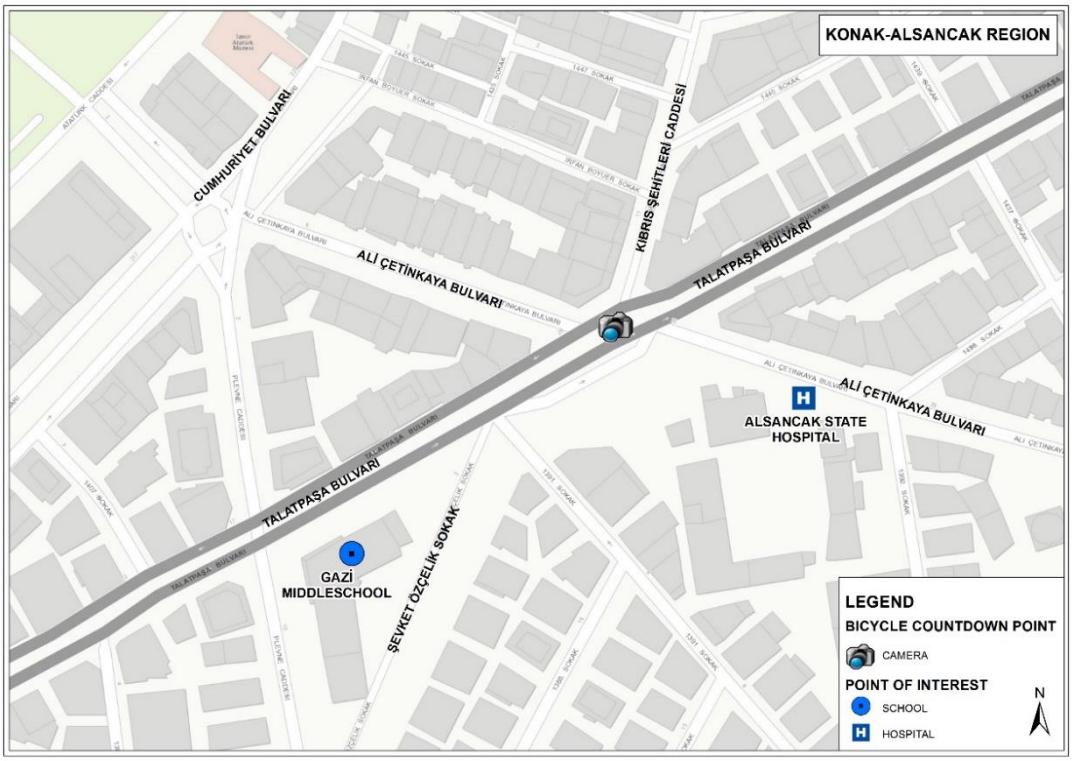


Figure 5.65 Konak-Alsancak counting point (Topaloğlu & Aydoğan, 2019)

Considering the use of bicycles in the Alsancak region, it ranks second with 285 bicycles in total. When cycling users were evaluated by gender, it was found that 95% were male and only 5% of women.

Table 5.18 Bike user gender distribution in Alsancak (Topaloğlu & Aydoğan, 2019)

	Gender			
	Male		**Female**	
	N	**%**	**N**	**%**
Bicycle User	272	95%	13	5%

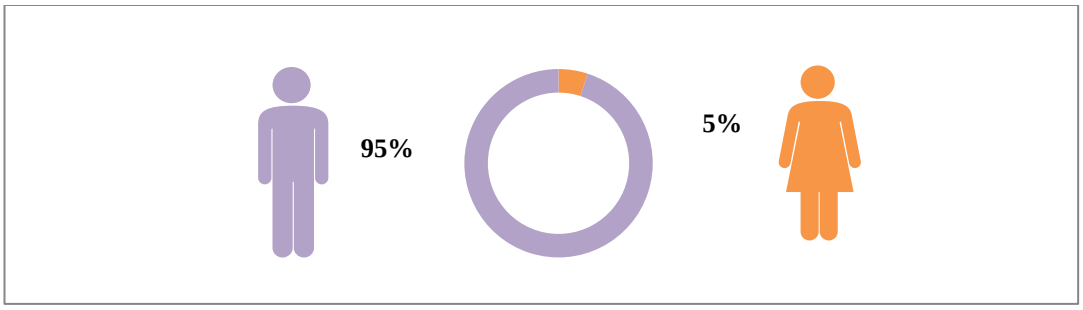
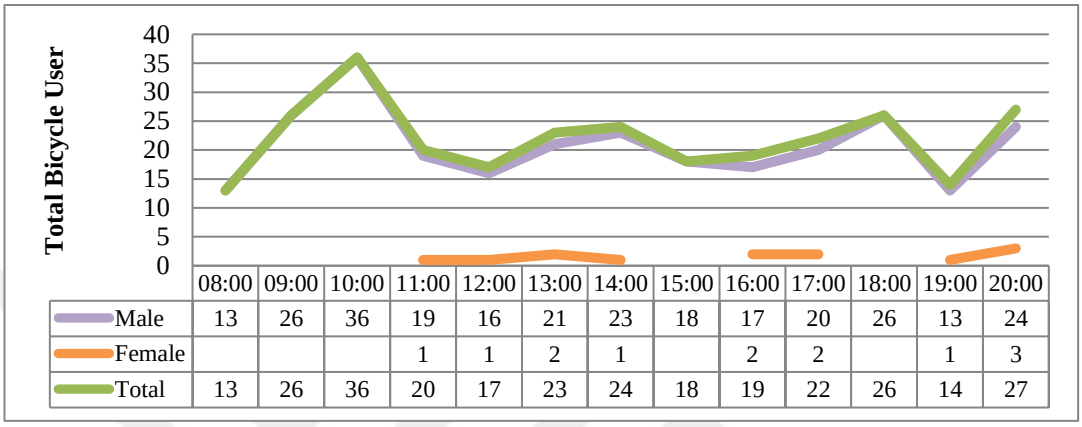


