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Analysis of Public Transport System, Hatay Example: Detection of Existing System

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***Abstract*—** *Today, with the development of our cities, the population density has increased and therefore many problems have arisen due to the increase of the traffic density in the city and the existing transportation systems which were previously not planned with erroneous technical infrastructure have become unable to answer. Measurements of the decision variables related to the routes, vehicles and passengers are made in order to determine the existing public transport system. These decision variables include the number of vehicles leaving service during the day, the passenger carrying capacity of the vehicles, the starting and ending times of the laps, the length of the public transport line, the number of laps made during the day, the number of passengers per vehicle, and the total number of passengers. By using these variables, the structure of the existing public transportation system is determined. Increasing the quality of public transport services in metropolitan cities and raising the quality of users in more economical conditions is only possible by incorporating business activities into an institutional structure, integrating public transportation enterprises into one and planning and managing them in a unified way. Our aim in this study is to evaluate the existing route structures, vehicle types and travel analyzes in the public transportation system in Hatay Province and evaluate the positive and negative points in the developing urban structure and to transform them into an effective and sustainable structure.*

***Keywords*— Public Transportation, Route, Decision Variables.**

I. INTRODUCTION

Nowadays, with the rapid and uncontrolled growth of our cities, population density has increased and caused many needs and problems to come along with them [1, 13]. The increase in population is accompanied by an increase in the number of cars per population and a vehicle traffic which is difficult to transport the system with the limited road capacities that the previous zoning applications have created [2, 13]. This situation has made traffic and transportation in our cities the most important problem to be solved [3].

In this study, it is aimed to evaluate the existing system in the urban structure that develops by examining the route structures, vehicle types and travel data in the public transport system of Hatay Province, which is a growing and developing city, in the districts of Antakya.

The 21 provincial municipalities, which were established with the fragmented local government structure, which has been in vogue in the 1990s in Antakya, which is the center of Hatay Province, constitute the cause of problems that are serious and reparable in terms of the development of the city [4, 5]. In the meantime, while the borders and centers of the Provincial Municipality and the Municipality of district generally need to be evaluated and structured as a whole, the lack of an autonomous and interdependent relationship between the relevant local governments and in particular the lack of integration between the decisions taken regarding the reconstruction of the city has adversely affected the development of the city and the urban transportation system was also irregularly structured in connection with this [6, 7].

The gathering of public, social, cultural, commercial and industrial sites in the Antakya center led to the population focus of the settlements in the surrounding areas of Antakya and, together with that, the mobilization of population towards the city center. In this regard, according to population movements, besides the city center's own public transport system, it has also caused the formation of public transportation networks towards the province center rather than the borders that are almost intertwined with the city center. Transportation services to be provided in Public Transportation Systems have been transferred to the cooperatives established in the region, and the public has preferred to be in the point of regulation and control rather than the point of application of this service [8, 9].

In cities where human beings exist, transportation is one of the basic needs. In order to meet the transportation needs of the people at this point, it is necessary to determine the transportation demand first. For this purpose; what kind of traffic demand will be met by means of transportation, and also how to measure the efficiency and performance of investments related to transportation is tested with models

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produced through computer programs [10, 11]. There are management problems and irregularities in public transport systems in our cities as there is not a central authority in our country that regulates the working conditions in public transportation services and the standards that constitute the standards related to service quality. In addition to these shortcomings, transportation and traffic problems in cities are increasing, and service quality is decreasing as public transportation activities become commercialized. In public transport systems in our cities, the price and quality of service are determined to a large extent by the positive competition conditions created by the public enterprises that provide this service. The more powerful and widespread the services are provided by the public enterprises, the more effective they are in determining the price and quality [12].

