The Analysis of Urban Transportation in Istanbul

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Abstract

This paper provides information on the environmental challenges faced in Istanbul with urban growth and possible improvements for the urban transport infrastructure of Istanbul to solve the environmental and structural problems. Due to extreme population growth and poorly planned transportation structure which fails to satisfy the demand, Istanbul has been facing severe traffic congestion that results in environmental issues such as air pollution, excess fossil fuel consumption. Past solution attempts and case studies that tried to tackle the problems, notably the Integrated Urban Transport Master Plan formed and implemented in 2009, are introduced, and their advantages and drawbacks are analyzed. The level of effectiveness and applicability of these case studies and research papers that promote sustainable transportation methods and innovative public transportation systems are evaluated by considering the cultural, geographical, and structural qualities of Istanbul. To devise the most suitable transportation solution for Istanbul and make constructive suggestions, the data about the aftermath of existing transportation structures are collected and summarized.

1 Introduction

Even though large cities provide convenience, career opportunities, cultural and social attractions to their residents, they face severe environmental challenges due to urban growth and their poor urban infrastructure. By 2050, two-thirds of the world's people are expected to live in urban areas. As cities grow in population, the drastic environmental problems are predicted to worsen. The most notable problems that are common around the world are poor air and water quality, insufficient water availability, waste-disposal problems. According to World Health Organization, ambient air pollution accounts for 4.2 million deaths per year. As intensive urban growth continues, concentrated energy consumption causes much greater air pollution in large cities more than ever before. This situation worsens human health causing many respiratory diseases including chronic obstructive pulmonary disease, asthma, and lung cancer. World

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Health Organization states that there are about 65 million people who suffer from chronic obstructive pulmonary disease. Moreover, large volumes of uncollected waste create health hazards and worsens the life quality of residents. Poorly planned urban structures affect animals and plants as much as humans. Soil pollution and physical barriers to root growth in large cities promote loss of urban tree cover. Animal populations are affected by toxic substances, and the loss of habitat and food sources [Geo21].

Transportation structure of cities is one of the most notable elements of urban structure that causes environmental problems. Transportation has direct, indirect and cumulative environmental impacts. These impacts are often the result of economic and political considerations. Lack of adequate regulations to ensure sustainable transportation and putting cost before environment worsen the situation at hand. Transportation causes the release of several million tons of greenhouse gases each year into the atmosphere, 25 and 30 percent of all greenhouse gas emissions. Some gases released due to transportation, most significantly nitrogen oxide, participate in depleting the stratospheric ozone (O3) layer, the layer that screens the earth's surface from ultraviolet radiation [Rod20]. In addition to being a contributor to climate change, transportation is also impacted by it, particularly over infrastructure, for example there are more floods nowadays due to rising sea levels, and operations. The emissions of sulfur dioxide and nitrogen oxides form various acidic compounds that result in acid rains. Acid precipitation reduces agricultural crop yields and causes forest decline. Fuel, chemicals, and other hazardous particulates discarded from cars, trucks, and trains contaminate water systems. Highway construction leads to an important loss of fertile land. Fuel and oil spills from motor vehicles are washed on roadsides and enter the soil. Transportation also influences biodiversity [Rod20]. The need for construction materials and the development of land-based transportation leads to deforestation. Transport routes require draining land and thus, they harm water plant species. Many animal species are becoming endangered as a result of changes in their natural habitats.

There are several known solution methods proposed by experts to tackle the issue of transportation planning. They are changing petroleum fuel vehicles to fuel cell technology, promoting more electric cars on the road, reducing the distance driven and time on the roads, changing travel and commuting patterns, building up sustainable public transportation, and constructing more walking and cycling roads. Their effectiveness will be discussed in detail in the following sections of this paper [E20].

The example used in this paper, Istanbul, is a city that greatly experiences the aforementioned problems. Its population has risen by over 1000 percent within 70 years, from approximately 1.5 million in 1950 to 18 million in 2019 [Aky15]. As this rapid urbanization continued the number of vehicles increased. According to the Road Motor Vehicle Statistics provided by TUIK (Turkish Statistical Institute) in 2019, the number of registered vehicles in Istanbul was 3 million in 2012 and has been rapidly increasing since then. The reasons behind owning a car rather than using public transport in Istanbul are poor quality public transport and underdeveloped rapid transit systems. The public

transport system has remained insufficient to meet the needs of the growing population.