Figure 5.66 Bike user gender distribution in Alsancak (Topaloğlu & Aydoğan, 2019)

When the hourly bicycle volume on Alsancak Talatpaşa Boulevard is evaluated, it is seen that the highest volume is reached between 09:00 and 10:00, the smallest volume is reached at 08:00 in the morning. When hourly volume values are evaluated on a user basis, it is found that female users are much less than male users and the highest female user volume is reached at 20:00.



	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Male	13	26	36	19	16	21	23	18	17	20	26	13	24
Female				1	1	2	1		2	2		1	3
Total	13	26	36	20	17	23	24	18	19	22	26	14	27

Figure 5.67 Hourly cycling user values in Alsancak area (Topaloğlu & Aydoğan, 2019)

When the helmet use of bicycle users is evaluated, it is found that this rate is 12% in Alsancak region.

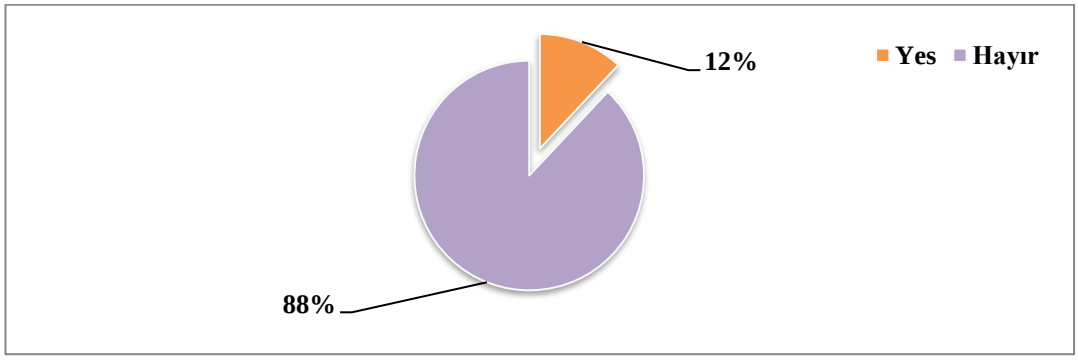


Figure 5.68 Helmet use rates in Alsancak (Topaloğlu & Aydoğan, 2019).

When the distributions of the helmet use rate were examined, it was found that 12% of men reached the general use rate while the proportion was 8% in women.

Table 5.19 Helmets use rates by gender in Alsancak (Topaloğlu & Aydoğan, 2019)

	Headguard Use			
Gender	**Yes**	**%**	**No**	**%**
Male	32	12%	240	88%
Female	1	8%	12	92%

Figure 5.69 Helmets use rates by gender in Alsancak (Topaloğlu & Aydoğan, 2019)

5.4.3 Konak-Kemeraltı Agora Region

The Kemeraltı-Agora sub-region is an important point where the business centers and commercial activities, which are the traditional city centers of İzmir. Kemeraltı Region, which is an important historical and commercial point for the people of İzmir, constitutes the most functional area of the city. Eşrefpaşa Street, which is also used by bicycle users in addition to public transportation used for access to the region, was selected as the center point and counted with camera imaging.

Figure 5.70 Konak-Kemeraltı Agora counting point (Topaloğlu & Aydoğan, 2019)

According to the results of the 12-hour counting conducted in the region, a total of 109 bicycle users, only 1 female and 108 men, were identified. When the ratio of women and men in total cyclist users is evaluated, it is found that this rate is only 1% for women.

Table 5.20 Bike user gender distribution in Kemeraltı-Agora (Topaloğlu & Aydoğan, 2019)

	Gender			
	Male		**Female**	
	N	**%**	**N**	**%**
Bicycle User	108	99%	1	1%

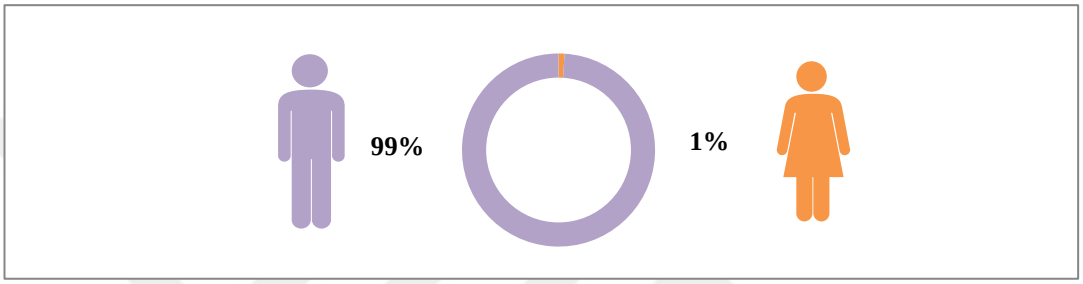
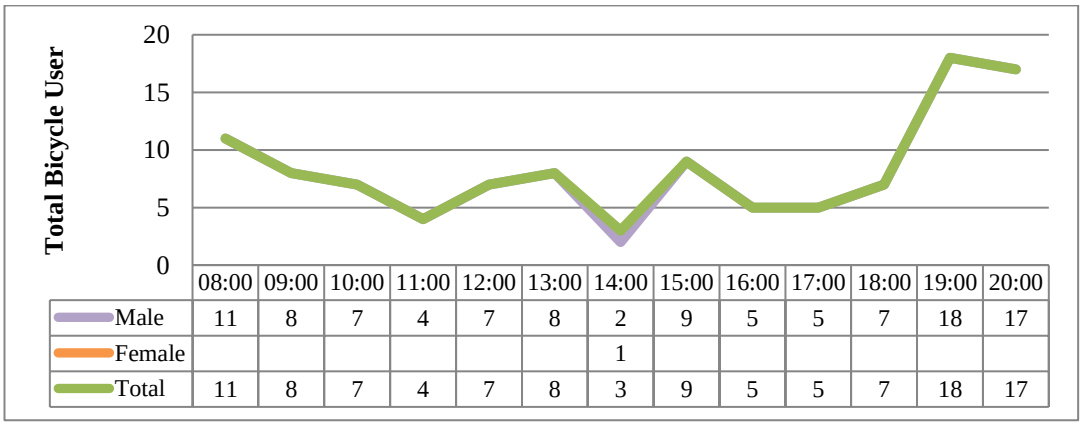