II. DETERMINATION OF THE CURRENT SITUATION

2.1. Urban Travel Data

In order to demonstrate the characteristics of the trip in Hatay, the "Household Questionnaire" study was carried out to determine the age, gender, educational status, working status, income level, socioeconomic data were obtained. At the same time, the travel information of the person one day before was obtained by filling in the travel forms for each person living in the household (number of trips, trip start / end addresses, types of transportation used, number of trips and number of transfers etc.). This study used a random list of up to 12000 addresses obtained from the Turkey Statistical Institute . It has been noted that there is a set of 3 percent of the sample. If no one is home, an address has gone 3 times. Two substitution lists have been created to be used if there has been no interview after three visits. The household questionnaire conducted on these study lists was conducted in 12.000 households and the questionnaire study was carried out in one school period. Household work; taking into consideration the new district and neighborhood borders of Hatay, it was realized in 15 districts and 374 localities. In this study, the observation unit is the "journey" [9].

Accurate measurement of travel rates is the most important component of transportation surveys. However, accurate measurement of travel/mobility ratios in studies with large sample sizes is very difficult due to "subject fatigue".

Table 1: Mobility Rates Determined in Household Questionnaires

Journey Aim	Gross Mobility	Net Mobility
Traveling from Home to Work	0,294	0,718
Traveling from Home to School	0,257	0,628
Traveling from Home to Others	0,269	0,656
Traveling Unrelated to home route	0,012	0,029
Total	0,832	2,031

Table 1 shows the net and gross mobility ratios obtained from household surveys. The gross mobility rate is derived from the entire population portion of the journeys made and the net mobility rate is derived from the portion of the journeys made for that purpose. Accordingly, the mobility rate in the field survey in 2016 was found to be gross 0,832.

2.2. Public Transport Data

In Hatay province Central Districts, all of the public transport services are provided by 9 cooperatives established in the city center or in the borders before the big city law. Some or close to each other are organized around a cooperative and carrying activities. All of these cooperatives, which provide public transport services, operate independently of each other and each enterprise prepares and implements its own work program [8].

A number of meetings were held with the president, administrators and cooperative members of the cooperatives providing public transportation services in the district in the section of Antakya districts of the rehabilitation works of the public transportation lines within the activities of Hatay Transportation Master Plan and the problems about the current structure, problems and anticipations were made. After this information has been evaluated, passenger counts have been made on the public transport lines and the number of lines, routes, number of working vehicles, number of passengers carried, operating speeds, The results of the field work were collected and tabulated [9].

The following data were collected via survey;

- Number of registered vehicles serviced during the day,
- The passenger carrying capacity of vehicles,
- Starting and finishing hours of the laps,
- Time-of-flight schedule,
- The length of the line,
- Number of tours in the day,
- Total number of laps
- A total time of one lap,
- Average commercial speed,
- The km per vehicle,
- Number of round trips per vehicle,
- The time of laps for vehicle,
- The total work duration of the vehicle,
- Working efficiency of the vehicle,
- Passenger number per tour,
- Passenger number per vehicle,
- Total number of passenger,

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- The km per passenger

2.2.1. Travel Data and Census Results

This section has been analyzed from the point of view of the journeys within Antakya townships. Antakya district public transportation can be done on seven lines [8].

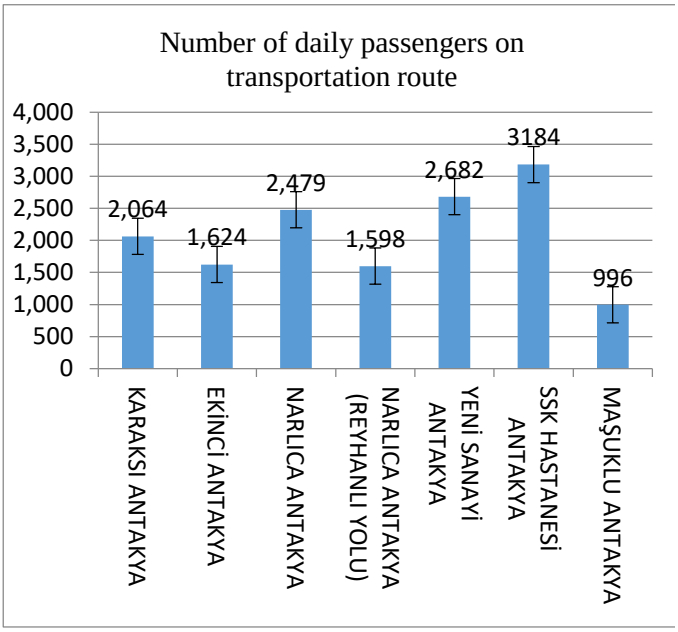

Fig. 1: Number of Daily Passengers on Transportation Route

As can be understood from Figure 1, there are big differences in daily average passenger numbers in the lines. SSK Hospital receives 3.184 passengers/day value in Antakya Central line and 996 passengers/day value in Maşuklu-Antakya Central Line.