Istanbul has a complex transportation structure with numerous modes of transport. Minibuses and buses form the main body of the public transport system in Istanbul [M.11]. Private minibuses form the main body of the public transport system in the city, generally with a seating capacity of approximately 10 seats. According to Istanbul Metropolitan Municipality, they carry approximately 2 million passengers daily out of approximately 6 million in the inner city, and there are more than 56000 minibuses on the roads of Istanbul. Approximately 2 million passengers travel by public bus. 7000 buses are operated daily [Jos14]. Therefore, they must carry more passengers than their capacity.

In the following sections of the paper, past attempts in Istanbul to solve environmental problems caused by insufficient transportation structure and traffic congestion will be analyzed. The planned future of the transportation structure of Istanbul will be discussed. Newly developed sustainable transportation structures and successful transportation solutions will be analyzed and their applicability to Istanbul's city structure, culture, and geographical conditions will be discussed.

2 Research Findings and Discussion

2.1 The Future of Istanbul's Transportation

The Istanbul Master Plan was approved by the Istanbul Metropolitan Municipal (IMM) Council in July 2006. However, partly as a result of criticism regarding both substance and the planning process, the IMM prepared another version of the Plan, having more input from district municipalities, university professors, civil engineers, and other non-governmental organizations. The Istanbul Master Plan sought to achieve five main goals:

1. Adaptation and orientation in line with the dynamics of globalization and the EU accession process
2. Protection of the ecological balance and fostering of sustainable and disaster resistant development
3. Help Istanbul achieve status as a world culture city
4. Develop tighter economic relations with other global cities and establish Istanbul as a global city
5. Improve quality of life in Istanbul [Ayd15]

2.2 Findings of the Report

The report states that the number of motorized vehicles in Istanbul will increase rapidly by more than 3.14 times to 4.19 million in 2023. The passenger car ownerships are estimated to increase to 67 percent of the households in 2023. The percentage distribution of trips between the European and the Asian sides

will not change much during 2006-2023, and Bosporus crossing trips increased 1.5 times, or as much as the growth of the total trips [Wak09].

The research suggests that there is no way to cope with the expected tripling of automobile traffic. Therefore, it is necessary to promote public transport. The congestion will chiefly occur on highways. It is essential to adopt policy instruments for dispersing the future motorized traffic to general roads. The transport capacity across Bosporus Strait and across Golden Horn Bay falls seriously short of the demand forecast.

2.3 Details from the Report

The report explains that the total cost of 10 projects scheduled for completion after 2023 is 5.5 billion US dollars. Currently, the transversal movement dominates the traffic flows in the city and is destined to do so in the future. The two-existing east – west expressways, TEM and D-100, will not be able to service the growing traffic. For this reason, the need for the third transversal thoroughfare has been stated. The traffic on the new east - west expressway in 2023 will be very close to the capacity of a 6-lane expressway. Therefore, the two existing expressways would suffer severe congestion unless the new thoroughfare should be provided. Moreover, the construction of elevated roads is also becoming increasingly difficult to find enough space. Going underground is the only possibility.

The master plan proposes 13 tunnel roads, and 110 million passenger km will be serviced by the railways [Wak09]. Passengers on private bus services provided by schools and companies will also shift to the railways. Such a shift requires a number of specific policy measures. The present study accordingly examined the possibility of the 2nd railway crossing under Bosporus. The location was sought between the existing two bridges, with two alternatives of a bridge and an undersea tunnel.

Consequently, the alternatives were increased to four by adding the choice over the Asian-side lines. Alternatives 1 and 2 involve a new bridge, while Alternative 3 and 4 a new undersea tunnel. The bridge is assumed to serve both railway and road, and the estimated cost is thus halved in the two bridge alternatives. Even halved, the cost of the bridge is the same as the tunnel. The estimated demand on the bridge would be larger by 20 percent than the tunnel, because it is possible to provide stations close to the abutment.

For regular bus services we have two options for the future: to give up long distance travels and specialize in short distance feeder services for transit stations, and to diversify into specialized niches, such as premium all-seated bus rides and late night services. Most of the existing bus services will eventually follow the first option [Wak09].