Figure 5.71 Bike user gender distribution in Kemeraltı-Agora (Topaloğlu & Aydoğan, 2019)

When the hourly user volume values in Kemeraltı Agora Region are examined, it is seen that the region has reached quite different values for bicycle users during the day. The highest cycling volume was determined at 19:00 in the evening and then at 20:00 with 17 bicycles. The lowest cycling volume was determined to be 14:00 with the passage of 3 riders.



	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Male	11	8	7	4	7	8	2	9	5	5	7	18	17
Female							1						
Total	11	8	7	4	7	8	3	9	5	5	7	18	17

Figure 5.72 Hourly cycling user values in Kemeraltı-Agora area (Topaloğlu & Aydoğan, 2019)

Eşrefpaşa Street, which is selected for Kemeraltı-Agora Region where bicycle use is quite low, is one of the streets with the highest traffic volume during the day. As it

is a region where the use of private vehicles and public transportation is high, it is one of the places where bicycle users should pay attention to the use of helmets for their safety. In the study conducted within the region, the helmet use rate was found to be 17%.

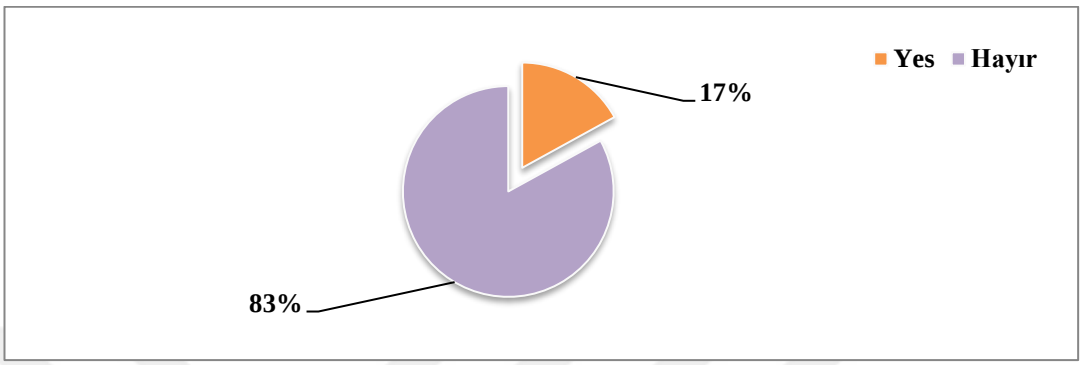


Figure 5.73 Helmet use rates in Kemeraltı-Agora (Topaloğlu & Aydoğan, 2019)

When the helmet usage rates for the Kemeralti-Agora Region were examined, it was found that 17% of men used helmets according to the tally results. Only one female cyclist was seen in the region and this cyclist did not use a helmet for safety.

Table 5.21 Helmets use rates by gender in Kemerlatı-Agora (Topaloğlu & Aydoğan, 2019)

	Headguard Use			
Gender	**Yes**	**%**	**No**	**%**
Male	18	17%	90	81%
Female			1	100%

5.4.4 Bornova Merkez Region

Bornova Merkez region serves as a sub-center for Bornova district of İzmir province. Bornova Square is one of the most important sub-centers of the city due to the presence of public institutions such as Government House, primary school and the necessary equipment for the commercial and social activities of the people. Mustafa Kemal Street and Fevzi Çakmak Streets were determined as the center in Bornova Central Region.

