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# Traffic Impact Analysis

## Akasya Acıbadem Shopping Mall Case Study

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***Abstract*— Shopping malls plays a major role in any country's economy, economic impacts, on one hand, the socio-cultural effect on the surrounding region, on the other hand, have made these places important. Shopping malls, in addition to the economic and cultural effect, that they create within themselves, also create small businesses around the shopping mall and can be said to generally affect the income and expenses of the people in that area. Shopping malls and retail trade create huge direct and indirect benefits for the economy through employment, income generation, and participation in GDP (Gross Domestic Product). Much research has been done in these cases, however, these studies on the impact of shopping or retail trade on the local, regional or national economy does not include the potential negative impacts of generating additional traffic and associated congestion and air pollution-related health effects possible because of the essential nature of retail trade and shopping in a modern economy. In this study, we examine the effects of a shopping mall on the traffic volume of major roads in that area.**

**For this purpose, we used the volume of daily traffic used by smart camera systems to count the number of cars passing through a road section. These counts were done with an interval of two minutes. We first converted these volumes into the total volume of traffic passing from one side in fifteen minutes and then into the total volume of traffic passing from one side in one hour. At this stage, we needed the volume of peak hour traffic in one day to separate the peak hour traffic volume for each day of the week and compare the same days of the week with each other. In this way, we were able to compare peak hour traffic volumes calculated for each day separately for different years (before the opening of the shopping mall, the year of opening, and after the opening). Hereby, we examine the impact of this shopping center on the volume of traffic in the region and, more importantly, how the impact of this shopping mall on the traffic flow in the region.**

***Keywords— shopping mall; peak hour traffic volume; impact assessment; GPRS communication infrastructure; TIA (transportation impact analyses)***

## I. INTRODUCTION

Shopping centers and retail trade (street shopping, food, restaurants, and cafés) play a major role in the economies of cities. These roles have direct and indirect effects on matters such as employment, income generation, and contribution of the GDP. The impact of shopping malls is usually on a larger scale than the small business center, which mainly affects local areas, Shopping malls are also more popular than retail trades because they can meet the different needs of people and bring together a bunch of different sectors. In the USA the retail sector is estimated to provide 16.1% of all jobs and 7.7% of GDP (Price Waterhouse Coopers 2014). In the EU, the retail trade is responsible for every 1 in 11 jobs [1]. In Turkey, during the last ten years until 2019, the number of shopping centers has increased from about 200 to 453.

In Turkey, one-fifth of all trips are for shopping, so researching the impact of the shopping mall on traffic in the region is not without merit and important. In this study, we tried to calculate the amount of traffic volume by day, from the two main roads around the shopping center, in two busy directions, using data obtained from the Istanbul Municipality Research Center.

Then calculate the peak hour traffic volume per day and check these traffic volumes in the years before the mall opened, the year the mall opened, and the following years. How and how much is the impact of this shopping center on the peak volume of traffic by day in this area.

Our initial data included the number of vehicles passing through each lane, which was recorded every 2 minutes. This data was collected 24 hours a day. We used the data of September, which is the busiest month in terms of traffic flow in Istanbul.

To compare and summarize the data, we needed data analysis method, which we used linear regression analysis. this data was first converted into the total volume of passing traffic every 15 minutes, and then this volume of traffic was converted into the total volume of traffic through each lane in one hour. The shopping center opened in 2014, so we checked the volume of traffic for 2013, which is before the start of the shopping center, and 2014, which is the year of the opening of the shopping center, and compared this data with the peak traffic volumes in 2017, 2018 and 2019. The details of this comparison and analysis

will be described in the following sections. Large shopping malls integrate many attractive services offering entertainment, shopping, and dining facilities, and are a popular destination for a vast number of people. The high concentration of visitors generates high transport volumes, which place a significant burden on the transport infrastructure, especially within the immediate vicinity of the shopping malls. The assessment of the transport attractiveness of these facilities, providing a synthetic and comparative description of a given facility in terms of its popularity, is pretty challenging. [2]