2.4 Implemented Mega Projects as Solution Attempts

Before the newly constructed mega projects of Istanbul, there were two bridges that connected Europe to Asia: Bosporus Bridge and Fatih Sultan Mehmet

Bridge. Bosporus Bridge opened in 1973 and features RFID tolling and reversible lanes. Its name was changed to 15th July Martyrs Bridge in 2016. Fatih Sultan Mehmet Bridge, opened in 1988, also features reversible lanes. In the 2010s, Turkey has engaged in a series of megaprojects with a net spend exceeding 400 billion US Dollars [Ayd15].

2.4.1 Eurasia Tunnel

Located at the southern end of Bosphorus, Eurasia Tunnel opened in 2016. It has a double-decked structure that consists of two lanes. There is heavy traffic along the east-west axis in Istanbul during rush hours. The Eurasia Tunnel aims to reduce the traffic loads on the 15th July Martyrs Bridge and bridges located above the Golden Horn.

Average travel time between the start and end points of the project was about 42 minutes, rising to a range of 60–100 minutes when traffic density is high. This project, for a daily capacity of 130,000 vehicles, aims to reduce this travel time to 15 minutes while minimizing the emission of harmful gases into the atmosphere, such as exhaust gases caused by extended travel times in congested traffic.

Moreover, the project aims to reduce the number of vehicles entering the historic peninsula, a significant tourist attraction site that houses buildings such as Hagia Sophia.

Since Eurasia Tunnel is built underwater, it helps Istanbul to achieve a green transportation infrastructure that doesn't damage the city's natural beauty and famous skyline. The results of a research conducted by the municipality show that travel times have fallen by 7 percent to 38 percent on the July 15th Martyrs Bridge and by 2 percent to 28 percent on the FSM Bridge. Average speeds rose by up to 63 percent on the July 15th Martyrs Bridge and by up to 36 percent on the FSM Bridge during peak hours [Ata17].

Even though the Eurasia Tunnel has several benefits, it fell short in certain areas.

As seen in the figure above, after the Eurasia Tunnel, no significant change was observed in the number of vehicles crossing the July 15th Martyrs Bridge, while the number of vehicles crossing the FSM Bridge fell slightly due to the impact of the YSS Bridge [Ata17].

According to the analysis results, the hourly saturation flow rate is approximately at full capacity on the July 15th Martyrs Bridge and the FSM Bridge at all times except at night; however, it peaks at 44 percent in the Eurasia Tunnel [Ata17]. The results indicate that drivers should be encouraged to use the Eurasia Tunnel to improve the distribution of continent-crossing vehicles between the bridges and the tunnel.

A solution method to encourage drivers is to reduce the costs of Eurasia Tunnel. Currently, the July 15th Martyrs Bridge costs 13 TL (Turkish Liras) for automobiles, whereas the Eurasia Tunnel is four times more expensive with a fee of 46 TL (Turkish Liras). However, this solution will not be applied any time soon: The government guaranteed that 25.6 million vehicles per year would

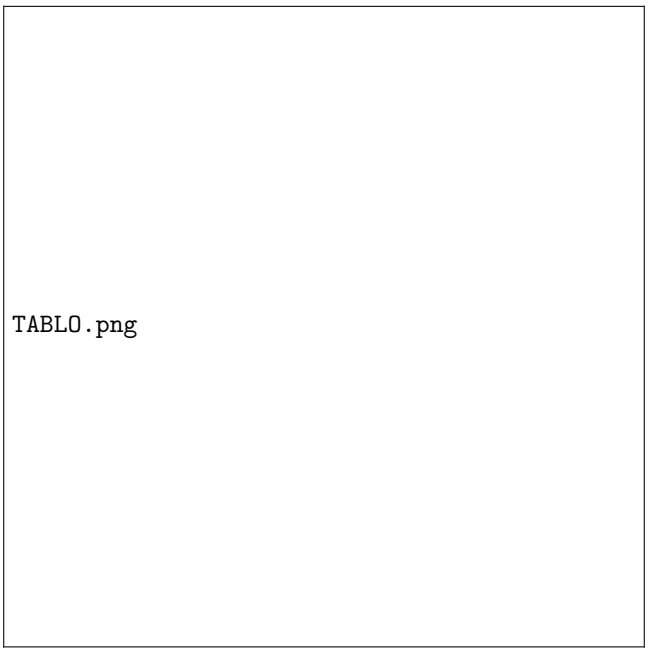

Figure 1: Figure 1. The difference in vehicle counts in the bridges of Bosporus before and after Eurasia Tunnel.

use the Eurasia Tunnel, but in the first year, only 15.6 million vehicles passed through, so the government had to pay 123 million TL (20m US Dollars) to the operator company [Ata17].

