

Investigating and Managing the Characteristics of Travel Behavior and Travel Patterns for the University of Kufa and Suggestion a Future Transportation Plan

Hamid Athab Al-Jameel

University of Kufa/Civil Engineering Department.

E-mail: hmidathab@yahoo.com

Ban Ali Kamel

University of Kufa/ Engineering Affairs Department.

E-mail: ban2005@yahoo.com

Abstract

Educational institutions are one of the main trip generators and distributors in the cities around the world. The main campus of the University of Kufa has more than 10 faculties with more than 12,000 people (staff and students). This makes the university is one of the high attracting area of trips in the city. These attracted trips use different modes of transportation such as taxi, private car, min-bus and even walking mode. This study aims to investigate the travel behavior and travel patterns for the current trips and put the suitable suggestions for shifting the travel characteristics using efficient modern modes of transportation. More than 4000 samples have been investigated using interviews asking about the origin, the purpose of trips and the mode of trips. The results of this analysis indicate the urgent need for improving the current transportation system by encouraging public transport such as bus and tram. Moreover, there is a need for improving the design and traffic management for the gates of the university.

Keywords: trip generation, trip distribution, travel behavior, transportation planning.

الخلاصة

المؤسسات التعليمية هي واحدة من المولدات والموزعات الرئيسية للرحلات في المدن حول العالم. الحرم الجامعي الرئيسي لجامعة الكوفة يحتوي على أكثر من عشر كليات بعدد يتجاوز الـ 12000 منتسب (موظف او طالب). هذا جعل الجامعة واحد من اكبر المناطق جذبا للرحلات في المدينة. الرحلات المنجذبة تستخدم وسائل نقل مختلفة كالتكسي والمركبة الخاصة والباص المتوسط وحتى المشي. الدراسة الحالية تهدف الى اكتشاف نمط الرحلات واسلوب الرحلات الحاليه ووضع المقترحات لتغير خصائص النقل باستخدام وسائل نقل حديثة ومتطورة. اكثر من اربعة الاف عينة قد تم اخذها باسلوب المقابلات الشخصية حيث تم السؤال عن منبع الرحلة وهدفها ونوع وسيلة النقل. نتائج التحليل اظهرت وجود حاجة ملحة لتحسين نظام النقل الحالي وذلك بتشجيع النقل العام كالباصات والقطار الكهربائي. وعلاوة على ذلك فهناك حاجة لتحسين وادارة المرور لبوابات الجامعة.

الكلمات المفتاحية: توليد الرحلات، توزيع الرحلات، سلوك الرحلات، تخطيط النقل.

1. Introduction

Mainly, travel is an essential part of everyday life. Consequently, transport results from the need that can't be met in situ (Gerike, 2007 ; Becker *et.al.*, 1999). However, the transportation system has adverse effect threatening human life and environment (EEA, 2007 ; European Commission, 2003).

Transportation modeling is the most commonly tool used to estimate the future performance of the existing or developed transportation system. The traditional transportation planning models depend on the Urban Transportation Modeling System (UTMS) which is more widely called as the 4-step model. This is because it consists of four major steps; trip generation, trip distribution, mode choice and traffic assignment (Naser *et. al.*, 2015). The UTMS is widely used around the world with some modifications to evaluate some of the emerging needs such as environmental impact assessment and parking management strategies.

Traffic Impact Assessment (TIA) could be defined as the evaluation of the effects of the particular development on its surrounding and supporting transportation infrastructure and how those effects can be mitigated (Naser *et.al.*, 2015). Regrettably, a car has been the only surface transportation mode used in Al-Najaf city.

Consequently, the car mobility represents one of major factor leads to congestion and pollution (noise and air pollution).

The trip generation is the key importance to estimate the demand for the transportation system which is carried out on daily or peak period basis. Mainly, this step estimates the number of trips produced and those attracted by the zones included in the study area. The Institute of transportation Engineers' (ITE) trip generation manual is one of the most commonly used references for estimating trip rates for different proposed land uses. This manual relies mainly on the physical features of the proposed development for estimating its generated traffic.

