UNDERSTANDING AND MODELLING TRAVELER TENDENCY TO RIDESHARE: A CASE STUDY OF BOĞAZİÇİ UNIVERSITY

by

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ABSTRACT

UNDERSTANDING AND MODELLING TRAVELER TENDENCY TO RIDESHARE: A CASE STUDY OF BOĞAZİÇİ UNIVERSITY

Psychological and social factors are as influential as travel time and travel cost, when ridesharing is a choice for an alternative type of transportation. The main purpose of this research is to investigate the attitudes towards the concept of ridesharing. This study estimates the binary logit model of ridesharing tendency of people staying at Boğaziçi University. The data needed to evaluate the tendency to ridesharing model were collected through questionnaires. These questionnaires were conducted with the undergraduate and graduate students, academic and administrative staff at North, South and Hisar Campuses of Boğaziçi University. The characteristics influencing travelers' ridesharing tendency can be broadly categorized into three groups which are socioeconomics, travel and the attitude towards ridesharing. In addition, the features of ridesharing applications used in Turkey and in the World, which are obtained from various sources, have been examined. The tendency towards ridesharing model has been set up as passenger and driver, separately. The factors affecting ridesharing attitudes are presented in detail. According to the results of the analysis, it was found that the most significant factor affecting the participation in the ridesharing is security concern in both groups. Other factors such as awareness on ridesharing, not wanting to depend on others and not wanting to be involved in vehicle traffic came out as other strong influences in the study.

ÖZET

YOLCULUK PAYLAŞIMINA KATILMA EĞİLİMİNİN ANLAŞILMASI VE MODELLENMESİ: BOĞAZİÇİ ÜNİVERSİTESİ ÖRNEĞİ

Yolculuk paylaşımının alternatif bir ulaşım türü olarak tercih edilmesinde, seyahat süresi ve seyahat ücreti gibi türel seçim kriterlerinin etkisi olduğu gibi, psikolojik ve toplumsal faktörlerin de etkisi vardır. Bu araştırmanın esas amacı web ya da mobil uygulamalar üzerinden gerçekleşen, aynı yöne giden iki ya da daha fazla insanın yolculuk masraflarını paylaşmak koşuluyla birlikte seyahat ettiği yoluculuk paylaşımı konseptine dair tutumların neler olduğu araştırmaktır. Bu çalışma B.Ü. kişilere uygulanmış olup, yolculuk paylaşımına etki eden faktörlerin modellenmesi için Ikili Seçim Modeli uygulanmıştır. Yolculuk paylaşımına olan eğilim modeli oluşturabilmek için gerekli veriler anket yoluyla toplanılmış olup, anket B.Ü. Kuzey, Güney ve Hisar Kampüslerindeki lisans, yüksek lisans ve doktora öğrencileri, akademisyenler ve fakülte de çalışan memurlar üzerine uygulanmıştır. Yolculuk paylaşımına olan eğilime etki eden karakteristikler 3 kısımda incelenmiştir. Bunlar; sosyoekonomik karakteristikler, seyahat karakteristikleridir ve yolculuk paylaşımı dair tutumlardır. Bunlara ek olarak, çeşitli kaynaklardan elde edilen, Türkiye ve Dünya'da kullanılan yolculuk paylaşım uygulamalarının özellikleri incelenmiştir. Yolculuk paylaşımına olan eğilim modeli yolcu ve sürücü olarak ayrı arı kurulmuş, analiz sonucuna göre iki grubun yolculuk paylaşımına olan ilgilerini etkileyen faktörler detaylı bir şekilde sunulmuştur. Analiz sonuçlarına göre yolculuk paylaşımına katılımı negatif yönde etkileyen en önemli faktörün her iki grup içinde güvenlik endişesi olduğu ortaya çıkmıştır. Bu tür uygulamaların bilinirliği, bağımsız seyahat etme isteği ve araç trafiğine dahil olmak istememe gibi diğer tutumların da güçlü etkileri olduğu çalışma sonucunda olarak belirtilmiştir.

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LIST OF SYMBOLS

P_i	Probability of condition i occurring
x_i	Value of the predictor variable
β_o	Constant value of multinomial logit model
β_1	Gradient value of the predictor variable
ε_i	Error term

LIST OF ACRONYMS/ABBREVIATIONS

BOUN	Boğaziçi University
GPS	The Global Positioning System
HOV	High Occupancy Vehicle Lane
İETT	İstanbul Electric Tram and Tunnel Company
İUAP	İstanbul Transportation Master Plan
TL	Turkish Lira
TUIK	Turkish Statistical Institute
US	United States

1. INTRODUCTION

1.1. Motivation and Problem Statements

Ridesharing is an alternative transportation mode which differs from taxis and jitneys in its financial motivation and origin/destination structure. The driver who wants to share a ride with the passengers that have a common origin and/or destination, shares a ride together and ridesharing payments paid by passengers only covers driver's cost. Day by day, ridesharing concept gains strength as a powerful strategy to reduce traffic congestion, emissions, fuel consumption. From another perspective, ridesharing has emerged as a sustainable and powerful type of transportation, with the development of urbanization. Along with the developing technology, ridesharing has become dynamic, and web and mobile applications have been developed to help people who want to share a ride together.

İstanbul is a developing megacity, which has been more developed towards east and west directions together with the population growth (Yazman *et al.*, 2009). Because of the natural borders, enlargement through neither north nor south directions is possible due to the Black Sea and the Marmara Sea. Rapid population growth directly affects the transportation. Increasing traffic, inefficiency and comfortless transportation systems together with crowded population, lead the public to different transportation alternatives. Cities that develop so fast need fast and sustainable transportation solutions.

Considering the specific vehicle ownership with the number of 3.651.166 (TUIK, 2016) and vehicle occupancy rates (1,57) available for İstanbul (IUAP, 2011), ridesharing is deemed to be an idea that alleviates the burden of mass transportation as a solution to traffic congestion. The number of vehicles in traffic will decrease due to the increase in the occupancy of existing vehicles (Alexander and Gonzalez, 2015). Ridesharing is a concept that has been widely used as a mode of transportation abroad, especially in the United States and has entered into our country through a series of applications. Awareness and the number of users are not comparable with the users in the United States and Europe. However, it is not certain whether these applications may create a target group in societies as closed as Turkey or not.

1.2. Goals and Objectives of the Research

In this thesis, it is hypothesized that ridesharing propensities can be predicted based on socio-demographic and attitudinal variables. Attitudinal variables such as interests, beliefs and behavioral intentions are hypothesized to have considerable influence on identifying the potential target groups to increase ridesharing. To achieve this main research goal, following research objectives were aimed:

(i) to carry out a literature review for ridesharing concept,
(ii) to collect and analyze data for understanding commuting traveling behavior for university campus access,
(iii) to analyze attitudes towards existing and potential alternative transportation program; ridesharing,
(iv) to provide conclusions and recommendations based upon the research findings and,
(v) to provide recommendations for further research.

1.3. Contribution of the Thesis

This thesis paper contributes to the existing literature on ridesharing concept in general and attitudes toward ridesharing in particular. It introduces a behavioral modeling approach that investigates the potential for ridesharing, distinguishing the roles of passenger and driver, and it examines how demand for ridesharing may differ between passenger and driver during their arrival to Boğaziçi University. Here, contributions must be listed;

(i) What are the travel characteristics of the respondents (Boğaziçi University's members) in the designed survey?

(ii) Is the ridesharing an alternative transportation mode for Boğaziçi University?

(iii) What are the barriers for ridesharing?

(iv) When, where, and how does ridesharing become a feasible transportation mode?

1.4. Scope and Limitations

This research aims to investigate attitudinal variables which have considerable influence on ridesharing by using face to face questionnaire at Boğaziçi University, North, South and Hisar Campuses. Respondents of the survey are students (undergraduate - graduate), academicians and administrative staff at referred campuses. The survey study was executed between February 23, 2017 and March 3, 2017.

In the analysis part of the research, some data were eliminated from 607 to 527 individual outcomes to conduct the questionnaire analysis in order to have a trustworthy logit model.

1.5. Thesis Outline

Next chapter focuses on the literature review about ridesharing concept and the previous studies. Then, within Chapter 3, the methodology of the study is explained with the relevant theory as well as the proposed framework. It is followed by the preliminary data analysis and statistics of the questionnaire in Chapter 4. The model development and its interpretations are presented in Chapter 5. Finally, conclusions and recommendations regarding the ridesharing concept introduced in this thesis are provided in Chapter 6.

2. LITERATURE REVIEW

2.1. Ridesharing in Literature

Records of ridesharing go back almost as old as the invention of the automobile itself and it went beyond the golden age of the late 70's consistent with MIT's research publication on (Research, MIT "Real-Time" Rideshare, 2009). Researchers have various claims on the period that is the start point of the ridesharing depending on several reasons.