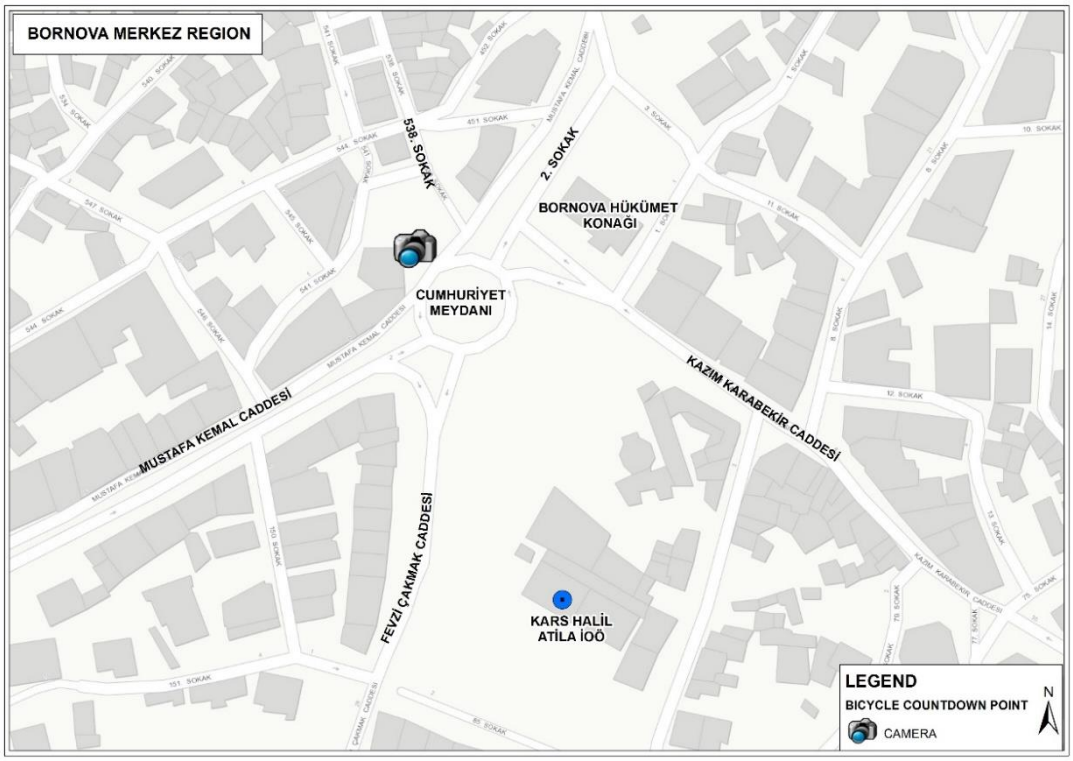


Figure 5.74 Bornova Merkez Region counting point (Topaloğlu & Aydoğan, 2019).

When the counting results for Bornova Merkez Region were evaluated, 89 male and 7 female bicycle users were observed. When the ratio of bicycle users according to gender is evaluated, 7% of total users are female and 93% are male.

Table 5.22 Bike user distribution in Bornova-Merkez (Topaloğlu & Aydoğan, 2019)

	Gender			
	Male		**Female**	
	N	**%**	**N**	**%**
Bicycle User	89	93%	7	7%

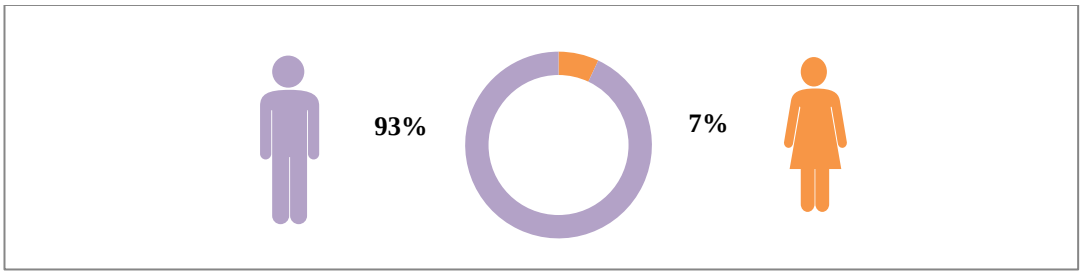
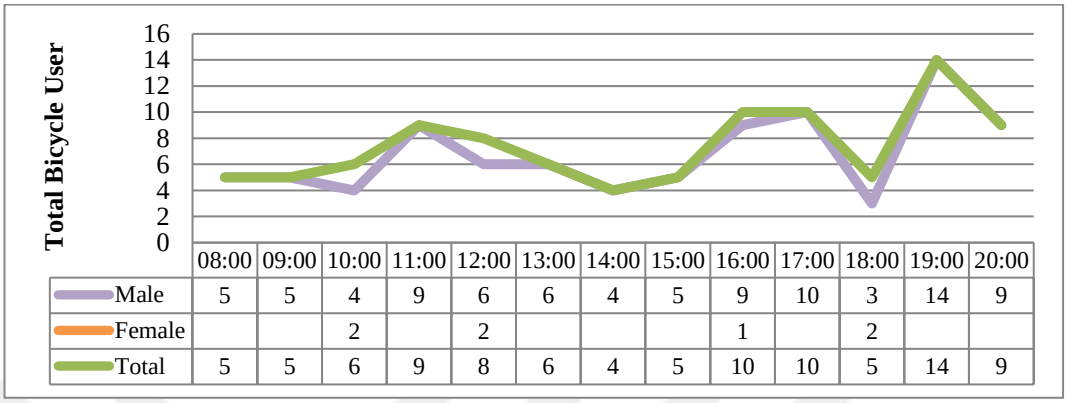


Figure 5.75 Bike user distribution in Bornova-Merkez (Topaloğlu & Aydoğan, 2019)

When the volume values of bicycle users detected on Bornova Merkez Region Mustafa Kemal Street and Fevzi Çakmak Streets are compared, it is observed that there

are fluctuations during the day. Cycling users increased between 08:00 and 12:00, while there was a decrease between 13:00 and 15:00. The highest cycling volume was reached at 19:00, while the lowest values were between 08:00 and 09:00.



	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Male	5	5	4	9	6	6	4	5	9	10	3	14	9
Female			2		2				1		2		
Total	5	5	6	9	8	6	4	5	10	10	5	14	9

Figure 5.76 Hourly cycling user values in Bornova-Merkez Area (Topaloğlu & Aydoğan, 2019).