University of Kufa is considered as one of the major trip generators and distributors in Al-Najaf city. The main campus of the university is located at the end of Al-Najaf city and at the beginning of Al-Kufa city as shown in Figure (1). A lot of congested areas could be observed clearly close to the university such as the main gate of the university which is located on Kufa-Najaf roadway and the roadway close to the Engineering gate.

This study tries to understand the travel behavior for a selected community represented by the different people that make trips to and from the university. Firstly, there is a need for travel behavior definition. Travel behavior could be summarized as the knowing the factors that control individual behavior such as car ownership, trip distance, mode choice (e.g. private car, public transport, or walking) and/or journey purpose (e.g. commuting, shopping or leisure). There is a difference between travel patterns and travel behavior in terms of the travel behavior needs to know the justifications and explanations why people travel (Headicar *et.al.*, 2009).

Curtis and Perkins (2006) reported that some papers either study the impact of urban form on travel behavior or these study socio-demographic and lifestyle factors that may influence travel behavior. Socio-demographic variables include age, household composition, income, gender and car ownership. Some of these factors and other planning and statically models are out of our study. Therefore, this study has aimed to study the university as a small city with pre-defined factors such as the land use and type of modes with possible graphical representations to put the suitable future plan to improve the transportation plan for the university.



Figure 1 Location of the University of Kufa (Google Earth, 2015).

2. Sustainable travel

The requirements of this study are mainly to suggest some improvements depend on understanding two important factors travel behavior and sustainable travel; therefore this section has been devoted to give brief definitions of these terms. Sustainable travel represents in other word what is called a sustainable transport system as reported by the ECMT (2004). Accordingly, a sustainable transport system could be represented by the system can do the following:

- The allowable of the basic access needs of persons and communities to be met safely, healthy and with justice within and between generations.
- In reasonably priced, efficiently operating, offering choice of transport mode, and supporting a vibrant economy;
- Determining the quantity of emissions and waste within the planet's ability to soak up them, reducing consumption of non-renewable resources, recycling renewable resources and minimizing the use of land and the production of noise.

Although the sustainability deals with economic, ecological and social issues but the sustainable transport area focuses on environmental matters (EEA, 2007; OECD, 2000a; Geurs and Van Wee, 2000). These environmental effects are better measurements than social and complex economic effects (OCED, 2000b; Steg and Gifford, 2005). The travel behavior has been discussed above in the introduction.

3. Data collection

More than 130 students have been involved in collecting data from all the gates of the University of Kufa. In each gate a group of students has distributed among these four gates in such a way where the team of student interviews the people entering from the gate and the other group of students interviewing the drivers. The sample of data is 4509 observations. Most of the people entered from the university gate at the time of collected data were captured by the interviewers.

Figure (2) shows the numbers of interviewed people from each gate. Obviously, the main gate located on Kufa-Najaf roadway has the highest number of attracted trips. This is due to high number of attracted trips to the university through this road for the main gate. One could see a high congestion along the section opposite the main gate as shown in Figure (3). The figure indicates the bottleneck which is close to

the main gate causing interruption of flow due to high percentage of pedestrian crossing the road from right side to the left one. A high number of pedestrians are up to 1300 pedestrian per hour crossing the main road Najaf-Kufa. The congested section occurs because of turning vehicles from the U-turn facing the main gate of the university.

The main gate is highly used and the engineering gate and Al-Mutinabi gate coming as the second and third in important in terms of number of entering people to the university, respectively as indicate in Figure (2).