2.1.1. Definition of Ridesharing

Researchers and policy makers have also proposed different definitions and notions for ridesharing. For example, Amey (2010) focuses on the three characteristics of ridesharing while proposing his definitions. Those Amey (2010) are the smaller vehicle capacities, focusing on the drivers' need and the lack of the motivation for profit for the participants. Thus, Amey (2010) defines the concept of rideshare as "the transportation of two or more individuals in a motor vehicle with a capacity not exceeding 15 passengers, when such transportation is incidental to the principal purpose of the driver, which is to reach a destination, and when such transportation does not seek to transport persons for profit". Furuhata *et al.*, (2013) on the other hand, offers a simpler definition for ridesharing as "the joint trip of at least two people in a shared vehicle" while focusing on the details of the management of the process. The authors puts rideshare under two main categories; organized and unorganized. The former includes the ridesharing that does not need any previous communication such as riding with family members or hitchhiking. The latter category needs prearrangements and an agency to offer ride matching opportunities (Dailey *et al.*, 1999). The officials of the State of Virginia, similar to Amey (2010) point out the non-profit format of ride sharing and prominent needs of the driver. They define it as "the transportation of people in a motor vehicle when such transportation is incidental to the principal purpose of the driver, which is to reach a destination and not to transport people for profit" (Code of

Virginia, 1989). Another definition stated by the State of Colorado is "the vehicular transportations of passengers traveling together primarily to and from such passengers places of business or work or traveling on a regularly scheduled basis with a commonality of purpose (shopping, health, educational, religious, athletic or sports facilities), if the vehicle used in such transportation is not operated for profit by an entity primarily engaged in the transportation business and if no charge is made other than that reasonable calculated to recover the direct and indirect costs of the ridesharing arrangement, including, but not limited to, a reasonable incentive to maximize occupancy of the vehicle. The term includes "ridesharing arrangements" commonly known as carpools and vanpools; however, this term does not include school transportation vehicle operated by elementary and secondary schools when they are operated for the transportation of children to or from school or on school-related events" (Colorado Revised Statutes, 2002). This definition taking the driving motivation of the "rider" into consideration separates this one from the other definitions.

2.1.2. History of Ridesharing

Nelson and Shahen (2012) explain the history of ridesharing in five major stages. It starts with the "Car-Sharing Clubs" which was built after the World War II. This period is between 1942 and 1945. It was a government-led action for a workplace to arrange ridesharing for its worker to conserve rubber for military reasons. The systems and tools were created in order to match the passengers and riders at the workplace such as Car Sharing Club Exchange and Self-Dispatching System. A bulletin board was used to match people, which was functioning just like an internet notice board.

The third phase is the early organized ridesharing schemes lasting from 1980 to 1997. Even though the telephone communication and internet technology to improve the ride-matching tools started to develop in this stage, the ridesharing lost its importance thanks to the lower oil costs. The focus was shifted from energy saving to the reduction of the traffic jam in the suburban office park, this was also the main motivation for ridesharing before the Arab oil embargo.

The fourth stage reliable ridesharing systems are the following. The ridesharing systems were facing the problem of creating consistent users that would bring sustainability. Thus, after the period between 1999 and 2004, the systems focused on the most reliable trips which were powered by the ride matching via the internet. It is the period where the ridesharing systems started to take place in online platforms. It became more organize and easy to find a prearranged matching.

The last stage is still an ongoing period from 2004 to present, which was named as the technology-enabled ride matching when the online platforms dominated the ridesharing industry. The communities started to be established based on the ridesharing platforms rather than websites, bringing people together with social networks.

2.2. Real-Time Ridesharing

Rideshares were conventionally arranged between two parties that are not related to one another in order to have a long-term and inflexible commute. In these arrangements, departure times and driver responsibility were fixed. But nowadays we are able to talk about "real-time" ridesharing also known as "dynamic" ridesharing or "technology-enabled" ridesharing that allows the two parties meet for occasional, short-term and flexible shared rides (Amey, 2010).

Formal definitions that have been brought out throughout real-time ride sharing's history focus on these aspects of the rides: they are "one-time" trips that happen occasionally and a little-advanced notice is needed when attempting to arrange a shared ride (Amey, 2010).

To be able to use "real-time" ridesharing services, people need similar set of technologies and features. Smart phones are vital features for real time ridesharing with their user-friendly and attractive interfaces. Another technology for real-time rideshare is a constant internet connection. Smart phones are important because of their access to the internet. The internet enables the rider and the driver to communicate, post their demands and requests, share their location and schedule. And for us to be able to send and receive locations, our devices need to be location aware. We need our smart phones to have Global Positioning System (GPS) so our location information is automatically published when we log in our trips. This feature is also crucial to save us time. The last feature is ride matching algorithm which is used by all systems to match riders and passengers. Algorithms may base their matches on origin and destination information or on the common route shared by the rider and the passenger (Amey, 2010).

In conclusion, real time rideshares are organized by the services that work on GPS and Internet-enabled smartphones just minutes before the trip takes place. Drivers inform others by posting their routes and passengers post their request rides just minutes before their desired departure time or even end-route. Ride matching algorithms match the two parties and send notifications to their smartphones (Nelson *et al.*, 2012).

Instead of posting long-term and inflexible ridesharing information, demands and offers systems could be more beneficial. For instance, someone with no car stays late for an overtime in the office. When it is time to leave the office, that person can either walk home for 40 minutes or walk for 15 minutes to the bus stop, wait for the bus for 10 minutes and have a 25 minutes bus ride. But instead, he or she can use an internet-enabled smartphone with GPS that automatically receives the location. Then he or she can pin the location of the destination -which can be home or somewhere else- as the arrival address and search for drivers that will be taking the same route and willing to pick that person up. At the end, he or she would be home without the hassle of walking or waiting for the bus to come.

Real time rideshares diminish the inconvenient aspects of traditional carpooling and vanpooling. It is advantageous when compared to the traditional rideshares since it is technology based, flexible, occasional and short term. It also provides feedback, rating and self-evaluation opportunities. Passenger's pick-up and drop-off locations do not have to be exactly the same as the car driver, a passenger only needs to be on the route of the driver's original trip (Furuhata *et al.*, 2013). But to be able to use its advantages most ridesharing services, need a high subscriber base (Nelson *et al.*, 2012).

2.3. Traffic Psychology on Ridesharing

Several studies have been conducted regarding the psycho-social motivations of dynamic ridesharing preference (Horowitz and Sheth, 1978; Oppenheim, 1979). Oppenheim (1979) stated that the personal, psychological and social motivations play an important role during ridesharing process. For example, potential limitations to the sense of independence or necessity to change public actions affect to what extent a person would choose ride sharing services. According to the studies conducted by Horowitz and Sheth (1978) and Oppenheim (1979), it is revealed that people who use ridesharing services graded these services as more easily accessible, dependable, and comfortable compared to solo drivers. Despite those attitudinal differences between the people preferring ride sharing and solo drivers, both groups perceive ridesharing to be beneficial in terms of air pollution, traffic congestion, and noise nuisance.

Similar to the previously mentioned studies, Margolin and Misch (1978) found that social interaction with the passengers, necessity to change the actions in a more plausible way when there is a stranger, potential lack of independence and being in a passenger or driver position outweigh the benefits of car share on account of the decreased cost and easy access. A study conducted by Glazer and Curry (1987), also supports these findings by stating that sense of freedom is the most indicated reason for solo drivers not to prefer ridesharing services. Even among the people who tend to use ridesharing services, most of the people stated that they would be only willing to share the ride with a family member (Flannelly and McLeod, 1990).

In contrast with the sociopsychology based explanations, Morales Sarriera *et al.*, (2017) suggests that travel time, travel cost and comfort are the key factors for the majority of people to use dynamic ridesharing; to be more specific, most of the users indicated that they find dynamic ridesharing faster and cheaper. Likewise, the potential users confirmed that dynamic ridesharing services appeal to them due to the above-mentioned factors (Morales Sarriera *et al.*, 2017). Even though socializing opportunities are important for people when choosing to use dynamic ridesharing services, they are not as predominant as time and cost concerns; that is, people are motivated by the idea of meeting with new people for networking purposes or having good time during the ride but sharing the costs and decreasing the ride duration are more important for them to use ridesharing services (Sarriera *et al.*, 2016). As a matter of fact, potential benefits which can be reaped from a socially interactive ride sharing experience seems to be weighed out by the prospect of having an unfavorable interaction during decision-making process (Sarriera *et al.*, 2016). Also, the study of Morales Sarriera *et al.*, (2017) reveals that most of the users hold negative attitudes towards the passengers with different racial and socioeconomic backgrounds. Moreover, the users indicated that they would like to be informed more. Some passengers may positively value the opportunity to interact with new people, while others may consider these interactions inconvenient, unsafe, or even as an unpleasant experience during which they are subject to discrimination from fellow passengers because of their passenger matches made via applications. Lastly, especially the women riders consider the safety as a key deterring factor for using dynamic ridesharing services and stated that they would feel safer in the case of matching with the same gender (Sarriera *et al.*, 2016).

Safety concern is one of the most deterring factors regarding ride sharing preferences according to several studies (Correia *et al.*, 2010; Sarriera *et al.*, 2016). According to Correia and Viegas (2011), especially in cities where potential danger exists and harmful events take place, loss of trust arise and in return, people feel unsafe. Although having a chance to know random people during the ride is an incentive for the ride sharing, there are still many people find this interaction uncomfortable and dangerous. However, this study also suggests that some of the respondents feel safer in the case of driving with someone else in the car rather than driving alone. Finally, gender difference was found in terms of safety issues; that is, female respondents indicated higher levels of safety concerns compared to their male counterparts (Sarriera *et al.*, 2016)

2.4. Ridesharing Implementations around the World

As mentioned in detail in the previous heading, ridesharing is a service that organizes on-demand shared rides on very short notice, usually arranged through smartphone applications. These rides make use of three recent technological advances such as GPS navigation devices, smartphones, and social networks. Smartphone apps have been created around these technologies helps riders to match with a driver, who then meet and share their ride. The most well-known companies in this sector are Uber, Lyft, and Sidecar; considered to be the best ride sharing companies in the transportation industry.

Table 2.1. Comparison Table of Well-Known Ridesharing Companies (Natasha, 2015).