Creation of a new traffic should consider its effect on the road network around the construction. Effect on the road network seen by the size of the building will be planned. Assessment is done by looking at whether the development affects the access roads around the building (site impact), affecting access roads and intersections in one direction around (traffic impact), or to affect the road network in the city that need consideration to change the city development master plan (master plan). [3]

Traffic Impact Analysis provides information in order to determine whether or not the existing and planned thoroughfare system can accommodate the traffic to be generated by a proposed development; and evaluate the appropriate traffic mitigation measures if the thoroughfare system cannot accommodate the impact. [4]

Development of urban areas follows the characteristic of inter-regional imbalance development and unequal distribution centre for community services. Those generate the problem as follows: the tendency of concentration of activities in certain areas (over concentration), mixed land use, land conversion of green and open spaces become awakened intensive region (residential, industrial, offices, infrastructure). [5]

Patterns of land use affected the transportation planning that are determined by the suitability of the transport facilities. These include road networks, parking areas, airports, and also affect the relativity of accessibility as well as increased travel costs at different locations. Evaluation of land use development patterns should be controlled regularly. It was due to unregulated land use can cause a burden on the road network. Increase the volume of traffic that weighed on the road segment if not supported by capacity expansion will result in reduced vehicle speed. Reduction of vehicle speed due to congestion will have an impact on the increase in travel time on vehicle.

The traffic congestion due to redevelopment is caused directly by the incoordination of transport demand and supply since after redevelopment the network capacity cannot afford the traffic demand. The demand for urban transport grew following the growth of the city population and its economy. Although there is a realization that the integration of land use and transportation planning is important in developing metropolises, up to date this is still far from reality, because of rapid and dramatic changes in city structures and institutional problems. [6]

Many land development projects have been approved for construction over the city areas. Those developments include office, condominium, exhibition hall, shopping center, and hypermarket projects. Many of these were located in Central Business District Areas, thus they have generated more traffic congestion along the urban networks. A main cause of congestion is the lack of effective measures to control such land developments. These congested conditions have prompted planners to necessarily implement TIA in their cities. [7]

Benefits of Traffic Impact Analysis is quite large but is still faced with some fairly complicated problems when applied in developing countries. determines whether or not the threshold of the required traffic impact analysis, and some are not. State that

determines the threshold easier to select financial proposal if necessary development of advanced traffic impact analysis or not, while countries that do not specify a threshold usually perform preliminary surveys (pilot survey) to determine the potential trip generation and then measure it later. Building restrictions that need to analyze the impact of this traffic is applied varies for each country, in the UK (1993) adding 10% to the existing traffic conditions required for traffic impact analysis, while ITE Institute of Transportation Engineers (1998), recommends limits differentiated by type of land use planning and capacity building). [3]

Therefore, the adaptation of TIA to the conditions of the study area is very important. The analysis must be consistent with the conditions of the region on which we are analyzing.

For a valid analysis we need a pre-analytical and then an analysis with conventional methods.

Trip generation is the first and the most important step in the four step process for forecasting the travel demand.[8]

It is critical that this step produces an accurate value as these values form the basis for the subsequent steps and the errors in this step can propagate in the entire estimation process. [9,10,11]

The trip generation step consists of the processes to estimate trip production and trip attraction (TA) of a traffic analysis zone (TAZ). Trip Attraction identifies the number of trips attracted by the various activity centers in the TAZ and trip production identifies the number of trips produced by the households in the TAZ. [12,13]

Trip Attraction is obviously most pertinent relative to traffic at specific land use activity. It also plays a role in many phases of transportation planning and traffic engineering related activities. [14]

The main contributing factor for Trip Attraction is work trips. Trips for shopping are the next main category of Trip Attraction. The objective of a trip generation model is to forecast the number of trips that begins or ends in each of the zones within a study area. [15]

Trip Rate Analysis (TRA), Cross-Classification Analysis (CCA), and Regression Analysis (RA) are widely used to determine the mean trip rates for a new development.