2.4.2 Yavuz Sultan Selim Bridge

The Third Bosporus Bridge, Yavuz Sultan Selim Bridge, opened in 2016. Carrying eight motorway lanes and a double-track railway across the strait at its northern mouth, it will ultimately form part of the Northern Marmara Motorway, allowing transcontinental traffic to bypass Istanbul city altogether.

The government guaranteed 135,000 vehicles would use Yavuz Sultan Selim Bridge. However, the predictions weren't the reality. The government had to pay 388 Million TL to the construction company. Therefore, similar to Eurasia Tunnel, the bridge is costly for drivers: it costs 28 TL to pass through the bridge [C.18].

This situation forms a vicious cycle. Since the bridge is costly, less people use it. Due to the lack of vehicles using the bridge, the government should pay huge amounts of money to the company that consequently increases the fee of the bridge. This cycle significantly decreases the effectiveness of the bridge and makes the citizens question the decision of the government, thus creating an unstable political environment.

In addition to financial aspects, Yavuz Sultan Selim Bridge causes many arguments. Main points of contention are the problem of land acquisition and the adverse impact on the natural environment and landscape. The project will have huge ecological impacts on Istanbul's Northern areas where some of the most important wetlands, forests and water basins of Istanbul are located and it will exacerbate population pressures. 2000 decares of land in the city will be zoned for construction.

Also, it is estimated that it will redirect transit traffic which constitutes a mere 2-3 percent of total traffic. Many NGOs objected to the project which has been conceived as a private auto-transport focused solution for a giant metropolis like Istanbul. Approximately 2 million trees were cut down to make way for the third bridge [H.19].

2.4.3 Marmaray and Havaray

Marmaray is a rail tunnel opened in 2013 that links the Asian and European sides of Istanbul from underwater. The project comprises a 13.6km tunnel with 63km of connecting suburban rail lines. Marmaray is projected to reduce the emission of CO2 by 54 kilo tons. Marmaray served as an alternative to the Metrobus system in Istanbul. Metrobus has a daily ridership of around 800,000. Due to overcrowding, it became less favorable among the residents of Istanbul [AFD13].

Marmaray was expected to carry 1.5m passengers each day, reducing Istanbul's traffic by 10 to 20 percent. Unfortunately, it shared the same destiny with other mega projects of Istanbul. One year after the opening, only 110,000 people used Marmaray each day [Z.15].

Havaray is a monorail project in which eight monorail lines connect a number of neighborhoods on both the European and Asian sides of the city, carrying 200,000 passengers a day.

However, the Chamber of Urban Planners of Istanbul is unsure whether the project is any beneficial to Istanbul. Akif Burak Atlar, the Chamber's secretary-general, thinks that the project lacks sufficient planning. He worries that the Havaray's separate lines wouldn't be integrated into the wider public transport system. He adds that passengers couldn't reach one station from the other. For all these reasons, the project was cancelled in 2017. Instead, the municipality focused on building additional metro lines [Z.15].

Buses and subways save about 37 million metric tons of carbon dioxide annually. Additionally, if an individual switches a 32-kilometer daily round trip commute to public transportation, their annual CO2 emissions will decrease by about 2,177 kilograms per year. Combining an increase in public transportation with better road engineering, land use and other factors could help reduce transportation-related pollution by more than 20 percent. For all these reasons, in the implementation order of mega projects, metro lines should be prioritized above highways and bridges [E20].

2.4.4 Ferries

Ferries were the most popular public transportation method in the last century. Due to the ongoing increase in metro lines, ferries become a tourist attraction instead of an actual means of transportation. To regain the popularity of ferry transportation, UberBoat tried to enter Istanbul. They believed that in order to create a livable and sustainable space a city must focus on sustainable transport options instead of expensive projects. UberBoat ran a 2015 motorboat ridesharing pilot across the Bosporus. Unfortunately, Uber failed to gain much purchase on Istanbul's roads, in part through the influence of a powerful taxi lobby [S.15].