	Uber	**Lyft**	**Sidecar**
Driver Screening and Vehicle Safety	Criminal record and driving record check; vehicles average from 2008, none older than 2000	Criminal record and driving record check; vehicles must be 2003 or newer, 2005 in a few states	Criminal record and driving record check; cars must be 2000 or newer
Pricing	Metered, Uber Pool fares are discounted and you're given a flat rate at the time of booking	Metered, Lyft Line fares are discounted 10-60% and you're given a flat rate at the time of booking	Flat fare; drivers Name their price
Regions Covered	58 countries and most major U.S. cities	59 cities in the U.S.	10 U.S. cities including LA, SF, Boston, Chicago, Washington D.C.
Maximum Passengers	2 on UberPool, 4 on UberX, more if you choose the pricier Uber Lux	2 on Lyft Line, 4 on Lyft, 6 if you choose Lyft Plus	4 as standard, extra seats able to be requested
Disability Access	Yes	Yes (but must usually be requested 24 hours in advance)	No

While these companies are big stakeholders in the rideshare industry, there are a number of other companies from around the world. Industry leaders and other companies are introduced below;

- Uber is an on-demand car service that allows users to request a ride through their smartphone applications. As the first ridesharing company in the industry, Uber has established itself in the ridesharing market as the leading player. With Uber, people can even get a private car, taxi or rideshare throughout smartphones.

Payment is made with the credit card attached to your account.

Uber is currently available in 72 countries which are United Arab Emirates, Argentina, Austria, Australia, Azerbaijan, Belgium, Bulgaria, Bahrain, Brazil, Bahamas, Belarus, Canada, Switzerland, Chile, China, Colombia, Costa Rica, Czech Republic, Germany, Denmark, Dominican Republic, Estonia, Egypt, Spain, Finland, France, United Kingdom, Greece, Hong Kong, Croatia, Hungary, Indonesia, Ireland, Israel, India, Italy, Jordan, Japan, Kenya, South Korea, Lebanon, Sri Lanka, Lithuania, Morocco, Macao, Mexico, Malaysia, Nigeria, Netherlands, Norway, New Zealand, Panama, Peru, Philippines, Pakistan, Poland, Portugal, Qatar, Romania, Russia, Saudi Arabia, Sweden, Singapore, Slovakia, Thailand, Turkey, Taiwan, United States, Uruguay, Vietnam, and South Africa.

- BlaBlaCar is a British originated ridesharing service that links drivers who have empty seats with a passenger looking for a ride. BlablaCar serves ride-matchings in 22 countries around the world. By using web or mobile application of BlablaCa; after choosing departure and arrival destination, the program matches you with drivers who travel in the same direction.

  BlablaCar is used commonly for intercity trips with fixed departure time and driving responsibilities (Amey, 2010). Available in Belgium, Brazil, Czech Republic, Germany, Spain, France, United Kingdom, Croatia, Hungary, Ireland, India, Italy, Mexico, Netherlands, Poland, Portugal, Romania, Serbia, Russia, Slovakia, Turkey, and Ukraine (Rideguru, 2017).

- Lyft is an on-demand, peer to peer, ridesharing service that connects passengers who need a ride with available drivers in the community. Lyft cars are available to be hailed through the Lyft smartphone app. Once a Lyft driver is requested through the Lyft app, the rider will be able to track their driver through the app and will receive a text notification when their ride has arrived.

  Lyft is a privately held American transportation company with an exclusive mobile application facilitating peer to peer ridesharing by means of connecting passengers who need rides from drivers with available cars. Payment is made with the credit card attached to your account. Lyft is used easily for daily trips and available in United States (Rideshareapps, 2017).

- Sidecar is a smartphone application that matches people for shared rides. Sidecar is currently just continuing along with minimal growth but is the next ridesharing company that will reach success. The only difference of Sidecar from Uber and Lyft is the way of payment. Sidecar allows users to set their own pricing and offers up-front pricing, therefore, participant knows exactly the price of the shared ride (Rideshareapps, 2017).

Real-time ridesharing applications used for travel sharing in Turkey, except Blabla Car, are introduced below;

- Volt is a mobile application which offers shared rides within the city of İstanbul. After downloading the app, the user should set a route that is intended to be used. If a driver also sets the route and offer his/her seats, they became matches and if both sides agree, they get in touch. In order to solve the security problems, the app has varied community groups such as a university group or a workplace. They do not accept any members to this group unless they verify their institutional identity such as university mails. Thus, people can only have passenger and driver matches within their own group. This creates a safer environment for people to participate. The driver and passenger can also share the cost of the ride via the app. The main motivation for the creating this app is to solve the traffic problem (Volt, 2016).
- Yolyola is a social entrepreneurship that aims to bring people together who travel to the same direction so they can share their ride instead of traveling in separate commutes. This way, in cities like İstanbul that deal with heavy traffic fewer vehicles will be on the roads. They claim they will help to reduce traffic, reduce natural pollution and become an economically alternative travel (Yolyola, 2016).
- Twogo is an on-demand, peer to peer, ridesharing service in which drivers and passengers enter their preferred starting point, destination and arrival time and the application analyze trips from all users. Twogo also identifies the best matching vehicle pool, even the exact roots and factors in real-time traffic data to calculate arrival times (Twogo, 2017).

3. METHODOLOGY

The study is focused on traveler tendency towards ridesharing. A set of revealed and stated preference data was obtained to facilitate the calibration of models. The collected datasets are socioeconomic characteristic, travel characteristics and ridesharing perceptions of respondents. After data collection, preliminary analysis of data was done by descriptive statistics analysis which shows the relationship between independent variables and their frequencies. Binary logit models were used due to the possible correlation between attitudes made by travelers. Details of the theoretical approach, the methodology and the statistical tests used for each part are explained in the sections of this chapter.

3.1. Data Collection

3.1.1. Information about Boğaziçi University, Turkey

Boğaziçi University is one of the oldest educational institutions in Turkey, established in 1863. The university operates on six campuses in İstanbul. Four of these campuses; South Campus, North Campus, Hisar Campus, and Uçaksavar Campus are within walking distance to each other, located on a hill in the Hisarustu district of Bebek, Besiktas. Kandilli campus is located in Uskudar, Asian side and Saritepe campus is located in Kilyos, Sariyer district in the Northwest of İstanbul.

South Campus is the historical campus of Boğaziçi University situated on a hill overlooking the Bosphorus and the fortress at Rumeli Hisari. It houses the main cultural centers, two dormitories, offices and some of the academic departments such as political science and mechanical engineering departments. North Campus houses the main library, sciences and engineering faculty, computer science, school of foreign languages, molecular biology and genetic buildings of the university with their laboratories. Hisar Campus houses the school of applied disciplines, institute of environmental Sciences buildings of the university. The campus also includes sports centers. Ucaksavar

Campus has housing facilities for the academic staff members' as well as two dormitories for students (Superdorm and Uçaksavar Dorm). There is a sports complex with a stadium and fully equipped gym (BOUN, 2017)

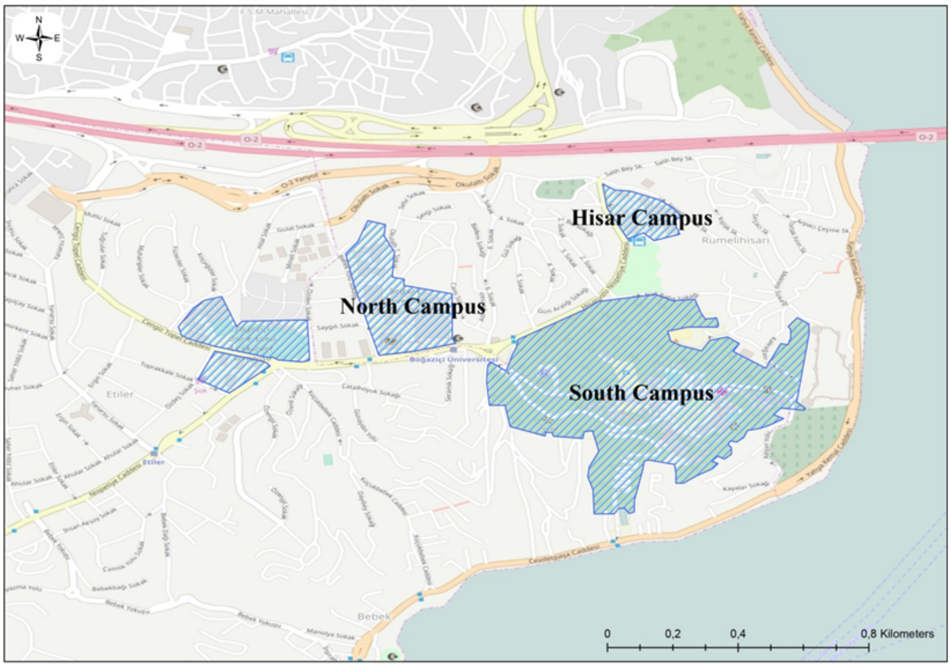

Figure 3.1. Location of the Boğaziçi University Campuses in Hisarustu District.

Inter-campus travel is quite extensive as university facilities and student residences are spread over these campuses. Basal transportation modes used for these trips are walking and shuttle buses (Bayrak, 2014).

There are various ways to access to Hisarustü district; Boğaziçi University campuses, such as 1 metro line, 6 bus lines and staff shuttle services for academic and administrative personnel (free of charge).

3.1.2. Population and Sample Size

Establishing the overall sample size is a key component of the sampling design. The sample size is generally calculated based on either precision requirements, such as limits on variance, or cost requirements. The type of sampling design and prior knowledge about the expected sample outcomes both play a role in sample size determination.

A survey study was developed for Bogazici University, South, North and Hisar Campuses. Revealed and Stated preference data are collected by distributed questionnaire. In those three campuses, there are 9020 undergraduate students, 4264 graduate students, and 718 academics according to “Fact and Figures: Boğaziçi University 2015” (Boğaziçi Üniversitesi-Statistics, 2015).

Yamane contributes a simplified formula for sample size determination to be 527 persons for the 95% confidence level according to Yamane formula for sample size determination (Yamane, 1967). Where n is the sample size, N is the population size and e is the desired margin of error.

$$\mathrm{n} = \frac{\mathrm{N}}{1 + \mathrm{N}(\mathrm{e})^2} \tag{3.1}$$

By applying this formula, the sample size was determined to be 390 people. A sample size of 527 was taken to stay on the safe side and all this data was used for analysis.