When the rate of helmet use was evaluated by bicycle users in Mustafa Kemal and Fevzi Çakmak Streets, which are very important in terms of traffic volume for Bornova Central region, it was found to be 19%

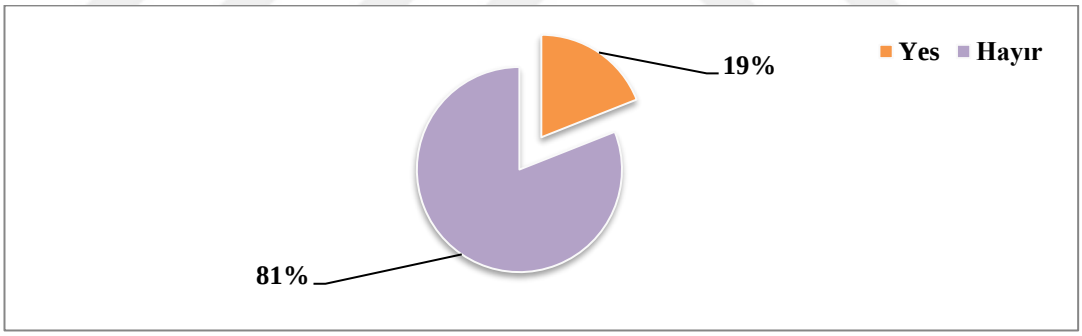


Figure 5.77 Helmet use rates in Bornova-Merkez (Topaloğlu & Aydoğan, 2019)

When the distribution of the helmet use rate by gender was examined, it was found that 12% of men reached the general use rate while the proportion was 8% in women.

Table 5.23 Helmet use rates by gender in Bornova-Merkez (Topaloğlu & Aydoğan, 2019)

	Headguard Use			
Gender	**Yes**	**%**	**No**	**%**
Male	13	15%	76	85%
Female	5	71%	2	29%

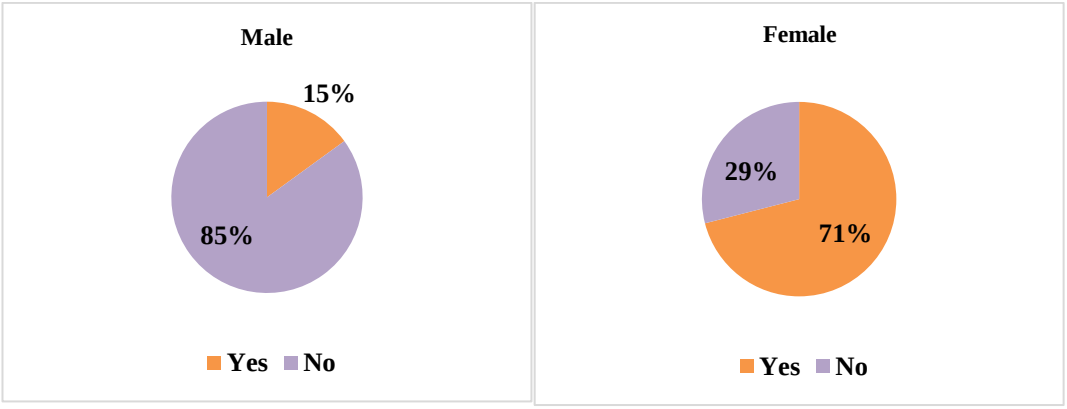


Figure 5.78 Helmet use rates by gender in Bornova-Merkez (Topaloğlu & Aydoğan, 2019)

5.4.5 Evaluaiton of Cycling User Counts

In the study conducted to determine the use of bicycle transportation in the city center and to create a user profile, a total of 935 bicycles were identified according to the region-based 12-hour counting results. The highest number of users with bicycles: Karşıyaka Iskele Region with 445 bicycles; and the lowest region: Bornova Central Region with 96 bicycles. The highest bicycle use rate was Karşıyaka İskele Region and the lowest rate was Kemeraltı Agora Region at 12%.