Trip Rate Analysis uses traffic volumes (incoming and outgoing) in a study area which are divided by a variable (representing characteristics of the study area, e.g., total of parking spaces, gross leasable area, gross floor area, occupancy rate, and number of employees) to obtain the trip attraction rate. [16]

Cross-Classification Analysis is a widely accepted method because the variables can be altered according to suitability and availability of data. According to Stopher and Meyburg (1978) [17], there are two ways to do the Cross-Classification Analysis which are for the trip production (in which the trip rate obtained will show the number of trips produced at that particular place) and the trip attraction ( in which the trip rate obtained will show the number of trips attracted to that particular place).
*Regression Analysis*, the number of trips is assumed to be linear to the variables used. The variables used can be combination of few independent variables to produce a multiple regression or one independent variable to produce a single regression. All the variables can be checked for the dependency of each other by using a statistical analysis to ensure a good fit of the data. The problem with this method is that trip is dynamic in nature which means it changes every time and again irrespective of any variables, which makes the trips non-linear. [18]

## II. Data Preparation and Location

The required traffic data in this article is obtained from Istanbul Municipality. Istanbul Municipality uses sensors and cameras to record instantaneous traffic conditions, this data is available instantly and online. Radar, image processing, and Bluetooth-based sensors are used to obtain traffic information. the instant traffic data sent to the Transportation Management Center with GPRS communication infrastructure from the sensors in the field, it is ensured that the traffic of Istanbul is monitored 24/7. The obtained data are interpreted as a result of the necessary analysis, and Variable Message Boards, and Density Map, etc.

The basic data used in this study is the volume of traffic passing vehicles in 24 hours from 4 points on the two main routes around the shopping center. The first route “D100” is one of the main traffic routes in Istanbul, which connects the Anatolian part of Istanbul to the European part. Naturally, we see people coming and going between these two sides of the city for work, shopping and even entertainment. You can also see the second route (O-1), which is located between two busy routes in the Anatolian side and connects the Ünalan neighborhood ( eastern parts of Anatolia) to the Kadıköy region, which is one of the main and famous crossings of Istanbul. Points 69, 104, 309 and, 115 are the data collection points used in this study. The location of the shopping center is also indicated in the figure, which has direct access from point 309. The direction we have examined was on the D100 Anatolian Highway to Europe (from point 69 to 104) and the O-1 Highway from the East Anatolian side to Kadıköy (from point 309 to 115).