3.1.2.1. Stratified Random Sampling. If the population is divided into subgroups which are homogeneous and mutually exclusive, then independent samples might be selected from each group. Each of these groups is called strata ($N_1, N_2 ... N_L$) and the method is called stratified sampling. The sample sizes within the strata are indicated by $n_1, n_2 ... n_L$ respectively. The whole procedure is described as stratified random sampling providing that random sample is taken in each stratum.

Inclusion probabilities usually vary from stratum to stratum; it depends on how the sample is allocated to each stratum. To calculate the inclusion probabilities for most sample designs, the size of the sample and the size of the population in each stratum must be considered (Frankin *et al.*, 2003). Proportionate allocation is often a desirable choice when the sampling goal is to generate estimates that apply to the entire population. Under this allocation, the rate of sampling in each stratum is equal:

(Cochran, 1977).

3.1.2.2. Proportionate Stratified Random Sampling . In proportionate stratified sampling, the number of elements allocated to the various strata is proportional to the representation of the strata in the target population. That is, the size of the sample drawn from each stratum is proportional to the relative size of that stratum in the target population.

The same sampling fraction is applied to each stratum, giving every element in the population an equal chance to be selected. The resulting sample is a self-weighting sample. This sampling procedure is used when the purpose of the research is to estimate a population's parameters. The sample size of each stratum in this technique is proportionate to the population size of the stratum when viewed against the entire population. This means that each stratum has the same sampling fraction.

One approach for allocation is proportionate stratification. With proportionate stratification, the sample size of each stratum is proportionated to the population size of the stratum. Strata sample sizes are determined by the following equation where n_h is the sample size of stratum h, N_h is the population size for stratum h, N is total population and n is total sample size:

$$n_h = \left(\frac{N_h}{N}\right) n \tag{3.2}$$

when the population used in this study is invaded, individuals of Boğaziçi University can be divided into sub-populations according to their statuses such as students, academicians, and administrative staff. Total sample size was taken 527 persons by exceeding the number in Yamane Formula (Yamane, 1967). In order to determine the sample size of each stratum, proportionate stratified random sampling was used. According to this sampling method, 455 respondents belong to student's strata, 32 respondents comes from academician's strata and 40 respondents come from administrative staff's strata.

3.1.2.3. Focus Group Discussion. Focus Group Study is a structured qualitative data collection method. It enables the determination of the needs of the participant and the proposal of the development plan. This study collects information on participants' perceptions, mental schemes, emotions and motivations in specific subjects. The aim of the study is to be able to deepen the information on the surface and to find the troublesome answers in the environment or experience. Especially in the context of the subjects in need of development studies, it is important to work in more detail to achieve consciousness and unconscious data (Davranis Bilimleri Enstitüsü, 2016).

A focus group study of 23 people was undertaken before the questionnaires were prepared to observe participants' approaches to ridesharing and to discuss the concept in many respects. In this context, a mini questionnaire of ten questions was conducted and data were obtained. The points drawn in this study played a leading role in shaping the survey questions.

When choosing among transport modes and services, the important attributes for the local residents were found out as travel time, time variability, travel cost, frequency, etc. There are also some attitudinal factors possibly affecting people's preference, such as comfort, privacy, flexibility, convenience, environmentally friendly, and security. A number of factors have been identified through focus group discussions, which are as follow;

- Loss of independence and the possibility of conflicts,
- Long travel time on peak hours, lack of reliability and security,
- Less flexibility,
- Reliability and precision,
- Low costs and environmentally friendly,
- Good option when public transport was not frequent,
- Good for transportation of people with disabilities.

3.1.3. Collection of Data for Survey

All the data required for the study were collected from the undergraduate-graduate students, the academic and administrative staff of Boğaziçi University throughout North, South and Hisar campuses. The survey was conducted to investigate commuting behavior, to evaluate existing transportation modes and to analyze the potential use of ridesharing in conjunction with attitudes toward this alternative transportation mode.

The most common types of field questionnaire surveys are Revealed Preference (RP) surveys and Stated Preference (SP) surveys. Traditionally, analysis of preference and behavior were based on the RP method (Sivakumar *et al.*, 2006), in which the observation was made on the existing transportation systems. SP surveys refer to asking respondents about their preferences, choices, frequencies of use, and so on, while revealed RPs refer to actual choices (Louviere *et al.*, 2000). The questionnaire consists of two sections including revealed preference data and one section including stated preference data:

(i) Travel characteristic considering the latest trip to campus, including departure location, departure/arrival time, travel time, transportation mode and frequency, transfers and travel cost. Since the trips from the campus vary greatly according to the day and time, only one-way transport to the campus trip data of the individuals were collected. Additionally, respondent's residential information was collected in order to have data about whether they were in the public transport impact area or not.

(ii) Socio-economic characteristics such as age, gender, educational level, role at the university, car ownership, income, etc. were collected.

(iii) Attitudes toward ridesharing as an alternative transportation option. Questions were asked to measure the knowledge and perception of the individuals on ridesharing. It was intended to reveal the factors that they could see as a deterrent while using any ridesharing application.

The questionnaire was distributed randomly to the selected individuals from three campuses. In total, 604 individuals participated in the survey, in which there were only 527 qualified responses since the rest were either inaccurate or incomplete. The data set comprises of some characteristics that categorized into different distinctive categories which were socioeconomics, travel, and opinions about ridesharing. A detailed explanation will be given in the descriptive features section.

3.2. Logistic Regression

The purpose of the logistic regression analysis is to predict the value of the categorical dependent variable so that it is the "membership" estimate of two or more groups. Accordingly, it can be said that one of the aims of the analysis is to investigate the association between the dependent and independent variables (Mertler *et al.*, 2005). If we are interested in a dependence form with a dependent variable and set of investigated variables, logistic regression emerges as an appropriate and convenient method.

While we are trying to estimate the membership, if the dependent variable is a categorical variable with two options, it is called "Binary Logistic Regression Analysis". If the dependent variable is a multi-category variable then it is called "Multinomial Logistic Regression Analysis" (Field, 2005).

In this study, binary logistic regression analysis was performed owing to the type of dependent variables. SPSS Statistics Software that is a widely-used program for statistical analysis was used due to developing model. In this study, we worked with IBM SPSS Statistics version 23. SPSS Statistical Software is a widely used program for statistical analysis. Logistic regression analyses performed in this study were also made using IBM SPSS Statistics 23 version.

3.2.1. Binary Logistic regression

Binary logistic regression is a method used when a dependent variable contains two categories (Denham, 2016). To explain the theory binary logistic regression analysis in an intelligible way, it is necessary to mention linear regression analysis.

In simple linear regression, estimation equation of the outcome variable Y, is stated below:

$$\mathrm{Y_i}=\beta_0+\beta_1\mathrm{x_i}+\varepsilon_\mathrm{i} \tag{3.3}$$

in which "β_o" is the interception at y-axis, "β_1" is the gradient, "x_i" is the value of the predictor variable and ε is an error term. When Y and "x_1" values are given, the unknown parameters in the equation can be estimated by using least squares method. When there is only one predictor variable X, the logistic regression equation from which estimates the probability of Y is given by (Field, 2005). The logit model has the formula of;

$$\mathrm{Logit\,(P)} = \log(\frac{\mathrm{P}}{1-\mathrm{P}}) \tag{3.4}$$

where Let Y be a binary response variable, Y=1 if the event is present in observation, Y=0, if the event is not present in observation, Let X be a set of investigated variables that can be continuous, discrete or a combination X = ($\mathrm{x_1,x_2,x_3,\ldots x_k}$)

$$\mathrm{P_i}= \mathrm{Pr\,(Y = 1 \quad X =x}_i) \tag{3.5}$$

then the model can be inscribed as:

$$\mathrm{Logit}\left(\frac{\mathrm{P_i}}{1-\mathrm{P_i}}\right) = \mathrm{logit(P_i)} = \beta_0+\beta_1\mathrm{x_i} \tag{3.6}$$

$$\frac{\mathrm{P_i}}{1-\mathrm{P_i}} = \exp(\beta_0+\beta_1\mathrm{x_i}) \tag{3.7}$$

$$\mathrm{P_i} = \frac{\exp(\beta_0+\beta_1\mathrm{x_i})}{1+\exp(\beta_0+\beta_1\mathrm{x_i})} \tag{3.8}$$

in which P(Y) is the probability of Y occurring, exponential is the base of natural logarithm base, and the other coefficients form a linear combination much the same as in simple regression. The bracketed portion of the equation is matching with the linear regression equation.

3.2.2. Multinomial Logistic Regression

Multinomial logistic regression is another method that used basically when a dependent variable contains more than two categories. Multiple logistic regression analysis is similar to multiple regression, as the linear logistic regression analysis is similar to the linear regression.

In multiple linear regression, the outcome variable Y is predicted from the equation below:

$$\mathrm{Y_i} = \beta_0+\beta_1\mathrm{x_i}+\beta_2\mathrm{x}_{i_2}\ldots+\beta_\mathrm{n}\mathrm{x}_{i_n}+\varepsilon_\mathrm{i} \tag{3.9}$$

As with the linear regression, it is possible to extend this equation to incorporate several predictions. When there are several predictors the equation becomes:

Then the model can be written:

$$\mathrm{P_i} = \frac{\exp(\beta_0+\beta_1\mathrm{x_i}+\beta_2\mathrm{x}_{i_2}\ldots+\beta_\mathrm{n}\mathrm{x}_{i_n}+\varepsilon_\mathrm{i})}{1+\exp(\beta_0+\beta_1\mathrm{x_i}+\beta_2\mathrm{x}_{i_2}\ldots+\beta_\mathrm{n}\mathrm{x}_{i_n}+\varepsilon_\mathrm{i})} \tag{3.10}$$

in which P(Y) is the probability of Y occurring, exponential term is the base of natural logarithms, and the other coefficients form a linear combination much the same as in simple regression except $ß_n$ which is regression coefficient of x_{in}.