2.2.2. Vehicles Data

In Antakya County, the average number of passengers per day is over 750 passengers/day. Public transportation services are provided by 230 different vehicles with 14 passengers carrying capacity by 6 different cooperatives. (Table 2)

Table 2: Number of Vehicles That Provide Public Transportation Services in Antakya District Lines

Name of Line	**Number of Vehicles**	**Cooperative in public transportation activity**
Karaksı Antakya	23	S.S.112 Karaksi
Ekinci Antakya	34	S.S.105 Ekinci
Narlıca Antakya	21	S.S. 98 Narlıca
Narlıca Antakya 2	21	S.S. 98 Narlıca
Yeni Sanayi Antakya	47	S.S. 52 Yeni Sanayi
Ssk Hastanesi Antakya	55	S.S. 103 Ssk
Maşuklu Antakya	29	S.S. 134 Maşuklu
Total	**230**	

2.2.3. Age of Vehicles

The average age of vehicles providing public transport in the district is 14.77 and the ideal fleet, which is considered as 6 years according to European Union standards, is more than 2 times higher than the average age.

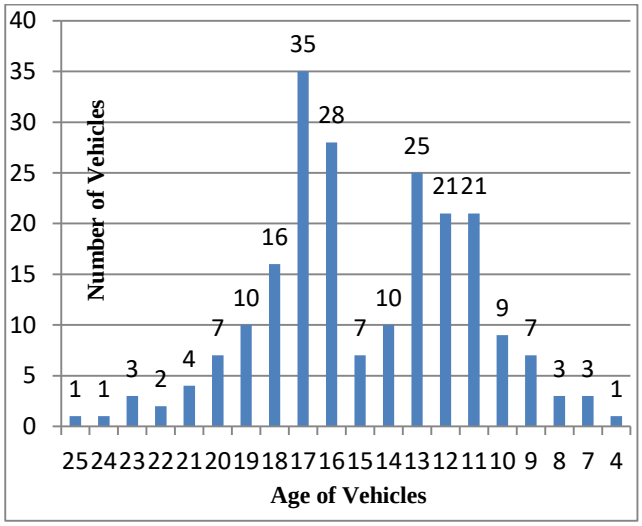

Fig. 2: Public Transport Vehicles Age Distribution

0.5% of the vehicles in the fleet are under 5 years old. The proportion of vehicles over the age of 11 completing the economic life in the system is 89.3%.(Fig.3)

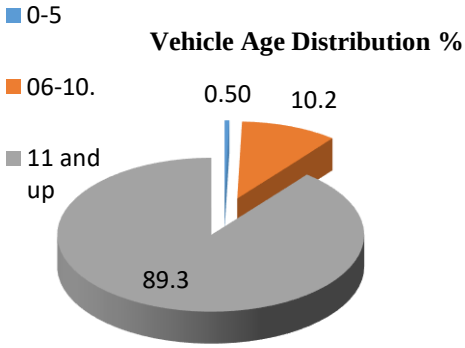

Fig. 3: Age Distribution of Public Transport Vehicles

The average age of minibuses that provide public transport services in the province of Antakya is higher than the average age of buses that provide public transport services in Istanbul, Ankara and Izmir. In other words, most of the vehicles that provide public transport services are made up of old vehicles that have completed their economic life.

2.2.4. Vehicle Capacities

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A large part of the vehicles that provide public transportation services in Antakya district lines are 14 passenger capacity and there are small number of 15, 16 and 17 passenger carrying capacity vehicles.