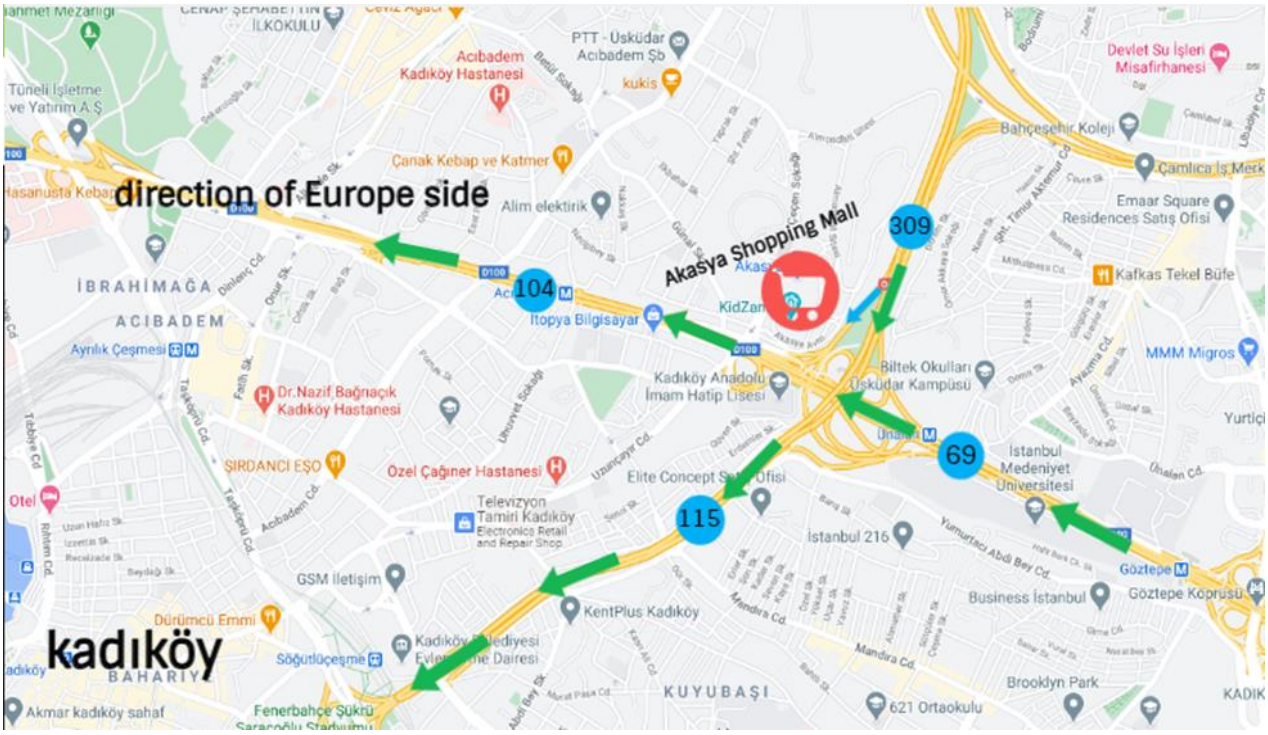


Fig 1. rote and coordinates of ‘D100’ & ‘0-1’ road.

Table 1. collected data at point 69 for September 2019.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/1/19 0:00 | 69 | 51 | 57 | 78 | 94 | 82 | 70 | NULL | NULL | 63 | 82 | 43 | 38 | 51 | 25 | 24 | 21 |
| 9/1/19 0:02 | 69 | 45 | 56 | 75 | 96 | 80 | 78 | NULL | NULL | 58 | 86 | 40 | 39 | 38 | 43 | 29 | 25 |
| 9/1/19 0:04 | 69 | 54 | 65 | 78 | 99 | 86 | 75 | NULL | NULL | 65 | 87 | 45 | 43 | 41 | 28 | 21 | 25 |
| 9/1/19 0:06 | 69 | 65 | 72 | 90 | 102 | 90 | 82 | NULL | NULL | 75 | 93 | 42 | 38 | 42 | 33 | 25 | 17 |
| 9/1/19 0:08 | 69 | 69 | 78 | 93 | 98 | 80 | 72 | NULL | NULL | 79 | 83 | 39 | 33 | 31 | 20 | 23 | 20 |
| 9/1/19 0:10 | 69 | 65 | 75 | 91 | 99 | 88 | 78 | NULL | NULL | 77 | 90 | 36 | 38 | 38 | 38 | 24 | 20 |
| 9/1/19 0:12 | 69 | 72 | 77 | 96 | 93 | 77 | 70 | NULL | NULL | 81 | 80 | 32 | 41 | 37 | 31 | 22 | 26 |
| 9/1/19 0:14 | 69 | 61 | 72 | 94 | 98 | 86 | 70 | NULL | NULL | 74 | 85 | 41 | 41 | 35 | 31 | 24 | 27 |
| 9/1/19 0:16 | 69 | 65 | 77 | 88 | 101 | 90 | 80 | NULL | NULL | 77 | 92 | 44 | 42 | 49 | 44 | 26 | 26 |
| 9/1/19 0:18 | 69 | 64 | 77 | 90 | 90 | 83 | 74 | NULL | NULL | 74 | 83 | 44 | 34 | 27 | 35 | 26 | 24 |
| 9/1/19 0:20 | 69 | 67 | 74 | 85 | 96 | 83 | 74 | NULL | NULL | 75 | 85 | 35 | 35 | 38 | 34 | 26 | 23 |
| 9/1/19 0:22 | 69 | 54 | 70 | 83 | 99 | 82 | 78 | NULL | NULL | 68 | 89 | 44 | 43 | 37 | 39 | 29 | 14 |
| 9/1/19 0:24 | 69 | 45 | 51 | 70 | 96 | 80 | 85 | NULL | NULL | 56 | 89 | 33 | 42 | 46 | 36 | 18 | 20 |
| 9/1/19 0:26 | 69 | 54 | 72 | 86 | 104 | 86 | 78 | NULL | NULL | 69 | 91 | 44 | 44 | 35 | 41 | 30 | 25 |