Istanbul Master Plan and the implementation of mega projects was an important turning point in the city's attempt to balance land use development and environmental protection. The plan sought to protect the natural resources of the city and create a balance between conservation and development.

In addition, the plan extensively discussed the city's vulnerabilities due to risks associated with natural disasters (such as earthquakes and floods) and overpopulation, and offered strategies for mitigating these risks. On the other hand, the plan did not include the environmental impacts of mega-projects such as the third bridge and highway ring, which were announced later and subsequently pursued. Today, massive construction sites are everywhere and cranes dot Istanbul's skyline in every direction. But the largest and most environmentally significant developments—the third bridge and highway ring are out of sight for all but the most intrepid of tourists and residents. None of these projects was included in the Master Plan, each is located in outlying preservation areas of the city to the north and northwest, and each occupies a vast land area.

Canal Istanbul, a planned project which will create a second waterway connecting the Black and Marmara Seas will not only make a sizable imprint on the topography of Istanbul,but will collectively have a tremendous impact on the nature and direction of residential development, commuting patterns, and urban sustainability in the Istanbul of the future.

The Istanbul Master Plan, referred to as the "Constitution of Istanbul" by the mayor, Kadir Topbaş, initially received serious criticism, including lawsuits by local non-governmental organizations. Community and non-governmental organizations use the legal system to block the implementation of these governmental plans. The Istanbul Chamber of Architects has also attempted to use the courts to prevent mega-projects from happening. For example, they filed a suit against the government for the Kuzey Marmara Otoyolu (the highway ring project associated with the Third Bridge), which was prepared by the Ministry of Environment and Urbanization in direct violation of the 2004 Law on Metropolitan Municipalities and Boğaziçi Law No. 2960. Although the court canceled the highway ring plan on May 25, 2015, it was eventually built [Ayd15].

As these examples illustrate, non-governmental actors have played a significant role in urban planning and the politics of urban growth management in Istanbul.

Second, the AKP (the ruling political party in Turkey) has also introduced new legislation in parliament to make future litigation more difficult. For example, the Environmental Impact Evolution requirement (which is a regulation based on Environment Law No: 2872, passed in 1983) was a very important obstacle since it slowed down the implementation of mega-projects by mandating that projects demonstrate that environmental impact has been minimized.

In May 2013, the party amended the Environment Law to exempt mega-projects from this requirement, thereby expediting their implementation [Ayd15].

The politics of urban planning in Istanbul are complex and characterized by a considerable degree of controversy and conflict. The increasing commodification of land and the need to attract larger and larger sums of foreign direct investment make the politics of growth extremely attractive and the lure of mega-projects almost impossible to resist. In the end, while the Istanbul Master Plan may not have achieved all of the goals it set out to, it has also not proved to be completely irrelevant.

2.5 Sustainable Transportation Solutions

2.5.1 Cycling

Bicycling is an underutilized transport mode in Istanbul. According to Ceyhan Vardar from the Public Health Institution of Turkey, "The negative effects of physical inactivity can damage our health. The studies demonstrate that 71.9 percent of individuals in Turkey are physically inactive. Therefore, bicycling is important for mobility and public health [Jos14]." Experts explain that the most problematic issue that limits cycling in Istanbul is the lack of cycling infrastructure.

One of the major problems for biking in cities across Turkey is finding a parking place. An interviewee says, "While even finding a parking space for cars is quite difficult, finding an area to park a bike is almost impossible. [Jos14]"

Additionally, there is insufficient support from local governments, awareness of cycling as a means of transport, and integration with other transport modes. To promote cycling, segregated bi-directional bike lanes should be implemented. These lanes should be painted in a way that color contrast on roads to improve traffic flow and save lives.

Experts suggest that bicycle escalators implemented in Norway are an appropriate solution for Istanbul's hilly terrain. Especially in recent years, the increasing bike-sharing market increases opportunities for bike riding. Sharing bikes from companies such as Ofo and Mobike have spread to many cities, and more facilities and infrastructures are constructed.