2.2.5. *Vehicle Comfort*

The comfort of public transport vehicles in our cities has been greatly increased in recent years. Automatic gearbox, Euro 5-6 engine, air conditioner, low floor, electronic line indicator, GPS applications, etc. has become the standard for mass overflow vehicles. A large part of the public transport services, especially in our big cities, have these facilities. In Antakya there is no such equipment in most of the vehicles that provide public transportation services. The service quality of minibuses is also very low. Most of the services are provided by neglected, poorly equipped old vehicles. This greatly reduces the comfort of the transport services provided by the district.

2.3. Performance Values Of The Lines

Data showing performance criteria such as the number of passengers carried, the kilometers made per vehicle, the number of passengers transported per kilometer and the frequency of service were collected and analyzes related to the performance of the cooperatives providing public transportation services in the Antakya District were prepared.

2.3.1. Number Of Daily Passengers Carried Per Vehicle

Table 3: Number of Daily Passengers Carried Per Vehicle in Antakya District Lines

Name of the Lines	Average Number Of Passengers Per Day	Number of Vehicles	Daily Moved Per Vehicle Number of passengers
Karaksı Antakya	2.064	23	90
Ekinci Antakya	1.624	34	48
Narlıca Antakya	2.475	21	118
Narlıca Antakya (Reyhanlı Yolu)	1.602	21	76
Yeni Sanayi Antakya	2.682	47	57
Ssk Hastanesi Antakya	3.184	55	58
Maşuklu Antakya	996	29	34
Toplam	**14.627**	**230**	**64**

The number of passengers carried per vehicle is low because of the large number of vehicles providing public transport services (Table 3).

2.3.2. Km Per Vehicle

One of the most important indicators of productivity in public transport operators is the km values the vehicles make during the day. It is desirable that public transportation vehicles are in constant motion throughout the day and that they produce higher value services. The fact that the vehicles that provide public transport in the city have a low capacity during the day shows that there is an idle capacity. The lengths of the lines and the number of laps were determined during the data collection phase. By evaluating these data, the kilometers of the vehicles during the day are calculated and evaluated. As can be seen in Figure 4, roads between 35.05 km and 123.76 km are made per day on the lines and the average km per vehicle running on the lines is 62.74 km. When these data are evaluated, it is seen that the vehicles make mileage far below the standards when the daily mileage values per vehicle are taken into account.

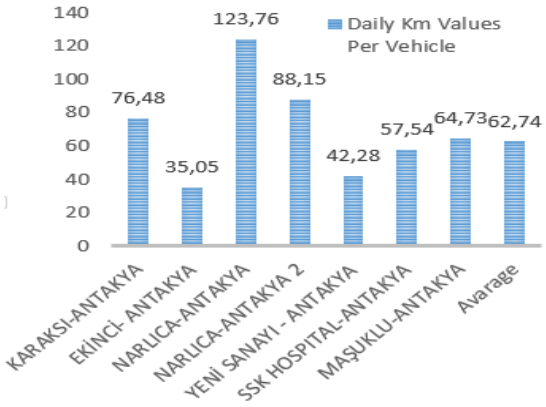

Fig. 4: Km Value Made Per Vehicle in Antakya District Lines.

Taking the 62,74 Km value per vehicle during the day, Antakya shows that the minibuses that provide public transport services in the city have an idle capacity of up to 75% due to vehicle overage.

2.3.3. Number Of Passengers Per Kilometer

One way of evaluating the number of passengers and thus their income is the number of passengers carried per kilometer. The low number of passengers carried per kilometer is an effective situation for income and productivity. During the collection of data, data such as the length of the lines, the number of laps, the number of passengers carried per day were obtained and the passenger counted per kilometer for the lines was calculated. Economically, sustainability requires passengers to carry passengers on a per-kilometer-per-kilometer vehicle in a minibus-based public transport service for a business.