In table 1 , where the first 15 data for point 69 are shown, the first column is the date and time the data was recorded, the second column is the recording camera number (which is equal to the number of our points), columns three to ten are passing vehicles medium speed and columns thirteen to eighteen are the number of passing vehicles from each lane.
As you can see in the first column, the data entry interval is two minutes, although in some places this interval was changed and we modified these data for the integration of our data when converting it to a total of 15 minutes vehicle volume. Here we only used the volume of passing vehicles in one direction because we wanted to understand the impact of the mall on the volume of peak traffic.
This data was available in the same way for all the points we studied( points 69, 104, 309 & 115) and we used these., We had an average of 80,000 rows and 15 columns of data for each point.

## III. Location and Study Site

The purpose of this study is to measure the impact of the shopping center on traffic in the region, of course, this impact in various parts such as the impact on revenue in the region, the impact on rental and property prices, etc, but here we look at the issue from a traffic perspective. Name of the area is Acıbadem. That area is one of the most important and crowded areas of Istanbul and on its Asian side, and due to its good transportation alternatives such as metro, Bus rapid transit system and other means of urban transportation, as well as proper transportation routes, it has a large population. The shopping mall we are looking at is located next to a Butterfly non-coplanar intersection that connects the Anatolian side to Europe on one side and connects the interior of Anatolian to the busy and important Kadıköy area on the other. Akasya Acıbadem Shopping Mall (AASM), with a project area of 182,000 m^2 and $ 650 million in the capital, began construction in 2009. In 2014 AASM was opened for use, but the sales of the residences had started the previous year. The shopping mall has direct access from O-1 (Point 309) road and for other places, this access is possible indirectly.

## IV. Methodology

First, we convert the volume of traffic recorded by the cameras in the unit “veh/ 2 min.” into a “veh/ 15 min.” for the data has to be in the same unit so that we can compare with each other. The method of converting two-minute traffic volumes to fifteen-minute traffic volume was to add the first-minute information to the fourteenth-minute information and divide the next two-minute traffic volume into two parts, the first part add to the previous fourteen minutes volume than the second part adds to the next fourteen volume, so we got exactly the volume of traffic in fifteen minutes, then we converted that volume of fifteen-minute traffic,

to the volume of hourly traffic. The reason for this is that we do not have a crawling error in terms of time, which means that if we have a time error when collecting data for two minute, this error will create a time difference of 30 minutes when converting the volume of traffic to the volume of one-hour traffic. Of course, sometimes some cameras recorded traffic volumes every five minutes, and sometimes they did not record traffic volumes at all for a few minutes. We corrected all mistakes when finding the volume of 15-minute traffic to get a reliable and accurate source. After making these corrections and summaries, we have now separated the hourly traffic volumes for each day, that is, we have 24 data for each day, each of which is the total volume of traffic passing at that hour. What we needed was peak hour traffic volume for each day separately. To do this, we selected the largest of the 24-hour data we had for each day, and thus found the busiest hour of the day, thus selected the peak hour traffic volume for each day. The volume of peak hour traffic changes or stays the same each day with a certain trend, if this trend changes over some time, it means that something impressive has happened to the traffic in that area. This is exactly where we want to understand how the existence of the shopping mall has affected its nearby routes.