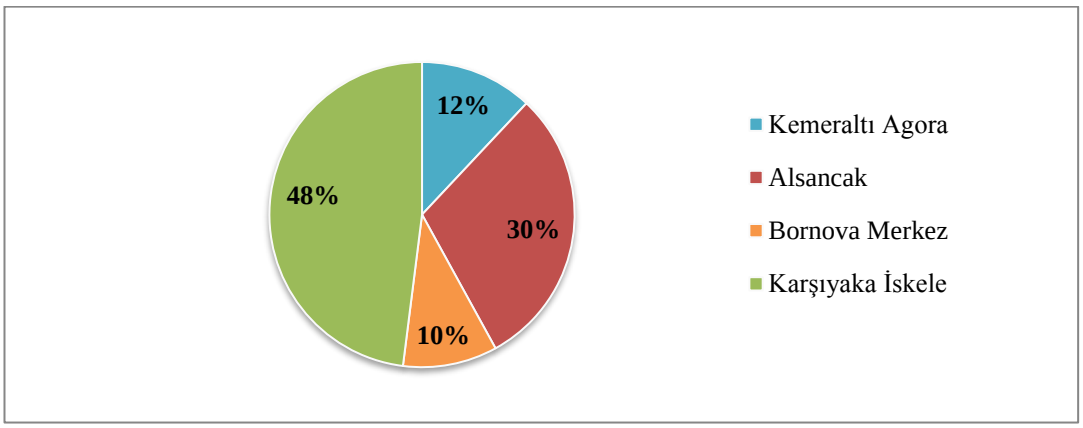
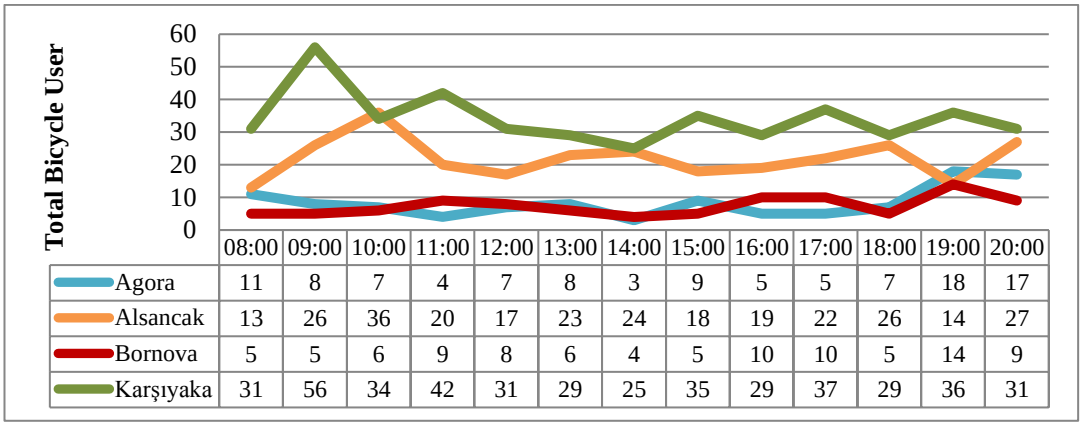


Figure 5.79 Bike use rates by region (Topaloğlu & Aydoğan, 2019)

When the hourly distribution of cycling users was examined, the highest user value in Agora and Bornova regions was found to be at 19:00 in the evening and between 09:00 and 10:00 in Karsiyaka and Alsancak regions. Thus, the high use of bicycles during urban traffic rush hours reinforces the assumption that bicycles increase the rate of preference for transportation.



	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Agora	11	8	7	4	7	8	3	9	5	5	7	18	17
Alsancak	13	26	36	20	17	23	24	18	19	22	26	14	27
Bornova	5	5	6	9	8	6	4	5	10	10	5	14	9
Karşıyaka	31	56	34	42	31	29	25	35	29	37	29	36	31

Figure 5.80 User volumes with hourly bicycles by regions (Topaloğlu & Aydoğan, 2019)

When the gender ratio of bicycle users was evaluated, it was found that the Kemeraltı Agora region had the highest male user rate with 99% male ratio. Among the female users, the highest value of Bornova Merkez and Karşıyaka Iskele was obtained with 7%. Thus, the study clearly shows the inequality in the number of male and female users.

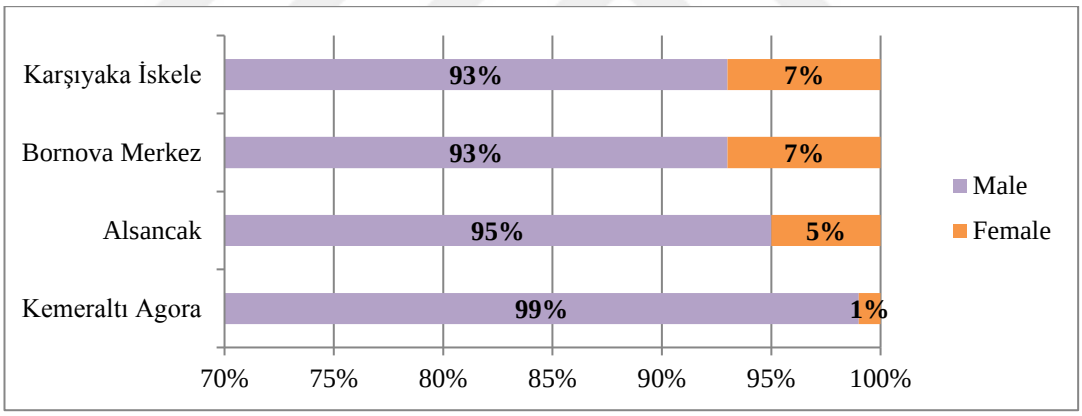


Figure 5.81 Gender distribution of cycling user rates by region (Topaloğlu & Aydoğan, 2019)

The current situation was determined by asking questions about the use of equipment in bicycle user surveys conducted within the scope of Action Plans (UPI 2030) of Izmir Transportation Master Plan. According to the results of the summer survey, it was found 38.9% of the bicycle users surveyed were wearing helmets compared to 30% in autumn. According to the results of the survey conducted in the summer period, it was determined 6 out of 10 people did not use helmets in the summer period, while in the autumn survey results was determined 7 out of 10 people did not wear helmets.

