

***A COMPARISON OF PERSONNEL SHUTTLE  
SERVICE OF UNIVERSITIES IN TERMS OF  
SCALE***

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## A COMPARISON OF PERSONNEL SHUTTLE SERVICE OF UNIVERSITIES IN TERMS OF SCALE

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### ABSTRACT

*Personnel shuttle system satisfies the transportation demand of the working citizens in high numbers and free of charge. The service is offered by both private and public working places for their employees. This mode of transportation is very common in the Middle Eastern countries as well as the US but not as much in European countries. However, these services also cause a significant amount of traffic congestion in the city especially near business districts and city centers. Therefore, the number of vehicles used in this system must be minimized and the route of these vehicles must be optimized. The scale of this system is an important factor for the optimization process. In this study, the personnel shuttle services of Bogazici and Istanbul Okan University were investigated and comparisons, in terms of scale, were made. It was determined that as the number of employees of a workplace increase, the number of route options also have to increase while other workplaces with less employees can offer more limited route options. Also, the size and capacity of the shuttles significantly differ between the two samples.*

**Keywords:** Traffic Engineering, Transportation Planning, Route Design, Capacity, Shuttle Services

### INTRODUCTION

The number of vehicles increasing in the city intensifies the daily traffic and consequently affects the quality of life negatively [1]. Public transport systems provide economic and environmental benefits as well as reducing traffic jams by reducing the number of vehicles [2, 3]. This type of transportation is an important solution especially for the city centers of the crowded metropolises [4].

As of 2018, Istanbul is the highest populated city of Turkey with a population of 16 million [5]. Istanbul, that has the 6<sup>th</sup> busiest traffic in in the world, causes an average of 46 minutes a day and 175 hours a year spent more in the traffic. These delays increase further in the morning and evening hours and can reach up to 91% longer travel times [6]. Istanbul, which has an important place in the business world, causes considerable economic, social and environmental problems as a result of the accumulation of delays experienced by passengers every day throughout the year.

Personnel services are a type of private public transport which is used widely by companies that employ many people. These services consist of different sized vehicles, depending on the location of the work place, employees' residence addresses and so on. Since each vehicle is larger than a standard private vehicle, it can cause traffic jams in the city center, especially during peak hours. Although these services are a useful solution for certain workplaces, they can under some circumstances damage the overall traffic. For this reason, reducing the number of these services, providing the right capacity and finding the best route is an extremely important step for both employees, employers and general traffic. If this work is done by many companies, it is expected that the number of vehicles in the traffic will decrease and traffic congestion will improve.

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There are two different methods in the literature related to the routing problems. In the first one, as in the case of cargo companies, the demand and the service that should be provided change every day, and accordingly different routing should be made each day (even many times in a single day) [7]. However, once a student or staff shuttle services are arranged, they provide the same service for the same demand every day for a certain period of time. However, service lines, capacities and times are revised depending on the change of demand [8].

It is not possible to satisfy all users at the same level in the service sector, especially when different users need to be given similar services at the same time. The reason for the emergence of multi criteria decision making (MCDM) methods was basically this point. There are a number of MCDM methods that take the views of stakeholders in a system, the importance they give to the criteria or the weight of the criteria into account and new ones are still included in the literature. The determination of the routes of personnel shuttle services can be considered as a multi-criteria routing problem.

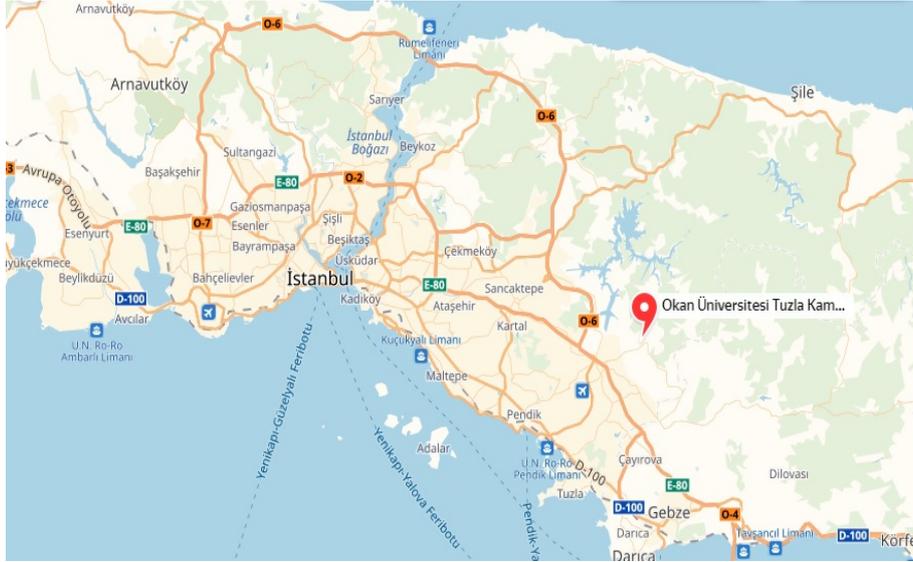
Undoubtedly, the quality of the services provided by the personnel shuttle services is evaluated according to different criteria by different stakeholders of this system. While the time spent in the service vehicle and the distance of the service route or stop to their destination are an important factor for users of the system, for the service providing company, the length of the routes, the number and the size of the service vehicles gain importance. These importance levels can differ between the various stakeholder groups and also they can be evaluated differently by different individuals within the same stakeholder group. Furthermore, the negative effects of the service vehicles on the environment (eg image, sound and noise pollution) are another criteria that should not be ignored. For these reasons, planning and optimization of service lines requires a multi-criteria evaluation.