For this reason, we found the peak hour traffic volume for each day of the week in September 2013 and 2014 and then compared it with the daily peak hour traffic volume in September 2017, 2018, and 2019. we obtained the peak hour traffic volume for each day, then we wrote this traffic volume for 2013 and 2014 separately by day and performed linear regression. We did this for each point and in one direction.

### *A. D100 & O-1 Roads analysis*

we start describing the results of our analyses with the 'D100' route. This road in our study area has 3 lanes from east to west direction and 3 lanes from west to east direction, we chose the route east to west (Anatolia to the European region of Istanbul) and two traffic cameras on this road is there (points 69 and 104). In general, we do not have much peak volume change and these changes are in a certain interval. Monday, because it was the first workday of the week, was important for find out how many vehicles are passing on this day during peak hours? And does that number change much?

As can be seen from the table 4, during the two consecutive September in 2013 & 2014, for poin 69 at one side there were fluctuations between 5,540 " veh/ h." and 5,600 " veh/ h." at peak hours. This fluctuation was about 1%, which can be said that the number of cars during peak hours for this day is almost constant. The value of R square, which is acceptable to us in this study, is 0.4 and upper, and we say that this data is fitted with linear regression. For point 69 on Monday, this number is 0.34, which is a little less than our acceptable threshold.

R squared explains the degree to which your input variables explain the variation of your output / predicted variable. So, in simple terms, the higher the R squared, the more variation is explained by your input variables, and hence better is your model. However, the problem with R squared is that it will either stay the same or increase with the addition of more variables, even if they do not have any relationship with the output variables. This is where "Adjusted R square" comes to help. Adjusted R-square penalizes you for adding variables that do not improve your existing model. Hence, if you are building Linear regression on multiple variables, it is always suggested that you use adjusted R squared to judge the goodness of fit of the model. In case you only have one input variable, R-square and adjusted R squared would be the same. As a general rule of thumb, if adjusted R squared increases when a new variable is added to the model, the variable should remain in the model. Typically, the more non-significant variables you add into the model, the gap in R squared and adjusted R squared increases. So comparing adjusted R squared with these explanations gives better results.

We performed all these analyzes for points 309, 115, 104 and 69 in years 2013 and 2014 as well as 2017, 2018 and 2019 for all day of the week.