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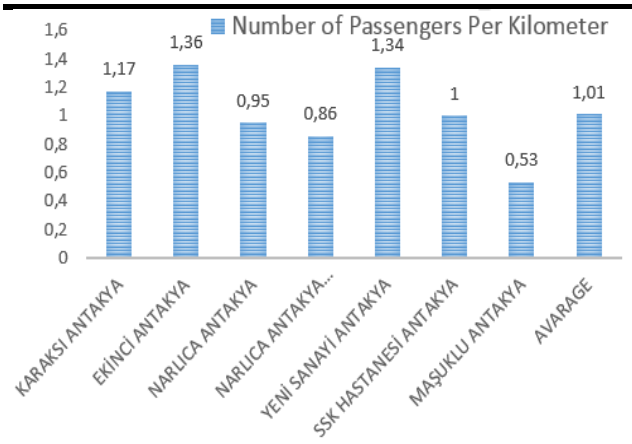

Fig. 5: Number of Passengers per Kilometer in Antakya District Lines

When the number of passengers carried per km is taken into account, the commercial potential of a part of the lines is low. (Figure 5)

2.3.4. Number of Tours per Vehicle

Due to the high number of vehicles on the line, the number of tours the vehicles make during the day is low.

Table 4: Number of Tour per Vehicle

Name of the Lines	Number of Vehicles	Number of Tour	Number of Tours per Vehicle
Karaksi-Antakya	23	60	2,61
Ekinci-Antakya	34	80	2,35
Narlıca-Antakya	21	102	4,86
Narlıca-Antakya 2	21	104	4,95
Yeni Sanayi-Antakya	47	180	3,83
Ssk Hastanesi-Antakya	55	160	2,91
Maşuklu-Antakya	29	76	2,62
Total	**230**	**762**	**3,31**

As seen in Table 4 and Figure 6, Ekinci-Antakya Central Line has the highest value with 2.35 rounds per vehicle and the lowest Narlıca-Antakya Central Line with 4.95 rounds per vehicle in terms of number of laps per vehicle on the district lines. The average number of laps per vehicle per day on the lines is 3.31.

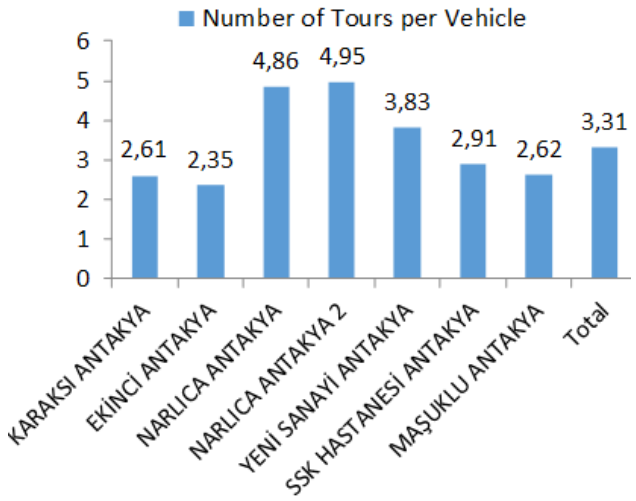

Fig. 6: Number of Tours per Vehicle

2.3.5. Average commercial Speeds

The average commercial speed of Antakya city buses varies significantly according to the lines they serve.

Table 5: Average commercial Speeds

Name of the Lines	Line Length (Km)	Travel Time (min)	Commercial Speeds (Km/h)
Karaksı-Antakya	29,32	34,2	25,71
Ekinci-Antakya	14,9	29	15,41
Narlıca-Antakya	25,49	27,97	27,34
Narlıca-Antakya 2	17,8	29,15	18,31
Yeni Sanayi-Antakya	11,04	21,55	15,36
Ssk Hastanesi-Antakya	19,78	30,46	19,48
Maşuklu-Antakya	24,7	27,2	27,24
Avarage			**21,26**

As you can see in Table 5 and Figure 7, the commercial speed at Narlica-Antakya Central Line is 27,34 km/h and it is worth 15,36 km/h in Yeni Sanayi- Antakya Central Line. The average commercial speed on the lines is 21.26 Km/h.