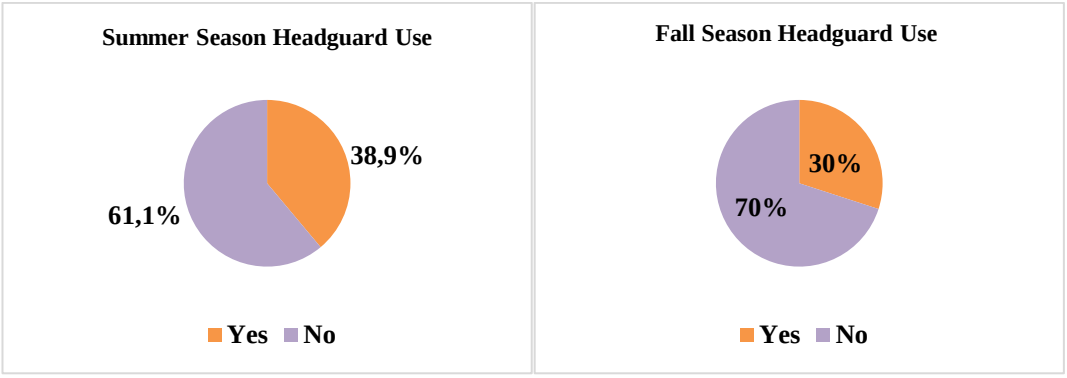


Figure 5.82 Helmet use rates according to survey results (Bisikletli ve Yaya Erişimi Şefliği, 2018)

According to the results obtained from the camera count images, the helmet use rates of the cyclists in all selected regions were well below the results of the İzmir Transportation Master Plan (UPİ 2030) Recommendations Action Plans. According to the results, the use of bicycle with helmets in all regions was determined as 14%. When the regions were evaluated within themselves, the highest utilization rate was Bornova Central Region with 19% and the lowest rate was Karşıyaka Pier with 13%. According to the results, it is clear that bicycle users ignore their safety.

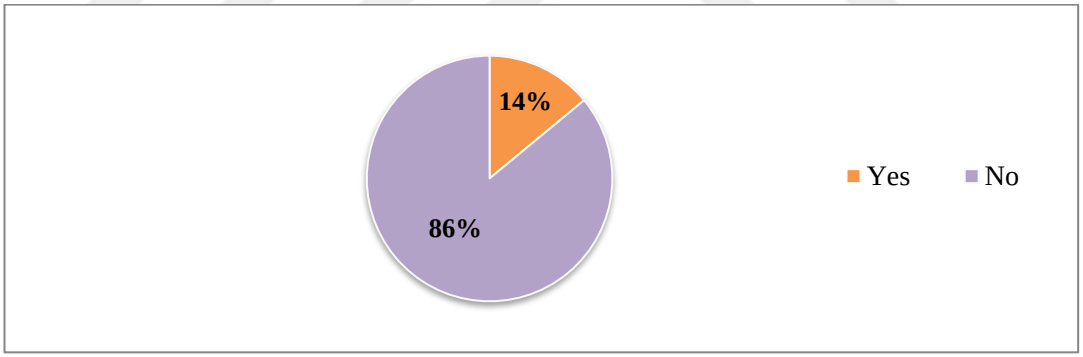


Figure 5.83 Helmet Use Rates According To Count Results (Topaloğlu & Aydoğan, 2019)

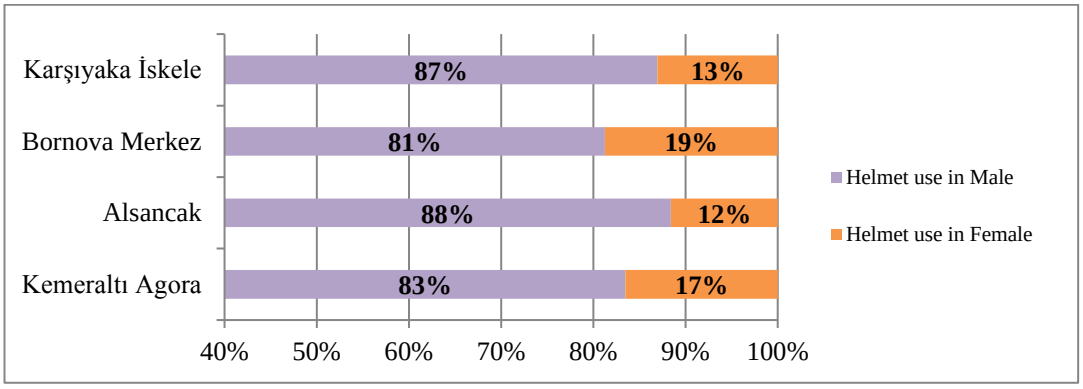


Figure 5.84 Gender distribution of helmet use by gender (Topaloğlu & Aydoğan, 2019)

CHAPTER SIX
CONCLUSION

Today, increasing car journeys create problems in cities with environmental, economic and social dimensions. In order to prevent these problems from growing in the cities of developed countries, the development of bicycle transportation has become an important element of transportation policies. Cycling trips provide opportunities for a healthy life and can be made for recreation, sports and socializing purposes. Especially in order to reduce the volume of travel with private vehicles, bicycle-type transportation alternatives should be developed.

In Turkey, lack of economic development and inconstancy of non-steady growth causes unplanned and uncontrolled urban growth. As a result of this, it is seen that the transportation system in urban life is moving away from a sustainable structure. The fact that the city of Izmir is the third largest populated city in Turkey is faced that bigger economic social and environmental problems than other cities. The rate of increase in population growth and short-term policies produced as a solution to the transportation problem increased the unplanned development in the city and affected life negatively. The solution proposals and investments, which are mainly produced for highway transport, have caused the macroform of the city to be shaped negatively. Therefore, instead of solving the transportation problem, it has triggered its spread to larger areas.

The share of car journeys in İzmir, which is 164‰ of car ownership, is quite high. By 2030, the population is expected to be approximately 6.5 million and the car ownership rate in Izmir is estimated to be at 233‰. In the current situation, the city of Izmir, which is experiencing serious traffic problems, will face with worse problems when the car ownership rate increases.