3.2.3. Assumptions of Logistic Regressions

When the binomial logistic regression was chosen as an analysis method, part of the process involves checking whether the data obtained are suitable for the desired model.

First, the dependent variable should be measured on a dichotomous scale which means to have a binary outcome. Examples of dichotomous variables include yes/no answer's questions, gender ("males" and "females") etc. Independent variables can be either continuous (interval or ratio variable) or categorical (nominal or ordinal).

- Linearity: ordinary regression, a linear relationship between outcome and the predictors were assumed yet, in logistic regression the outcome is categorical thus this assumption is violated (Field, 2005). This is the main reason why the logit of the data was used. This assumption can be tested by checking whether the interaction term between the predictor, and its log transformation is significant (Hosmer and Lemeshow, 1989).
- Independence of errors: Basically, it means that cases of data should not be related; for example, you cannot measure the same people at different points in time. Violating this assumption produces over dispersion.
- Multicollinearity: Multicollinearity is a problem as it was for ordinary regression. Predictors should not be too highly correlated. As with ordinary regression, this assumption can be checked with tolerance and Pearson correlation values, VIF statistics, the eigenvalues of the scaled, uncentred cross-products matrix, the condition indexes and the variance proportions (Field, 2005).

3.3. Spatial Data Collection by Using ArcMap

This section describes the use of ArcMap, a central application used in ArcGIS, in this work. ArcMap is a modality that displays data sets in map workings where points are dropped within a specified study area. ArcMap is also used to create data sets and organize them by representing geographic information as layer collections and other items in a map.

The data collected with the questionnaire survey has coordinates of the points where the respondents started their trip to the campus. The coordinates of these points, metro stations, and metrobus stations are prepared so that they can be input data into ArcMap. The purpose of using the coordinates of metrobus and metro stations is to determine how much of the people who get to the campus stay in the impact area of transit public transport.

The influence area of the stations was determined by drawing a circle with the station being the center (Gokasar *et al.*, 2016). The radius of the circle for semi-rapid transit mode is used as 1/2 miles, which is the primary catchment area (Group, APTA Standards Development Urban Design Working Group, 2016). The points inside and outside these circles were coded as 1 and 0 respectively. Using this data, the effect of being in the impact area of transit public transport on ridesharing was investigated.

4. ANALYSIS AND RESULTS

4.1. Preliminary Analysis of Data

4.1.1. Descriptive Results of Survey Data

Descriptive statistics are used to describe the basic characteristics of the data in a study. It provides simple summaries of examples and measures. Along with simple graphical analysis, they form the basis for almost every data quantitative analysis.

The questionnaire used in this research aims at students, academicians, and staff who are located in the campuses of the Boğaziçi University in Hisarüstü district. In total, there were 527 respondents to the questionnaire study. 72 (16%) of the Respondents were university staff (both academic and administrative) and the remaining part was students.

In this section, the data obtained with the survey study were examined under the headings of socio-economic, travel characteristics and attitudes related to ridesharing with their frequencies.

4.1.1.1. Socioeconomic Results. Table 4.1 shows gender distribution of the respondents. Although information of actual gender distribution of all staff is unknown, the gender distribution of student is published in “Fact and Figures: Boğaziçi University 2015” (Boğaziçi Üniversitesi - Statistics., 2015). According to the figures in the published report, there is a probability that males were overrepresented in the study compared to the ratios published, male 53% and female 47%.

Table 4.1. Gender Distribution of the Respondents.

Gender	Academic Staff		Administrative Staff		Student	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Male	20	62.50%	12	30.00%	277	60.88%
Female	12	37.50%	28	70.00%	156	34.29%
Total	32	100.00%	40	100.00%	455	100.00%

Age distributions of the respondents were presented in Table 4.2. As expected, age distribution of the students was concentrated between 20 ages and 24 ages. For age distribution of staff, 57.8% of the staff was under the age of 40. It can be claimed that majority of the staff consists of young and middle-aged people.

Table 4.2. Age Distribution of the Respondents.

	Academic Staff		Administrative Staff		Student	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Under 20	0	0.00%	1	2.50%	48	10.55%
20-24	4	12.50%	5	12.50%	348	76.48%
25-29	11	34.38%	2	5.00%	56	12.31%
30-34	3	9.38%	8	20.00%	2	0.44%
35-39	3	9.38%	5	12.50%	0	0.00%
40-44	4	12.50%	9	22.50%	0	0.00%
45-49	3	9.38%	6	15.00%	1	0.22%
50-54	0	0.00%	3	7.50%	0	0.00%
55-59	1	3.13%	1	2.50%	0	0.00%
60-64	0	0.00%	0	0.00%	0	0.00%
Over 65	3	9.38%	0	0.00%	0	0.00%
Total	32	100.00%	40	100.00%	455	100.00%

Table 4.3 shows income distribution of the respondents. An expected result is many of the students (80.44%) are below 2000 Turkish Liras.

In this part of the questionnaire, vehicle ownership, number of campus parking permit holders, preferred transportation mode choices for trips to university, travel times and arrival times from university, were investigated. In Table 4.4 vehicle, ownership percentages were given. Corresponding to the data on the campus travel characteristics given in Bayrak's thesis study (Bayrak, 2014), these numbers indicate that the vehicle ownership of the students is low as predicted. This ratio is roughly in half for administrative staff yet majority of the administrative staff are not vehicle owner.

Table 4.5 shows parking permit ownership. Because of the limited parking space in the campuses, student parking permits are not free since staff parking permits are free of charge. Parking permit ownership has ratios proportional to vehicle ownership. There are also those who own a car and do not use university's parking area or not using their car for transportation to campus.

Table 4.3. Income Distribution of the Respondents.

	Academic Staff		**Administrative Staff**		**Student**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Under 500 TL	1	3.13%	3	7.50%	54	11.87%
500-1000 TL	0	0.00%	0	0.00%	146	32.09%
1000-2000 TL	0	0.00%	4	10.00%	166	36.48%
2000-3000 TL	2	6.25%	18	45.00%	45	9.89%
3000-4000 TL	12	37.50%	10	25.00%	24	5.27%
4000-5000 TL	6	18.75%	3	7.50%	14	3.08%
5000-6000 TL	2	6.25%	1	2.50%	1	0.22%
6000-7000 TL	5	15.63%	1	2.50%	1	0.22%
7000-8000 TL	1	3.13%	0	0.00%	0	0.00%
8000-9000 TL	2	6.25%	0	0.00%	0	0.00%
9000-10000 TL	1	3.13%	0	0.00%	0	0.00%
Over 10000 TL	0	0.00%	0	0.00%	4	0.88%
Total	32	100.00%	40	100.00%	455	100.00%

Table 4.4. Vehicle Ownership of the University Respondents.

	Academic Staff		**Administrative Staff**		**Student**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Vehicle Owner	17	53.13%	16	40.00%	86	18.90%
Not Vehicle Owner	15	46.88%	24	60.00%	369	81.10%
Total	32	100.00%	40	100.00%	455	100.00%

Table 4.5. Parking Permit Ownership of the Respondents.

	Academic Staff		**Administrative Staff**		**Student**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Has a parking permit	16	50.00%	15	37.50%	42	9.23%
Do not have a parking permit	16	50.00%	25	62.50%	413	90.77%
Total	32	100.00%	40	100.00%	455	100.00%

4.1.1.2. Travel Statistics. The number of days that respondents go to university was also investigated. Results were shown in Table 4.6, the majority of the administrative staff go to university every weekday. 58.90% is the lowest every weekday attendance rate, found for the students

Table 4.6. Number of Days that Respondents go to University.

	Academic Staff		**Administrative Staff**		**Student**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
1 day per week	0	0.00%	3	7.50%	16	3.52%
2 days per week	3	9.38%	1	2.50%	31	6.81%
3 days per week	5	15.63%	0	0.00%	52	11.43%
4 days per week	2	6.25%	1	2.50%	88	19.34%
5 days per week	22	68.75%	35	87.50%	268	58.90%
Total	32	100.00%	40	100.00%	455	100.00%

In contrast with the administrative staff, it is seen in Table 4.7 that the majority of the students and administrative staff travel less than 1 hour to campus. The fact that 20% of the students are under 10 minutes of campus access can be interpreted as living in their dormitory or campus area, on the other hand, the administrative staff mostly reside farther away from the campus.

Table 4.7. Total Travel Time for Campus Arrival.

	Academic Staff		**Administrative Staff**		**Student**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Less than 10 min.	3	9.38%	1	2.50%	92	20.22%
10-30 min.	10	31.25%	12	30.00%	143	31.43%
30-60 min.	14	43.75%	15	37.50%	127	27.91%
60-90 min.	4	12.50%	8	20.00%	61	13.41%
90-120 min.	0	0.00%	3	7.50%	28	6.15%
Long than 120 min.	1	3.13%	1	2.50%	4	0.88%
Total	32	100.00%	40	100.00%	455	100.00%

There is no fixed public transit cost for users in İstanbul. It depends on public transport type, fare type and the number of connections made on the transit network (Gokasar *et al.*, 2016) The public transit rates and their types for users shown in Table 4.8 (IETT, 2016). Users pay the public transit fee by buying tokens or using a transit card named "İstanbul Kart", a type of a pre-paid payment system (Gokasar *et al.*, 2015).

Table 4.8. Public Transport Fees in İstanbul.