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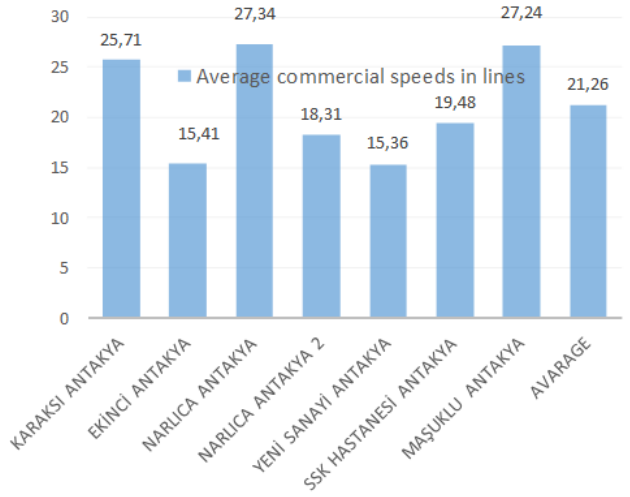

Fig. 7: Average commercial Speeds (Km/h)

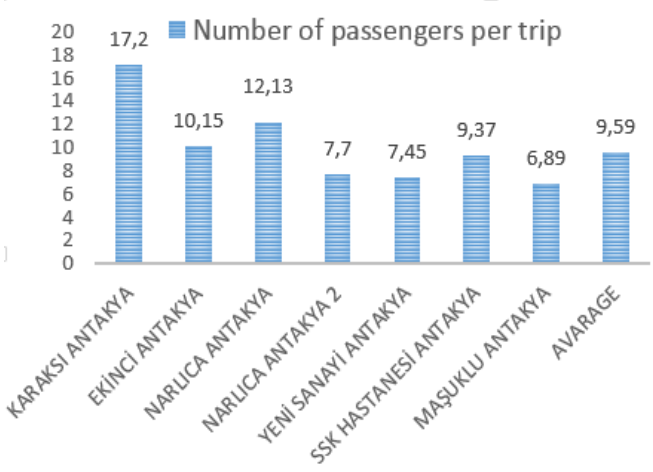

Fig. 8: Number of Passengers Per Trip

2.3.6. Number of Passengers Per Trip

The number of passengers carried by vehicles that provide public transport services within the city of Antakya is given in the table below on a line by line basis.

Table 6: Number of Passengers per Trip

Name of the Lines	Average Number of Passengers per Day	Number of Trip	Number of Passengers per Trip
Karaksi-Antakya	2.064	120	17,2
Ekinci-Antakya	1.624	160	10,15
Narlıca-Antakya	2.475	204	12,13
Narlıca-Antakya 2	1.602	208	7,70
Yeni Sanayi-Antakya	2.682	360	7,45
Ssk Hastanesi-Antakya	3124	320	9,37
Maşuklu-Antakya	996	152	6,89
Total	**14627**	**1524**	**9,59**

The average number of passengers carried per trip in Antakya district lines is 9.59. (Table 6)

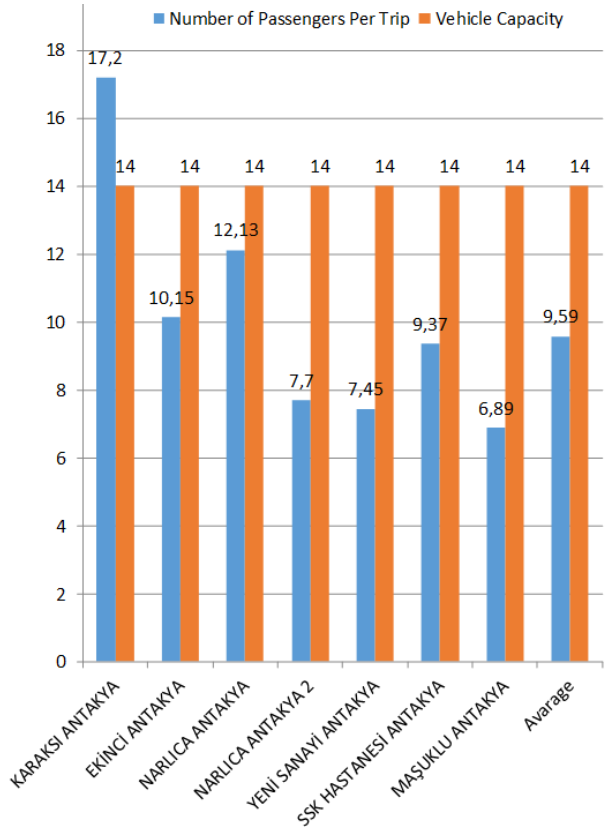

Fig. 9: Number of Passengers per Trip - Vehicle Capacity Comparison

As shown in Figure 9, the number of passengers carried on the Karaksi-Antakya line is higher than the average passenger carrying capacity of public transport vehicles. There is a need to increase flight numbers in terms of user satisfaction.