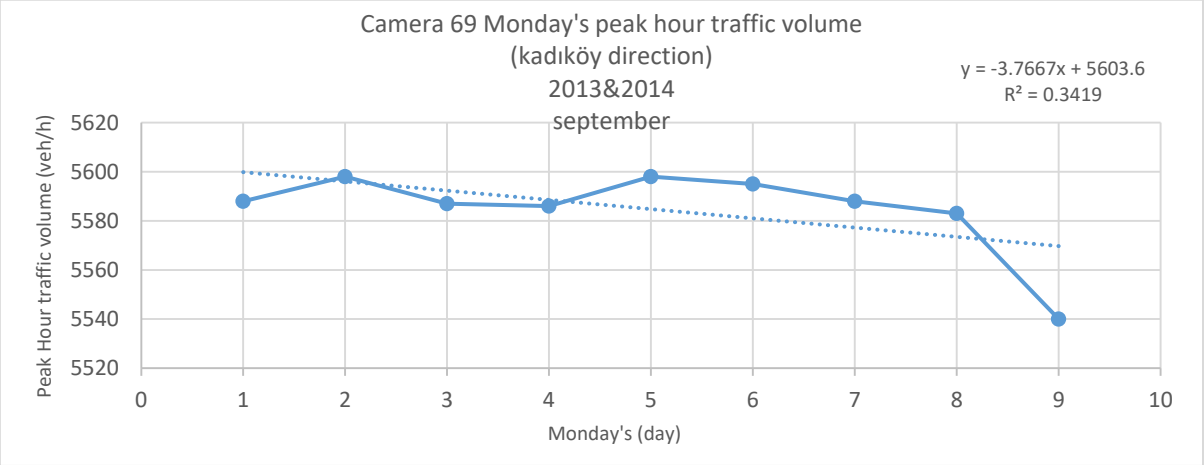


Fig 2. Mondays peak hour traffic volume for point 69, September, 2013 & 2014.

The analyzes obtained from this table are as follows:

Regression Statistics

| | |
|---|---|
| Multiple R | 0.584752252 |
| R Square | 0.341935196 |
| Adjusted R Square | 0.247925938 |
| Standard Error | 2.374985361 |
| Observations | 9 |

*B. Results*

After we have done the analysis for each point, now we want to draw conclusions from these analysis. We categorized the data needed for our discussion into tables for 2013, 2014, as well as 2017, 2018, and 2019.

Table 2. Results of linear regression analysis in 2013 & 2014 on the study areas.

| Camera (point) | day | A.R square | R square | R squ - A.R squ | Fluctuation | Slope |
|---|---|---|---|---|---|---|
| 69 | Monday | 24.8% | 34.2% | 9.4% | 1% | -3.77 |
| 104 | Monday | 77.8% | 81.0% | 3.2% | 5% | -26.76 |
| 309 | Monday | 74.1% | 77.3% | 3.2% | 25% | -93.96 |
| 115 | Monday | 62.2% | 67.6% | 5.4% | 3% | -6.27 |
| 69 | Saturday | 31.0% | 40.9% | 9.9% | 12.8% | -54.88 |
| 104 | Saturday | 40.4% | 47.8% | 7.4% | 14% | -48.28 |
| 309 | Saturday | 71.3% | 75.4% | 4.1% | 6.4% | -30.82 |
| 115 | Saturday | 84.1% | 86.4% | 2.3% | 4.7% | +12.92 |
| 69 | Sunday | 34.6% | 42.8% | 8.2% | 9.7% | +33.28 |
| 104 | Sunday | 28.4% | 38.6% | 10.2% | 8.8% | +28.21 |
| 309 | Sunday | 49.1% | 55.4% | 6.3% | 3.3% | -12.78 |
| 115 | Sunday | 84.5% | 86.4% | 1.9% | 3.4% | +7.85 |
| | **Average weekend results** | ***Camera (point)*** | | ***R squ - A.R squ*** | ***Fluctuation*** | |
| | | 69 | | 9.05% | 11.25% | |
| | | 104 | | 8.8% | 11.4% | |
| | | **309** | | 5.2% | 4.85% | |
| | | 115 | | 2.1% | 4.05% | |

Table 3. Results of linear regression analysis in 2017,2018 & 2019 on the study areas.

| Camera (point) | day | A.R square | R square | R squ - A.R squ | Fluctuation | Slop |
|---|---|---|---|---|---|---|
| 69 | Monday | 49.1% | 53.7% | 4.6% | 12.7% | +45.15 |
| 104 | Monday | 77.9% | 70.2% | 7.7% | 18.8% | -75.18 |
| **309** | Monday | 38.0% | 42.7% | 4.7% | 8.7% | +16.89 |
| 115 | Monday | 28.0% | 35.0% | 7% | 40.7% | +60.46 |
| 69 | Saturday | 17.5% | 23.8% | 6.3% | 6.4% | +9.55 |
| 104 | Saturday | 70.4% | 72.7% | 2.3% | 27.8% | -81.95 |
| **309** | Saturday | 40.2% | 45.2% | 5% | 9.5% | +17.67 |
| 115 | Saturday | 12.1% | 20.1% | 8% | 32.5% | +46.32 |
| 69 | Sunday | 14.5% | 21.5% | 7% | 2.4% | -4.00 |
| 104 | Sunday | 28.9% | 34.4% | 19.9% | 5.7% | +8.67 |
| **309** | Sunday | 35.0% | 40.4% | 5.4% | 4.6% | -8.05 |
| 115 | Sunday | 29.7% | 36.1% | 6.4% | 52.6% | +73.80 |
| | **Average weekend results** | ***Camera (point)*** | | ***R squ - A.R squ*** | ***Fluctuation*** | |
| | | 69 | | 6.65% | 4.4% | |
| | | 104 | | 11.1% | 12.25% | |
| | | **309** | | 5.2% | 7.05% | |
| | | 115 | | 7.2% | 42.55% | |