	Full	**Elderly**	**Student**
First Ride	2.30 TL	1.65 TL	1.15 TL
1 st Connection	1.65 TL	0.95 TL	0.50 TL
2 nd Connection	1.25 TL	0.75 TL	0.45 TL
3 rd Connection	0.85 TL	0.5 TL	0.40 TL
4 th Connection	0.85 TL	0.5 TL	0.40 TL
5 th Connection	0.85 TL	0.5 TL	0.40 TL
Monthly Fee of İstanbul Kart	205 TL	125 TL	85 TL
(Passing units)	(180 units)	200 (units)	200 (units)

Transportation type, transfer numbers and payment type information of the respondents were used in the calculation of the total travel cost. Monthly İstanbulKart users' travel cost for per trip was calculated by dividing the monthly card fee to the maximum unit. The transfer fee without discount, which is the case when changing the second transportation mode for a metrobus ride, was also considered in the calculation. As shown in Table 4.9 students go to the campus with a fee of less than 1 TL with public transport or they make their transportation free of charge which means as a pedestrian. Almost all of the administrative staff go to the campus with staff service (shuttle-bus), which seems to be the case that the vast majority of the administrative staff spent fee below 1 TL.

Table 4.9. Total Travel Cost for Public Transport User.

	Academic Staff		**Administrative Staff**		**Student**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Less than 1 TL	8	50.00%	34	89.47%	185	48.05%
1-2 TL	7	43.75%	2	5.26%	135	35.06%
2-3 TL	1	6.25%	0	0.00%	48	12.47%
3-4 TL	0	0.00%	0	0.00%	10	2.60%
4-5 TL	0	0.00%	0	0.00%	1	0.26%
More than 5 TL	0	0.00%	2	5.26%	6	1.56%
Total	16	100.00%	38	100.00%	385	100.00%

In order to calculate the travel cost of the groups that come to campuses with the private car, the distances of their trip were asked in the survey. By using the value of fuel cost per kilometer (0,34 TL) from Gokasar's research (Gokasar *et al.*, 2016), total travel cost was computed for private car users.

Table 4.10. Total Travel Cost for Private Car User.

	Academic Staff		**Administrative Staff**		**Student**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Less than 1 TL	1	6.67%	1	50.00%	5	7.35%
1-2 TL	2	13.33%	0	0.00%	11	16.18%
2-3 TL	1	6.67%	0	0.00%	4	5.88%
3-4 TL	0	0.00%	1	50.00%	11	16.18%
4-5 TL	0	0.00%	0	0.00%	6	8.82%
More than 5 TL	11	73.33%	0	0.00%	31	45.59%
Total	15	100.00%	2	100.00%	68	100.00%

4.1.1.3. Ridesharing Statistics. A questionnaire study was carried out and several questions were asked about ridesharing concept by defining its characteristic with participants. Statistical results are given in the following tables.

Participants were asked which ones of the existing ridesharing applications they were informed about in Turkey. One of the earliest ridesharing application BlaBlaCar has the highest rate of awareness. Another point that needs to be noted is that the ridesharing concept is mixed with shared-taxi, ride sourcing applications such as Uber and ZipCar. The applications shown as "other" on the Table 4.11 are largely composed of these two applications.

Table 4.11. Ridesharing Application's Awareness.

	Academic Staff		**Administrative Staff**		**Student**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
BlaBlaCar	12	37.50%	9	22.50%	267	58.68%
Volt	3	9.38%	2	5.00%	3	0.66%
Yolyola	0	0.00%	0	0.00%	4	0.88%
BlaBlaCar, Volt	2	6.25%	0	0.00%	33	7.25%
BlablaCar, Yolyola	1	3.13%	0	0.00%	21	4.62%
BlablaCar, Volt, Yolyola	1	3.13%	1	2.50%	12	2.64%
Other	2	6.25%	2	5.00%	6	1.32%
None	11	34.38%	26	65.00%	109	23.96%
Total	32	100.00%	40	100.00%	455	100.00%

As it can be seen in the Table 4.12 below, the usage rate of ridesharing applications is very low. No one in the administrative staff has experience with these applications.

Table 4.12. Rideshare Use Frequency.

	Academic Staff		**Administrative Staff**		**Student**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Never	25	78.13%	40	100.00%	369	81.10%
Only Once	5	15.63%	0	0.00%	41	9.01%
Once in a Year	1	3.13%	0	0.00%	35	7.69%
Once in a Month	0	0.00%	0	0.00%	9	1.98%
Once in a Week	1	3.13%	0	0.00%	1	0.22%
Total	32	100.00%	40	100.00%	455	100.00%

Another important point emerging as a result of the survey is that the attitude of individuals towards ridesharing with people they have never known is rather negative. However, their attitudes towards ridesharing with a person they are in the same university are positive. This situation does not show any difference in participation in ridesharing as a driver and passenger as well as it seen in Table 4.13 and Table 4.14.

Table 4.13. Ridesharing Involvement Attitude as a Passenger.

	Positive Attitude		**Negative Attitude**		
As A Passenger	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Total**
Ridesharing with Foreigners	172	39.18%	267	60.82%	439
Ridesharing with University Member	400	91.12%	39	8.88%	439

Table 4.14. Ridesharing Involvement Attitude as a Driver.

	Positive Attitude		**Negative Attitude**		
As A Driver	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Total**
Ridesharing with Foreigners	27	31.76%	58	68.24%	85
Ridesharing with University Member	71	83.53%	14	16.47%	85

4.2. Spatial Analysis with ArcMap

Neighborhood and street-based home addresses of respondents were converted into coordinates with the help of Google Earth to mark their start of transportation on the map. After that, metro and metrobus station coordinates determined from Google Earth are processed on the map and transit public transport networks are created. Black dots represent the start of the transportation points and respondents on Table 4.15. Metrobus and bus stops are used for the metrobus and metro lines to be imaged, the red circle for the metrobus and the blue circle were formed from stop's coordinates. The percentage of participants who are not located in the transit public transport impact area is shown in the table below.

Table 4.15. Impact Area of Transit Public Transport.

	Academic Staff		Administrative Staff		Student	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
In the impact area of transit public transport.	15	46.88%	26	65.00%	212	46.59%
Not in the impact area of transit public transport.	17	53.13%	14	35.00%	243	53.41%
Total	32	100.00%	40	100.00%	455	100.00%

As seen in the Table 4.15, roughly half of the respondent lives in transit public transport impact area. The percentage increases for administrative staff by 15%.

4.3. Binary Logit Model

This section starts identifying a statistical model, which is used to analyze the results of the binary logit model. The elements of the statistical model are described with particular focus on their relevance to the research question of what factors influence an individual's participation in dynamic ridesharing by using survey data, Binary Logit model has been developed to reveal the effect of behavioral and attitudinal factors on travelers' ridesharing involvement. In this study, two different types of ridesharing involvement, containing ridesharing as a driver and ridesharing as a passenger were analyzed separately. Binary Logit (BL) Model was proposed with two travel behavior; "Interest in Ridesharing Involvement as a Passenger" and "No Interest in Ridesharing Involvement as a Passenger".

As dependent variables, interests in ridesharing involvement were taken. These variables, whose responses are binary categorical data, are designed in such a way that a binary logistic model can be constructed.

The independent variables that were used in the choice model are the answers of the questions about barriers to ridesharing which are also binary categorical data, dummy variable.

Before the model was established, related tests were performed which looked for the presence of correlations between the independent variables and the result were given in the 0 and 0. As it was mentioned earlier; on this table, the "Pearson Correlation" values should be checked.

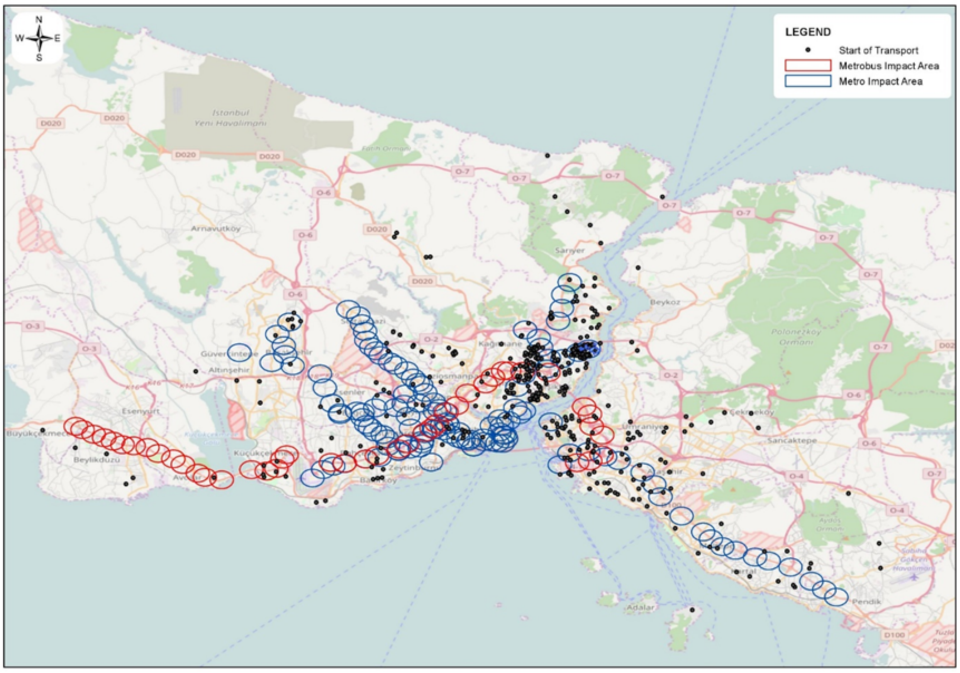

Figure 4.1. Location of the Boğaziçi University Campuses in Hisarustu District.

Pearson's correlation (r) shows that the linear relationship between two sets of data. The coefficient always ranges from -1 to +1, and + 1 means perfect positive and -1 means perfect negative correlations. Across the diagonal there all one, it is because correlating a variable with itself would be perfectly positively correlated. When Pearson's r value is close to 1, this means that there is a strong relationship between the variables. Anything but the value is close to 0, this means there is a weak relationship between the variable which is the condition that we are looking for developing a logit model. As seen in both Tables, r values of all variables are close to zero, variables are uncorrelated with each other.