## ANALYSIS

The existing personnel shuttle service system of Boğaziçi University has 61 vehicles. These vehicles travel a total of 3460 km of roads (roundtrip) in one day. According to the surveys conducted previously with the employees in the campus, the reasons for avoiding the usage of this system although being registered into it were mainly the routes and the times of the services being not suitable and/or useful and the preferred alternative transportation way being much faster.

Istanbul Okan University provides service to its employees working in Tuzla Campus with 24 shuttle service lines. These vehicles cover a total of 868 km of road (roundtrip) in one day. Istanbul Okan University Tuzla Campus is located far from the city center (Figure 1). There is only one bus (KM28) line and a minibus line as a public transport line to the campus. For this reason, employees mainly use the personnel service and/or their own private vehicles to reach the campus. Therefore, routes for both universities should be organised and improved according to registered personnel.

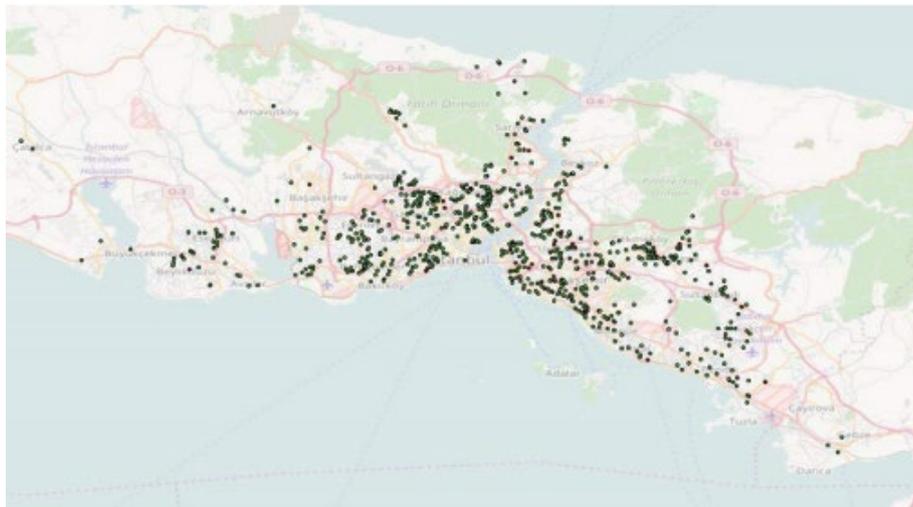
In this context, it was decided that the actual address information of the administrative and academic staff using the services and the realization of the study by taking this address information into consideration would be the most important factor in its success. Then, the General Secretariat has obtained the information of the employees who use personnel shuttle service from the Human Resources and Administrative Affairs units. Then, these people were first called from their internal phones and then from their personal mobile phones, the address and the service information was checked and updated if necessary. At this stage of the study, the people who declared their quittance from the institution were removed from the list and the current information of the ones who had the address and service changes were taken. In addition, some people need to specify their requests and complaints about service lines and these opinions have been carefully noted. During the process until the completion of the study, the current information of the people who are known to have joined or quitted the institution as well as people with known address changes are included in the project scope. In addition, the address and service information of the people who have not been reached either internally or mobile phones have been accepted as current. As a result, the study was carried out with the data of 1166 people for Boğaziçi University and 594 people for İstanbul Okan University.