2.3.7. The Capacity Utilization Rate

The most important performance criterion that shows the capacity utilization rate in public transport vehicles is the km that it carries during the day. Capacity utilization ratios

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are taken out on the basis of line making 250 km of each vehicle during the day and the table below is given.

Table 7: Operational Efficiency in Lines

Name of the Lines	Km per Vehicle	Operational Efficiency in Lines %
Karaksı-Antakya	76,48	30
Ekinci-Antakya	35,05	14
Narlıca-Antakya	123,76	50
Narlıca-Antakya 2	88,15	35
Yeni Sanayi-Antakya	42,28	16
Ssk Hastanesi-Antakya	57,54	23
Maşuklu-Antakya	64,73	25
Total	**62,74**	**28**

Some vehicles cannot be operated during the day because of the excessive amount of vehicles. In addition to this, the vehicles are still operating with low performance during the day due to the high number of vehicles on the lines. The average efficiency of the lines is 28%. (Table 7 and Figure 10).

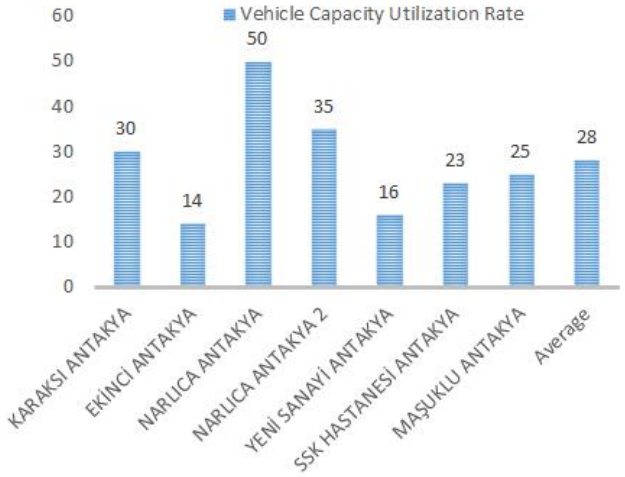

Fig. 10. Vehicle Capacity Utilization Rate in Lines

III. CONCLUSION

To expand public transport services in metropolitan cities is possible only by increasing the quality of the services and bringing them to the users on more economic conditions by integrating the business activities into an institutional structure, integrating public transport enterprises into one and planning and managing them in a unified way [13]. Where public transport activities cannot be incorporated into an institutional structure throughout the city, hundreds of individual operators operate without any coordination between them [14]. For this reason, efficient operation of system, lines and vehicles is not possible. In order to get rid of the clutter and inefficiency of the public transport system in Hatay, it is necessary to plan and manage the public transportation related management, investment, auditing and business activities in a single institution and to plan and manage them from one hand. For this reason, public transport systems with different status, business model and vehicle capacity within the public transport system should be incorporated into an institutional structure and operated in a system integrity.

In Hatay, collective transportation activities should be planned and managed from one hand, transportation statistics should be collected on system, corridor, line, vehicle basis and transportation planning should be done in order to ensure co-operation between public transportation types in order to provide business integration in public transportation system in Hatay. Hatay should have a sufficient number of specialized personnel and technical equipment in order to carry out the organizational structure planning, management, auditing and operation activities that will ensure the integration of the public transportation system.

The main problem in terms of public transport in our cities is that it is impossible to develop an integrated public transport system that takes into account existing facilities and ensures cooperation between the species preventing competition. In Hatay, where almost all of public transportation services are provided by private operators, it is suggested that the priority in solving public transport problems should be given to the rehabilitation of the private operators that constitute the existing mass transportation system.

For the rehabilitation of the existing public transport system in Hatay, firstly;

- To reduce the number of vehicles providing public transport services,
- The integration of enterprises,
- The establishment of the Public Transport Hierarchy,
- In order to ensure wage integration,
- Regional pools there needs to be created.

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