These apps should be promoted by the Istanbul municipality to offer a variety of options when a citizen wants to cycle. However, there are several problems that need to be addressed including a lack of safe cycling infrastructure, insufficient prioritization of road safety for cyclists and pedestrians, and urban design that favors cars. Considering Istanbul's ambitious target of 1,000 kilometers (620 miles) of bike lanes by 2023, the aforementioned issues should be addressed

immediately to promote this sustainable transportation practice [Jos14].

2.5.2 Passenger drones

Intelligent multicopters using Distributed Electric Propulsion technology to reduce the noise and emissions of conventional helicopters, promise to make urban air mobility mainstream. Istanbul's residents may soon be able to benefit from a shared eVTOL ride ascending minutes later from a rooftop helipad and taking the form of a steep parabola high above the Bosporus. An autonomous air-taxi trial is underway in Dubai using a Volocopter 2X machine with nine drivetrains and 18 rotors. It has a maximum range of 27 km. "We can start with point-to-points, over bottlenecks like the Bosporus," says Zosel, "and short distances in urban space, jumping from skyscraper to skyscraper. Building a bridge takes years, but our system can start immediately. It's infrastructure on demand."

In contrast to monolithic infrastructure projects requiring huge spending and land acquisition, eVTOL operations would make limited demands on urban space, since take-off is vertical from ports or hubs. "Hubs are like stations with a lot of Volocopters going in and out," Zosel explains. "Ports are at the hotel or on the balcony of a skyscraper." Mobile İnfrastructure promises improved flexibility since it can be redeployed across a city to assuage localized spikes in ground-level congestion. In contrast to pathway-based road and rail transit, air mobility has the added advantage of being node-based [J.18].

To guarantee safety, while bringing the network efficiency required to cost-effectively compete with other modes, lower airspace air traffic control will be needed. Uber claims eVTOLs will make up to 60 trips per day, carrying 3.5 persons on average, making it as productive as 20 cars. When someone orders a trip, the system determines where and at which moment he/she lands, calculating wind and everything [J.18]. Often, major highway and bridge projects are not welcomed by environmentalist groups and urban planners. They believe that these projects generally conflict with environmental aims and sustainability outcomes. However, traffic congestion is not only about time losses in traffic, but also environmental externalities since it is an ever-growing problem interfering with other urban functions. While many debates on traffic congestion concentrate on the insufficient number of crossings over the highly congested parts of cities such as the bridges over Bosporus in Istanbul, other views advocate that the traffic problem is not related to building bridges, but is about unbalanced situations between the land use and malfunctioning of transport systems.

Congestion problems can be tackled effectively through an efficient urban management solution largely favoring sustainable and active transport options over private motor vehicle mobility dependence. The environmentalist or sustainable view believed that the bridges built by now, such as the ones on Istanbul's Bosporus, have worsened the transport problem. It encouraged a highway-based and vehicular means of transport in the long-term rather than sustainable means, such as water transport, railed systems or bicycling for both mixed and compact types of cities. These mega-projects might irreversibly change the known historical image of cities. Some stated that they and highway-based

transportation encouraged the uncontrolled sprawl of development year-after-year, as is the case of Istanbul.

In addition, the annual rate of increase in motor vehicles is growing more than the population increase in the city of Istanbul with an increase of around 85,000 every year. Apparently, the transport supply cannot catch up with the demand figures, which is one basic source of the traffic congestion on urban streets [J.18].

The future of ferry commuting will be colored by faster, cleaner vessels – though experts say they're unlikely to ever be the centerpiece of urban transportation. The Norwegian Zero Cat 120, the world's first battery-powered, zero-emission car ferry, is set to begin operating this year. However, this model needs to be recharged after every six-kilometer trip, and in cities prone to blackouts caused by storms and hurricanes, would result in chaos.

2.5.3 Walkable Communities

The new trend in urban planning has become "walkable communities." The idea is to mix residential, business and industrial concerns together so people who live in the area could walk to their work, a store or even to their doctor's office without ever needing a car. The incentive here is not only to reduce pollution and use less fuel, but to increase the quality of life for the residents and promote local businesses. But people will still need to travel. Many of the community plans integrated public transportation, ride-sharing programs or hourly car rental programs such as Zipcar into the overall planning.

In the case of Istanbul, the opposite is true. The current development favors expansion over walkable communities. The residential areas are being built outside the financial district, and then they are being connected by mega bridges. However, to make Istanbul an enjoyable place to live in, plans that include walkable communities should definitely be considered.