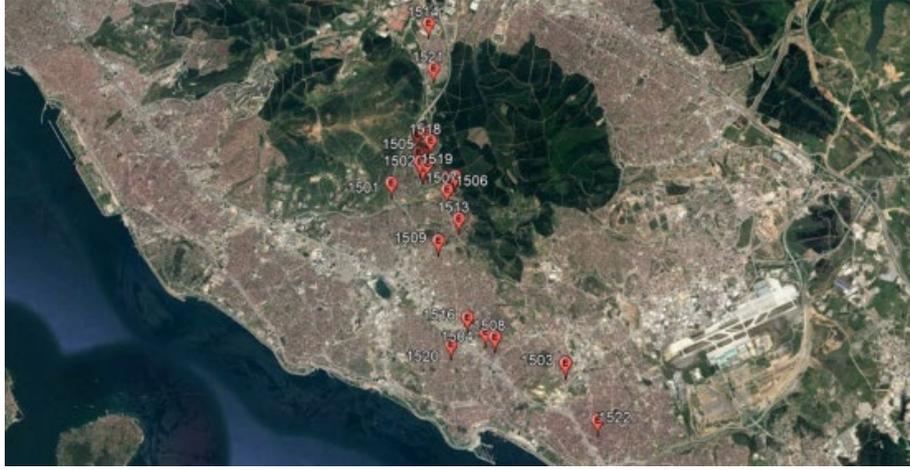
**Figure 1: Location of Istanbul Okan University Tuzla Campus**

After verifying the address data, each of the service users is assigned a separate code number. The numbers that make up the thousands or hundreds digits of the code assigned as a 3 or 4 digit number indicate the service number, and the digits forming tens and ones indicate the person code that uses a particular service. For example, code 713 shows the 13<sup>th</sup> person using service 7 and 1402 shows the 2<sup>nd</sup> person using service 14. After each service user has been coded with a separate number, the name data has been deleted from the records and the evaluations have been made through these assigned code numbers.

In the next phase of the study, the addresses of each user were identified using the map services of Google and Yandex companies and their coordinates were determined. After the determination of the coordinates, the addresses of the users are deleted from the records just like their names. The specified coordinates are individually set and marked on the Google Earth program. During marking, persons are identified with a pin indicating the service number they use and the codes assigned to them. Figure 2 shows the location of personnel shuttle service users of Boğaziçi University, while Figure 3 shows a sample for the marking process.



**Figure 2: Location Of Personnel Shuttle Service Users Of Boğaziçi University**



**Figure 3: Marking The Location Of Personnel Service Users Of Istanbul Okan University On A Digital Map**

After determining the current status of services, an intuitive method was developed to improve service lines. According to this method;

- First, service users were clustered and the services used by people in close clusters were examined.
- Then, services using the same route were identified and evaluated together.
- Average traffic conditions were examined and, it was determined that except for very exceptional conditions the service vehicles reached the destination fastest using the main roads. For this reason, service routes were arranged to use the main roads as much as possible.
- When the service vehicles using the same route were investigated, the conditions of combining vehicles with low passenger demand and capacity were examined.
- Then, the conditions of service vehicles using the same route to serve different stops were examined. For example, it is planned that a personnel shuttle service would not receive passengers after a certain point and other service(s) will be served to the passengers following that point.
- Then the condition of dividing shuttle services with high number of passengers according to the location of the people and if possible transferring some passengers to another service vehicle was examined. In some circumstances, it was proposed to create new lines by taking into account the requests and suggestions of the users.
- Finally, alternative routes where service vehicles can pass closer to the passenger clusters and alternative routes that shuttle services can take in a shorter time have been identified. At this stage, some of the service lines were shortened and some passengers were advised to use other services. In this case, it was also proposed to extend the routes of some service lines.

A second alternative solution was also developed for Boğaziçi University only. The system is basically based on the principle that all personnel who are located within 1 km of any metro or metrobus stop or at the same distance of the bus lines passing through the University, to come to the university by using these public transportation vehicles or by using the services starting from some specific centre points. Areas of influence, one of the most important parameters of public transport systems is defined by American Public Transport Association (APTA) as the area within a certain distance of public transport stops and has a high potential for providing passengers [9]. The radius of this area of influence was chosen as 1 km to be a walkable distance in Istanbul. Passangers that are residing in the area of influence of M2 (Yenikapı-Hacıosman) and M6 (Levent-Rumeli Hisarüstü) metro lines, 559C (Taksim-Rumeli Hisarustu) and 43R (Kabatas-Rumeli Hisarustu) bus lines and between the Halıcıoğlu and Zincirlikuyu stops of the metrobus line were decided to come directly to campus using the public transit lines.