In the fifth column, we get the difference between the R square and the adjusted R square. We want this difference because we want to know whether our traffic changes at the desired point are linear or not. The smaller the difference, the more linear the traffic changes. The sixth column shows the difference between the minimum and maximum volume of peak traffic per day on the desired point. the greater difference shows greater instantaneous traffic volume in the area, meaning that non-routine trips also occur in the area. In the last column, we have the slope of the linear equation, the higher it is, the faster our traffic volume changes. Finally, we have averaged the results of the weekend so that we can compare the results of the weekend with The results of the beginning of the week.

The point we were looking at in this article to see the impact of the mall on the traffic on the main roads around it was point 309. This is the main way to enter the mall.
On Monday, the working day of the week, the difference between adjusted R square and R square has increased in the years, which indicates the non-linearity of traffic conditions. On the other hand, the resulting slope has gone from negative to positive, that's mean in the years before the construction of the shopping center, the trend of changing the volume of traffic was downward, and after the shopping mall opening, this trend has increased and the tendency to use this route has increased. In the discussion of fluctuations in the volume of peak hour traffic, this fluctuation has been relatively high and has declined in subsequent years, which indicates the regularity of traffic flow. If we explain this further, when this

fluctuation is high, it means that the number of drivers who use this route usually is less. These changes also apply to weekends.

When reviewing the data, the traffic changes at point 115 were interesting. At this point, the difference between the results is very large. This indicates the sharp changes over the years, For example, the slope of the linear analysis chart at this point has changed a lot and gone positively. The rate of fluctuation and difference between adjusted R square and R square has also increased significantly.

When we look at the reason for this, we see the tendency to travel from the European side to the western side of Anatolia for various reasons, including:

- Increased business in the Anatolian side of Istanbul in recent years.
- Increased living in the Anatolian side due to the crowded European side and the expensive life on this side.
- Optimal level of access from Kadıköy to different sides of Istanbul.
- This side has been a commercial center since ancient times.

## V. CONCLUSION

In this article, we used the peak hour traffic volume by days. Therefore, the effects of a structure on the traffic volume of peak hours around the roads are important, creating any structure both during the construction process and during use causes traffic volume and traffic disruption. Some structures are well designed and neutralize traffic impacts.

The shopping center we surveyed has had an upward effect on the peak hour traffic volume and a downward trend in upward traffic volume changes, but these effects are not to the extent that changes in roads are needed. This can happen for three reasons:

- The design of the shopping mall is accurate and its traffic impact has been well studied.
- The design of connection roads around this shopping center has been accurate and has been able to withstand the additional volume of traffic.
- The scale of our review is large and the mall has influenced the surrounding local roads.

In our opinion, the traffic generation forecast of the shopping center was accurate and did not cause traffic disturbances.

For analysis, we used linear regression analysis, which by looking at our graphs, we saw that this analysis was a good method for our data and we were able to conclude. Finally, it can be said that besides, it is a well-known fact that traffic generation is affected by various socio-economic variables. The inclusion of socio-economic, demographic, and land use data can be used as important variables to estimate traffic changes, and by including this data, a more accurate analysis is obtained.

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