Even though the mega projects mentioned in this article looks quite fascinating on paper if we only consider their specifications and concept renders, they have many environmental and economic drawbacks that outweigh their appeal and benefits.

2.6 Conclusion and Recommendations

As a citizen of Istanbul, for example, I have never used Yavuz Sultan Selim Bridge, the latest bridge that connects Europe and Asia from the northern shores of Bosporus. However, I am reminded of the deforestation caused by the construction of the bridge daily while commuting from school to home. The green scenery I previously observed become yellower as years passed. The nature still hasn't recovered from the damage because each day a new road construction starts and thus, the government and the companies they collaborate with cut more trees.

Even though I've used Marmaray a few times, I still prefer using the ferries to travel across Bosporus. Many of my friends and relatives are on the same page

with me. Since it is more favorable for people to use ferries, the municipality should invest into developing and utilizing ferries in a more efficient way. Moreover, sustainable and modern startups such as UberBoat should be supported to have them expand their business across the shores Istanbul. Encouraging sea travel in Istanbul will encourage other sustainable startups to emerge and enter the market, thus benefiting the city financially. Apart from my experience as a citizen who lives in Istanbul for 17 years, it is crystal clear that the mega transportation projects of Istanbul were not the most applicable and beneficial solution to solve traffic congestion while paying attention to being sustainable and innovative.

In fact, as the findings that were discussed in the previous section shows the environmental, economic and social damage of these projects, they are far from being perfect even though they had solved several issues regarding traffic congestion. Marmaray and other public transportation projects were more beneficial compared to mega projects targeting automobiles since they weren't interfering with the historic silhouette of Istanbul and allowing more people to use public transportation who were previously unable to use them due to the lacking amount of metro stations across the city.

Istanbul is one of the most beautiful cities in the world. However, overpopulation and actions without proper risk assessment and planning are lessening the value of the city. To reverse this grave situation, green transportation methods and urban development practices including creating walkable communities, cycling friendly neighborhoods, and using passenger drones should be funded and promoted by the government. These sustainable startups and approaches can be promoted by providing them with tax incentives and by including them in governmental press to help them broaden their audience.

Prioritizing environment and life quality of citizens is the best method to solve the transportation problems in Istanbul. By shifting the focus from mind blowing mega projects to approaches that are more familiar and suitable to human nature and wellbeing, Istanbul may once again become a desirable place to live instead of a city that hosts people with stressful and grim expressions who are only in the city because of financial motives.

References

[AFD13] AFD. More sustainable transport to support istanbul's growth. 2013.

[Aky15] E. Akyuz. The solutions to traffic congestion in istanbul. *Research Gate*, 2015.

[Ata17] A. Atahan. Effects on istanbul traffic of the eurasia tunnel and removal of additional lane. *IBB*, 2017.

[Ayd15] A. Aydogan. Mega projects and the limits of urban planning in megacities: The case of istanbul in the akp era. *Middle East Institute*, 2015.

[C.18] Turhan C. Yavuz sultan selim bridge: An overview. *TBMM*, 2018.

[E20] Baxter. E. 10 possible transportation pollution solutions. *HowStuffWorks Science*, 2020.

[Geo21] National Geographic. Urbanization effects. 2021.

[H.19] Paker H. Movement against the third bridge, turkey: Fiatlas. *Environmental Justice Atlas*, 2019.

[J.18] Roper J. Solving istanbul's congestion problem. 2018.

[Jos14] C. Joseph. Making istanbul a cycling city. *WRI Ross Center for Sustainable Cities*, 2014.

[M.11] Hennig M. Sustainable urban mobility: The example of istanbul. *Federal Ministry for Economic Cooperation and Development*, 2011.

[Rod20] Jean Paul Rodrigue. Transportation and the urban form. *The Geography of Transport Systems*, 2020.

[S.15] Starr S. Istanbul shows ferries have a future. *The Guardian*, 2015.

[Tor04] B Torrey. Urbanization: An environmental force to be reckoned with. *PRB*, 2004.

[Wak09] T Wakui. The study on integrated urban transport master plan for the istanbul metropolitan area. *Japan International Cooperation Agency (JICA)*, 2009.

[Z.15] Weise Z. Istanbul is building a 47km monorail network to deal with its crippling traffic congestion. *City Monitor*, 2015.