Table 4.16. Correlation between Variables for Passenger Model.

		Awareness of Ridesharing	Gender	Traffic Concerns	Safety Concerns
Awareness of Ridesharing	Pearson Correlation (r)	1	-0.138	-0.078	-0.185
	N	439	439	439	439
Gender	Pearson Correlation (r)	-0.138	1	0.079	0.339
	N	439	439	439	439
Traffic Concerns	Pearson Correlation (r)	-0.078	0.079	1	0.009
	N	439	439	439	439
Safety Concerns	Pearson Correlation (r)	-0.185	0.339	0.009	1
	N	439	439	439	439

Table 4.17. Correlation between Variables for Driver Model.

		Safety Concerns	Income	Depending on Others
Safety Concerns	Pearson Correlation (r)	1	0.123	0.066
	N	85	85	85
Income	Pearson Correlation (r)	0.123	1	-0.138
	N	85	85	85
Depending on Others	Pearson Correlation (r)	0.066	-0.138	1
	N	85	85	85

4.4. Ridesharing Tendency as a Passenger Model

Under this heading, Binary Logit Model which was developed to understand the deterrents behind the ridesharing involvement as a passenger is explained in detail. Respondents are questioned whether he or she is interested in ridesharing as a passenger or not. The gender, status, awareness of ridesharing, traffic concerns and safety concerns of these individuals are also considered. Table 4.16 presents the estimated results of Binary Logit model that includes their Wald statistics and significance. The significant variables which have 95% confidence level were involved in passenger model.

It is important to look at predictor model in terms of goodness of fit here by the omnibus test results at SPSS were examined in terms of overall model fit. There are various ways to examine the overall fit the model, and the chi-square test is the most conventional one of those. Chi-square is the value that describes the model's significance. The chi-square value in the table written as 120,990 with the significance value (p) smaller than 0.05 means that prediction model fits significantly better to the data and the null model so that the model has a significant improvement and fit.

The table also gives three different descriptive fit statistics (Pseudo R-square) measures that used by some to assess model fit by determining the effect size of the model. For this analysis, two more pseudo R2 statistics were as follow: contains the Cox & Snell R Square and Nagelkerke R Square values, which are both methods of calculating the clarified variation. According to the related statistics, between 24% and 33% of the variance in dependent variables is explained by our independent variables. McFadden's likelihood falls between 0 and 1, so the log of a likelihood is less than or equal to zero. If a model has a very low likelihood, then the log of the likelihood will have a larger magnitude than the log of a more likely model. Thus, a small ratio of log likelihoods indicates that the full model is a far better fit than the intercept model. Louviere and Street state that values of r-squared between 0.2-0.4 are considered to be indicative of extremely good model fits, therefore with the value of 0,206 passenger model has pretty good fit (Louviere and Street, 2000).

Percent Correlation Prediction shows overall predictability. 75,2% of the cases that are correctly predicted based on the model. This percentage has increased from 60,8% for the null model to 75,2% for the full model.

Observing beyond just the overall fit of the predictor model, the separate predictors were examined and determined which seem to be doing most of the work in terms of helping the model's classification accuracy in overall model fit.

The values of significance (p-value) column are the extension of chi-square value for each predictor. By interpreting these values, which predictor is the strongest influence on the model values were stated.

B coefficients are the regression coefficients which are interpretive as a change in logits for every one-unit change increase or decrease on predictor variable. B can be used to determine the direction of any significant effects. In this occasion, the B value related with "Awareness of Ridesharing" is positive. This positive value specifies that awareness of ridesharing is positively correlated with the grouping variables. Particularly, reminding that 1 returns "Interest in Ridesharing Involvement as a Passenger" and 0 returns "Not Interest in Ridesharing Involvement as a Passenger". Hereafter this positive B value shows that individuals have more awareness of ridesharing in the group categorized 1, (who has the tendency towards ridesharing) than individuals in the group categorized 0, (who has no tendency towards ridesharing). On the other hand, if the B value has negative value as with "Traffic concerns", this negative value specifies that "Traffic Concerns" is contrariwise associated with the grouping variable. Respondents with traffic concerns in the group are categorized as 0 and they show no tendency towards ridesharing when compared to the individuals in the group categorized 1, who has the tendency towards ridesharing.

Exp (B) values are equal to the power of each B value column and directly refer odd ratios. For every one-unit increase in predictor variable "Traffic Concerns", the odds are changing by a factor of 0.595. If traffic concern is obtained on a respondent, that person becomes 0.595 times reluctant to ridesharing. When we have odds ratio value of smaller than 1 it means odds are decreasing. If the odd ratio is 1, regression coefficient will be zero.

In terms of the relationship between independent and dependent variables, people falling in certain categories give more information or better information. The strong determinants in the model are examined below.

Gender variable has p-value which is less than cut off (<0.05). This means gender is strongly influential on people to rideshare as a passenger for their travels. A change in gender results turns out -0.819 times decreasing on ridesharing perception. Females are 0.441 less likely to involve ridesharing, compared to males. Similarly, to a potential assumption that woman may be less likely to rideshare due to fear of physical harm by strangers. A study has found that males are more likely to rideshare than women (Sarriera *et al.*, 2016). Another more recent study from 2012 found gender (especially being a woman) to be the most significant factor in determining the likelihood of respondents to use dynamic ridesharing (Siddiqi, 2012).

The status predictor is another factor that has a strong influence on passenger model. In the previous study of (Hwang *et al.*, 1990), income and occupation have been identified as crucial factors with lower income and laborers occupations being more likely to carpool than higher-income, professional occupations. Similarly, the status of individuals provides important finding in this study. The academic and administrative staff has the negatively significant effect on the tendency towards ridesharing. A change in status results turns out -0.226 times decreasing on ridesharing perception. Academic staff is 0.798 times less likely to involve ridesharing, compare to students.

"Awareness on Ridesharing" predictor has p-value is less than cut-off (<0.05). The statement, which is used to measure the awareness on travel sharing applications, is statistically determinative. This means that one of the powerful factors that influence people to rideshare as a passenger for their travels is having an inadequate awareness of this transportation concept and its platforms. A research explains that ridesharing systems are not a popular option for a variety of reasons by stating the fact that 69% of the participants did not know of at least 4 of the websites that provided their members to find and share riders online (Chaube *et al.*, 2010). This situation is also experienced with this study. The outcome can be explained numerically as; respondents who are aware of ridesharing applications are 2,461 times more likely to involve ridesharing.

The most prevalent situation was the safety concerns of the people and the predictor of "Safety Concerns" that revealed it with the p value of 0.000. Researches have shown that psychological factors are very effective in ridesharing participation of individuals. Worries for personal space, resistance to being placed in obligatory social situations, racial and ethnic prejudice may all play a key role in mode choice decisions

(Bonsall, *et al.*, 1984; Levin, 1982). If the model result of this subject is interpreted, a person with safety concerns becomes 0.595 times reluctant to ridesharing can be said.

The study asked its participants that what type of individuals they would accept rides from. 98% percent of the participants replied to the former question that they would gladly accept the ride offers coming from their friends. When the question was about the ride offers from the friend of a friend the percentage dropped down to 69%. Again the 69% of the participants replied that they would accept the ride offer from people if they belonged to the same community. When it comes to the same university community the percentage was 50%. Only 7% of the participants replied that they would accept rides from strangers. This shows that percentages were greatly related to how strong the social relationship (Chaube *et al.*, 2010). Lastly, the "Traffic Concerns" predictor indicates handicap of staying in traffic in İstanbul when ridesharing is selected as the transportation mode. Predictor value is statistically determinative with the p-value 0,033.

Table 4.18. Binary Logit Model of Ridesharing Tendency as a Passenger.

	Coefficient (B)	**Std. Error**	**Wald**	**Significance**	**Exp(B)**
Gender	-0.819	0.243	11.355	0.001	0.441
Status	-0.226	0.111	4.121	0.042	0.798
Awareness of Ridesharing	0.901	0.282	10.204	0.001	2.461
Traffic Concerns	-0.519	0.244	4.526	0.033	0.595
Safety Concern	-1.688	0.253	44.688	0	0.185
Constant	1.030	0.414	6.191	0.013	2.802
-2 Log Likelihood (Full Model)	466.872				
-2 Log Likelihood (Intercept Model)	587.862				
Cox & Snell R Square	0.241				
Nagelkerke R Square	0.326				
Mc Fadden R Square	0.206				
Mc Fadden R Square (Adjusted)	0.214				
Chi-square	120.990				
Percent Correction Prediction	75.2				
N	439				

4.5. Ridesharing Tendency as a Driver Model

In this section, Binary Logit Model which was developed to understand deterrents behind the ridesharing tendency for driver and passengers is explained in detail. Table 4.18 presents the estimated results of Binary Logit model that includes their Wald statistics and significance. The number of samples of the driver model is less than that of the passenger mode there for the significant variables for each category at 90% confidence level were included.

Chi-square is the value that describes the model's significance as it is mentioned in the previous heading. The chi-square value in the table written as 14,810 with the significance value (p) smaller than 0.100, means that prediction model fit significantly better to the data and the null model so that the model has a significant improvement and fit.

Cox & Snell and Nagelkerke R Square values are both methods used to calculate the explained variation. According to related statistics, between 16% and 22% of the variance in dependent variables is explained by our independent variables. McFadden's R square value is below 0.2 for driver model, it means that the model is not as strong as passenger model.

Percent Correlation Prediction shows overall predictability. 74,1% of the cases can be correctly predicted based on the model. This percentage has increased from 68,2% for the null model to 74,1% for the full model.

There are three predictors in driver model those have the values of significance (p-value) less than cut-off (<0,100). By interpreting these, the predictors that have the strongest influence on the model values were stated as "Income", "Safety Concerns" and "Depending on Others".

Table 4.19. Binary Logit Model of Ridesharing Tendency as a Driver.