The center point system is proposed as an alternative system, instead of bringing all personnel from their houses to their working place. The personnel will be brought to the central points to be built in the densely populated areas, if possible with their own means (public transport, walking etc.), if not by small service vehicles. All employees that need to be collected here, when they are ready, will be taken to their work places using large shuttle service vehicles (buses). The main purpose of the central point system is to reduce the number of kilometers traveled by these services rather than by decreasing the number of services, and also to reduce the negative effect on the main arterials due to this decrement. If this system is also used by other institutions, it is thought that it will create a positive trend especially in the vehicle traffic in the main arterials.

## RESULTS

Urban traffic of Istanbul causes very long delays to all passengers, especially during the evening peak hours. In order to solve this problem, the number of vehicles in the traffic should be reduced and public transport systems should be expanded. Thanks to the proposed method 61 personnel services of Boğaziçi University were reduced to 43. In the current system, the total distance covered by the vehicles is 3460 km, while the suggested method of improving the routes, has decreased it to 2626 km. Alternative method decreased it even more to the 2092 km by using public transportation. The main important point is to decrease number of vehicles entering the city center traffic.

24 service lines serving to Istanbul Okan University Akfırat Campus were tried to be improved in a way that provides benefits for both users and operators by using a heuristic method developed within the scope of this study. In the improvement plan, lengths, travel times in morning and evening hours of service lines, distance of service shuttle passengers to the service lines or stops and their times spent in the service vehicle were taken into consideration. In addition to the changes in service routes, the most suitable service line for each user is also proposed. It should be noted that these lines are a recommendation, and that employees cannot be forced to use any service lines. Due to the inadequacy of public transport lines that provide access to the campus, it was not possible to develop an improvement by using the alternative method for Istanbul Okan University.

As a result of the study, no change is recommended for “Taksim, Bostancı, Kurtköy-1, Fenerbahçe, Ataşehir, Acıbadem, Tuzla, Kurtköy-2” service lines. Minor changes were recommended to the routes of “Mecidiyeköy, Kazasker, Kozyatağı, Üsküdar, Ziverbey, Kadıköy, Paşabahçe, Uğur Mumcu, Pendik, Ümraniye, Maltepe and İzmit services. The comprehensive changes proposed for service lines include the combining of Kartal and Maltepe services, changes on Paşabahçe and Ümraniye service routes that will affect each other, dividing Pendik route into two separate routes, addition of a new line as Batı Ataşehir-Libadiye and as a result, rerouting the Göztepe service as Bostancı-Dudullu and finally the extension of the Esenyalı-Güzelyalı service to Gebze. As a result of the study, it is planned to have a total of 1735 km of roads (roundtrip) in one day. A comparison of the results of the proposed methods is shown in Table 1. Results indicate that as the scale of the institution or corporation increases, the demand for the service lines also increase. Proposing an improvement includes decreasing the number of service lines for a higher scales, while it is the contrary for the lower scales. Total distance covered by the personnel shuttle services increased for İstanbul Okan University due to the addition of a new line. However, average distance covered by each shuttle service decreases as a result of the improvement plan. Both methods decreased the number of lines, total distance and total passenger.km for the Boğaziçi University. The proposed improvement plan decreased average distance covered in each line, due to the decrement in the number of lines. However, the alternative plan that includes the usage of public transport systems decreased this value drastically.

**Table 1. Comparison of the proposed methods**

	Boğaziçi University			İstanbul Okan University	
	Current	Improved	Alternative	Current	Improved
<b>Lines</b>	61	43	48	24	25
<b>Total Distance (km)</b>	3460	2626	2092	868	896
<b>Total Passenger.km (million)</b>	4,06	3,06	2,44	0,52	0,53
<b>Avr. Distance/Line (km/line)</b>	56,72	61,07	43,58	36,17	35,84

The developed study was carried out using the current residence data of the personnel who indicated that they were using the service lines. Therefore, those who do not use the service lines due to reasons such as finding the routes away from their houses or finding the service vehicles too crowded could not be taken into consideration in the study. This is one of the missing points of the study. In addition, it is known that there are personnel who joined and left both institutions within the period of the study. Therefore, it was not possible to use the most up-to-date location information. This is another deficiency of the study. In addition, it should be taken into consideration that some personnel may be harmed by the arrangement of service lines and the reactions that these people can show should be answered by explaining the reasons for the changes on the service lines.

In order to optimize the service lines, first of all, the personnel records should be kept carefully, and the information of the people who have left or who are newly joined should be kept up to date. However, this information of personnel with change of address should also be updated periodically. In addition, it is useful to conduct regular surveys to monitor personnel views and requests regarding service lines. These questionnaires can be created on the intranet to collect data from the vast majority of personnel in a short time. In addition to the evaluations on existing lines in the survey, the requests of the personnel who do not use the services can be collected. It is thought that the benefit of the service lines arranged in the light of the collected data will be even higher.

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