In this context, it is seen that developed countries accept cycling in order to make the city more livable and sustainable. When the transportation plans of these countries were examined, it was determined that people-oriented studies were carried out, creating a vehicle-free city is considered as being visionary, and policies were developed and implemented for pedestrian or bicycle use especially on short-distance

trips, and most importantly, incentives were made for the use and dissemination of the system. When bicycle-friendly cities were examined:

- Sufficient importance is given to bicycle transportation, made part of the transportation system in the city and integration with other types is ensured,
- In the urban transportation plans, bike use in transportation is aimed to reach at least 10% of the travels between work-school-home,
- Bike paths and bicycle parking areas are located in city centers and transfer points and are easily accessible in integration with other means,
- Efforts are made to ensure an environmentally sensitive urban life by means of traffic calming policies produced in cities, low emission zones and the construction of recycled bicycle paths,
- Increasing the use of bicycle paths and use of important axes are encouraged, the priority of the cycling path is supported by law and shared bicycle systems are developed to realize this,
- In order to raise awareness and provide encouragement, it has been determined that trainings are provided in schools and cycling days and competitions are organized.

When succesful bike transportions in world cities plan were examined, it was observed to have direct relationship with;

- the planning by integrating with other types,
- policies and investments produced for urban transportationthat include bicycle transportation,
- uninterrupted cycling routes,
- and production of bicycle parking areas in the city center.

Within the scope of the study, in order to examine the bicycle network structure in Izmir city and to question its competencies, geographic information systems were used. According to the results of the study, the bicycle routes constructed in line with the development and promotion of bicycle transportation in İzmir do not serve a large part of the city population and they do not reach the important points of the city. In order to establish a sustainable and environment-friendly transportation system in the city, the objectives such as the integration of bicycle transportation, integration with other transportation systems and the creation of bicycle parking areas have not been achieved. The lack of security of the stall areas in the transfer centers is an important deficiency. In addition, the disruption of the existing bicycle network, irregular construction of road widths affects the comfort and travel time of the bicycle users and decreases the use of the bicycle for transportation purposes.

The Action Plans of the İzmir Transportation Master Plan (UPİ 2030), which was implemented by the İzmir Metropolitan Municipality, aimed to increase the use of bicycle as a means of transportation. According to the results of the survey, 62.2% of the bicycles were used for recreational/sports purposes. 37.8% of the people who prefer bicycles have been found to travel by bikes for economic and short-distance travel. Although the existing bicycle path in the city of İzmir is clearly defined on the coast, it is found that approximately 31% of the users are not aware of bicycle paths and bicycle parking areas. This situation can be evaluated in many ways related to the lack of promotion for bicycle transportation, lack of sufficient information about bicycle transportation, lack of prevalence of bicycle culture yet, and lack of sufficient horizontal and vertical markings on bicycles.

Within the scope of the study, camera images, detection and counting method were used to evaluate the use of bicycles for transportation purposes in Izmir city center and to determine user profile. Numerically different observations have been made from the findings made by methods such as questionnaires. As a result of the observation, it was determined that the highest volume of bicycle use was reached during the hours when vehicle traffic in the city is dense. The findings showed that there is a high demand for cycling, even in urban centers where no facilitation or urban design arrangements are made. To realize this potential, to support it, to ensure the safety of

citizens who use bicycles without infrastructure, to increase transportation efficiency; it should be a priority public target for both local governments and central government.

The promotion of bicycle use on a national scale is a public goal that can achieve major gains in the fields of nature protection and public health nationwide. To this end, strategic plans should be made to facilitate the use of bicycles for people of all ages and genders, and design guidelines should be established to guide the steps to be taken in all cities in our country. In addition, in order to expand the use of bicycles for transportation purposes and to integrate them as a vehicle to the transportation system in the city, first of all, planning consciousness should be changed and transportation plans appropriate to the geography and infrastructure of the city should be produced. Bicycle paths prepared on the scale of urban design can serve for recreational use, but they cannot make an effective contribution to the transportation system of the city.

To ensure cyclic transport, integration with other modes of transport is essential where urban topography is not suitable for cycling routes. In order to ensure the interaction of cyclists with other transportation modes, bicycle-parking areas should be recommended at rail stations, health facilities and schools. With the "Park & Ride" (P&R) system to be developed, it should be ensured that they leave the vehicle in the parking areas to be recommended for private vehicles and continue with public transportation. For cyclists, parking spaces should be recommended in these areas.

Organizations and panels should be organized in cooperation with platforms such as public institutions and non-governmental organizations in order to increase the range of users of bicycles and increase the use of bicycles for women. Panels should be organized on this issue in schools and various organizations in order to let safety precautions known in bicycle transportation. Public awareness should be made by promoting bicycle paths on television and social media in order to increase the awareness and promotion of bicycle for transportation purposes.

The need for bicycle paths in the development areas of the city should be taken into consideration in order to promote the use of bicycles and to make them more effective in urban transportation. Bicycle paths in newly planned areas such as vehicles and pedestrian roads should be planned systematically with an integrative approach.

As a result, bicycle transport should be promoted as a form of urban transport. In urban transportation planning studies, instead of suggesting solutions to motor vehicle mobility, a planning approach that will enable individuals to move more freely and safely should be adopted. In order for the bicycle to increase the safety and comfort of travel in the city, the transportation infrastructure of the city should be rearranged as a whole. The perception of the public will change with the separated bicycle paths to be built in the city, the shared bicycle system to be developed and the "Park & Ride" system.

As a result of all these arrangements, the increase in the use of bicycles for transportation purposes and the fact that the bicycle becomes a part of the urban identity and urban culture will increase the level of spatial viability and provide an important threshold for the creation of sustainable cities.

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