	Coefficient (B)	**Std. Error**	**Wald**	**Significance**	**Exp(B)**
Income	-0.215	0.132	2.646	0.099	0.806
Safety Concerns	-1.214	0.517	5.519	0.019	0.297
Depending on Others	-1.975	0.845	5.466	0.019	0.139
Constant	2.638	1.114	5.603	0.018	13.987
-2 Log Likelihood (Full Model)	91.454				
-2 Log Likelihood (Intercept Model)	106.264				
Cox & Snell R Square	0.16				
Nagelkerke R Square	0.224				
Mc Fadden R Square	0.139				
Mc Fadden R Square (Adjusted)	0.168				
Chi-square	14.810				
Percent Correction Prediction	74.1				
N	85				

Income predictor is another factor that has a strong influence on passenger model. As it is mentioned for passenger model for "Status" variable; study of (Hwang *et al.*, 1990) indicates "Income" as a crucial factor with the argument of "lower income and laborers occupations being more likely to carpool than higher-income, professional occupations". Likewise, the income of the individuals provides important finding in this study. Academic and administrative staff have the negatively significant effect on the tendency towards ridesharing. A change in status results turns out -0.215 times decreasing on ridesharing perception. Academic staff is 0.806 times less likely to be involved in ridesharing, compared to students.

"Depending on others" variable has p-value is less than cut-off (<0.05) which shows that it is important that people prefer to move flexibly in their daily trips and it is a factor that prevents their participation in ridesharing as a driver. Here are few studies supporting this attitude in the literature. The first of these, a study of suburban workers in California revealed that the most frequently identified reason for not ridesharing was a preference for the freedom of driving alone (Glazer *et al.*, 1987). Another study from another perspective is that ridesharing modes are inferior to driving alone because of the extra time required to pick up or drop off passengers or to wait to be picked up.

The most prevalent situation was the safety concerns of people, and the variable of “Safety Concerns” that revealed it, was statistically determinative. As supported by studies in the literature, this is an impressive element of the involvement of rideshare, regardless of driver and passenger. If the model result of this subject is interpreted, the person with safety concerns becomes 0.297 times reluctant to rideshare which means that this predictor is more effective in driver model than passenger model.

The fact that users do not depend on the people they do not know also indicates that they have a problem of trust against people they travel with. From this perspective “Safety Concerns” and “Depending on Others” factors can be associated with one another. Previous research studies mentioned that only a very small percentage of commuters lean to rideshare with people outside their own family (Flannelly *et al.*, 1990). The potential problems from unknown habits and character traits may experience such potential problems may be related to safety concerns in some people.

In the study participants were asked that what type of individuals they would prefer to give rides to. 99% said if it was their friends they were most comfortable offering rides too. When the question involved their friends’ friends the percentage dropped down to 82%. This percentage while being similar to accepting rides it is slightly higher. It is also the case when they are asked about strangers. They are more comfortable when they are the ones offering rides to the strangers rather than taking one from them. If the participants have a prior knowledge of a social relationship, that becomes crucial when establishing trust. Besides, the trust factor is redefined when you meet someone for the first time and when that person is introduced you by a friend. Participants that were asked if there was a system they trusted and could tell them that someone who is offering a ride is a friend of a friend or member of a shared community, 67% responded they would request a ride but before only 7% answered they would request a ride from a stranger. Likewise, if the system was able to identify people and your relationship to those people who are seeking a ride, 66% are more likely to offer one, up from 10% when they thought of strangers (Chaube *et al.*, 2010).

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The study has mainly investigated the factors that have an influence on ridesharing involvement by using survey data which was conducted in Boğaziçi University and marked questionnaire was collected from undergraduate - graduate students, academic and administrative staff stayed at North, South and Hisar Campuses.

Binary logit model (BL) is developed in order to predict a nominal dependent variable given one or more independent variables. The passenger model contains 5 factors, including gender, status, awareness of ridesharing, traffic concerns and safety concerns while the driver model contains 3 factors including income, depending on others and safety concerns. The model was proposed with two travel behaviors; "Interest in Ridesharing Involvement as a Passenger" and "No Interest in Ridesharing Involvement as a Passenger". Regarding the factors that influence the decisions just mentioned, it appears that safety concerns significantly affect individuals tendency towards ridesharing both for passengers and drivers. Many demographic and travel characteristic variables were examined in the models, but remarkably most were not useful in explaining potential rideshares or potential rideshare program participants. The study's key aim reached by proving that personal, psychological, and social issues, also play a significant role in the interest or tendency to ridesharing. The main conclusions of this study are summarized below:

- Distribution of total travel times and total travel costs for a one-way trip to campuses of respondents obtained in the study are statistically revealed. As mentioned in Section 4.1.1.2, there are 89% of administrative staff and 48% of students paying less than 1 TL for a trip to campus. In this context, public transport is a very affordable alternative for respondents. It can be suggested that rural workplaces as a potential target audience increase ridesharing because urban residents having more options for travel than their rural counterparts (Lee *et al.*, 2015). This outcome makes ridesharing ineffective in reducing travel costs for inner city trips. It can be interpreted that the costs of travel within the city are not necessarily shared by people as in long distance travel between cities.

- It should be taken into consideration that 20% of students live houses that are in less than 10-minute distance to campuses. Particularly, students who come from other cities are choosing their housing considering the transportation conditions.
- It is a fact that urban traffic in İstanbul is almost daily crowded. In this case, it is an important challenge that ridesharing might not be seen as an alternative to urban traffic. On condition that transit public transport mode is an option, the participants are not warmly welcomed by ridesharing idea, especially considering that travel times will be longer during peak hours. The shortening of travel time is an acceptable condition in the countries where the HOV lane consulate is located. Regarding the study held in Texas, access to HOV lanes and relaxation while traveling has a strong influence on ridesharing tendency (Li *et al.*, 2007).
- The results of passenger model show that academic and administrative staff tend not to participate in ridesharing, this can be interpreted with two dimensions. One of the reasons might be their social status which put certain limits to their daily social interactions and the value they put on their privacy. As the reason for this issue, another position can focus on the shuttle buses that are provided to academic and administrative staff by institution/corporation free of charge. This may lead them to be indifferent in alternative transportation as well as social trends.
- The results of driver model show that income has an influence on participation motivation in ridesharing negatively. The amount of money earned from the shared cost of travel is not motivative enough to download an application and search for passengers. There is also another issue related to Turkish culture that people in middle and high-income level are not comfortable while asking or receiving a small amount of money for short travel expenses, instead of voluntarily giving it away.
- As shown in the both driver and passenger model results, safety concerns affect their decision making the most on ridesharing involvement. In the studies con-

ducted in the United States and Europe ridesharing benefits people by reducing travel cost and travel time (HOV Lanes), but in Turkey, since both cost and the time of the travel do not differ a lot, compared to USA and EU it is not commonly preferred. Thus, the concept stays unfamiliar while people do not have any references regarding the program being trustworthy and convenient.

- For drivers, even if they share their rides during the travel, they will have to depend on the passenger (For example, losing time to pick the passenger up, small changes on the route and time spent related to passenger's delay etc.) which will eventually increase travel time. Because of this kind of situations, drivers would like to preserve their independence of driving alone.
- The study shows that awareness of real-time ridesharing application is lower than expected. The lowest awareness rate was detected in administrative and academic level. The reason behind might be about the company's advertisement strategy that left some target groups in the population out or their failure in marketing activities targeting the target group involving the academic and administrative staff.

5.2. Recommendations for Future Studies

The application of the proposed methodology can prove to be very helpful for potential/substantial ridesharing users, researchers, and policymakers. The model developed can be used to realistically predict the variations that take place in the individuals' ridesharing tendency. Recommendations have been made separately for future studies and for existing ridesharing practices. For future studies, some recommendations are given below;

- The study survey was not designed to request respondents to compare trip alternatives which would allow us to build a mode choice model, but to assess a wider range of aspects (social and non-social) of dynamic ridesharing which would not be measured in a traditional stated preference survey.
- Larger sample size may give different results so that the model can be repeated with much more sample especially for driver model.

- A more focused and detailed survey will provide more informative model results and in turn, will provide better decision-making capability and several policy implications can be based on these results.
- There are various modeling approaches depending on study purposes and questionnaire types. In this study, the binary logit model is used however, scenario analysis can be investigated by manipulating some relevant variables and make prediction under particular changes in the system.

For existing ridesharing system used in Turkey, some recommendations are given below;

This study provides detailed information on the dynamic ridesharing system and their web or mobile applications for users. As it is shown in analysis results, this system which can be used as a mode of transportation in urban and interurban trips is not known in our country as well as it is not used by the known ones.

- Considering that the participants' tendency towards share ride with people they know from university due to the safety concerns, a ridesharing platform should be a form that provides reliable, safe, low cost or more comfortable trips. Giving a concrete example, Ozyeğin University has experienced a similar work with different motivations. To avoid the use of high-priced school services, web and mobile application was created as a travel-sharing platform for university members. Additionally, when we promote the young people to use sustainable mobility services such as ridesharing, this will also affect them at educational level (Colorni *et al.*, 2011).
- Shared mobility such as ridesharing is transforming transportation options, particularly for older adults and people with disabilities (Transit Cooperative Research Program Report 188, 2016). It is very important that the applications of ridesharing used in Turkey to be extended to such target population.
- Studies like this study that focuses on influencing attitude, perceived behavioral control and behavioral intention, present lots of important findings that have the power to influence policy and policy makers. Thus, this kind of research and

studies should be supported financially and academically; therefore, policymakers may use the tools this kind of studies proclaimed to influence attitudes and perceived behavioral control.

- To meet GHG emissions reduction goal worldwide, ridesharing can be a powerful alternative transportation that companies, agencies and institution should be considering. Ridesharing sustains its power from bringing commuters who lack access to transit commuters and who are willing to share rides (Erdoğan, *et al.*, 2015).

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