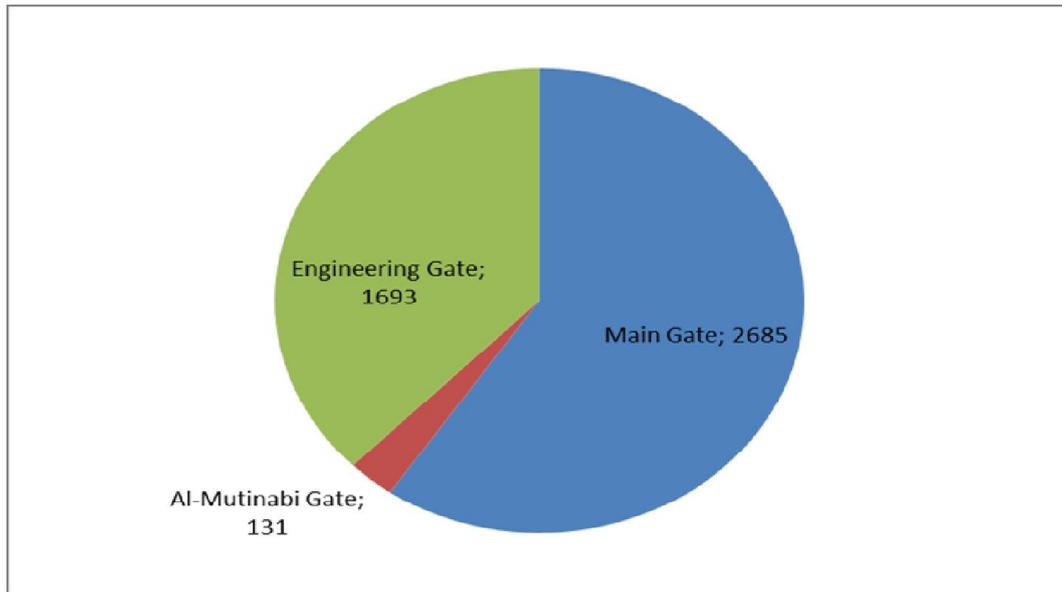


Figure 2 Proportion of trips by different modes (taxi, public, private and walk)

The main important conclusion comes up with these data. These data are the trip distribution among different modes of transportation which indicates that 44% of the trips are done using the taxi vehicles, 34% using private cars, 20% by public and 2% by walking as shown in Figure (4).



Figure 3 Long queue and congested area close to the main gate.

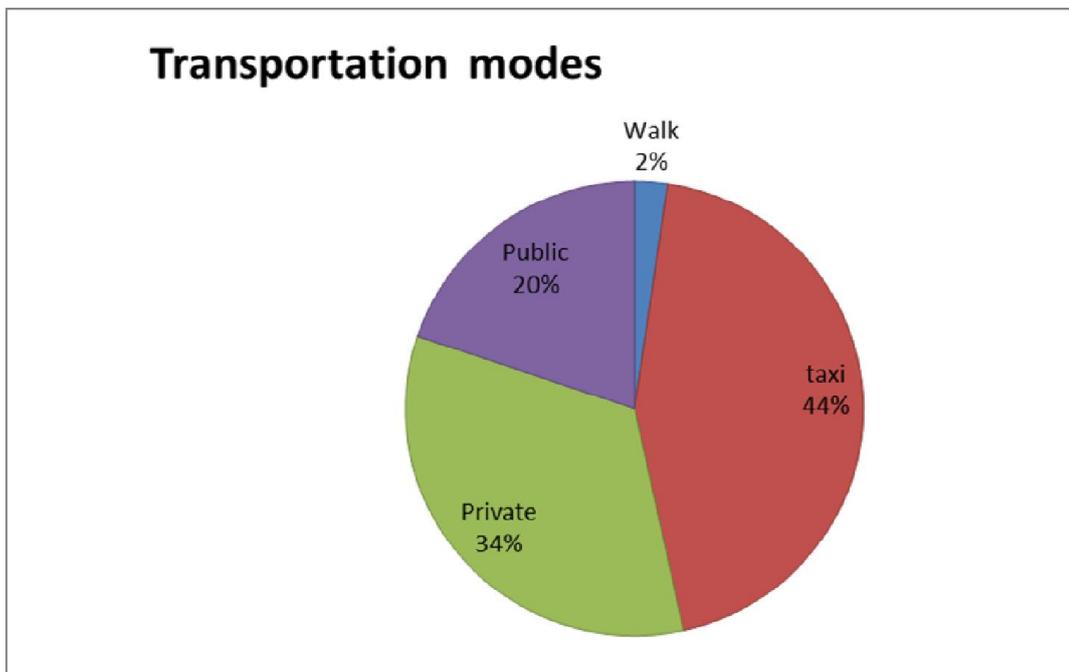


Figure 4 Transportation modes used by trip makers.

Field data obtained from the survey shows that the percentage of trips generating from Al-Najaf city is about 70%; whereas the percentage of trips coming from Al-Kufa is about 20% as indicated in Figure (5). The same figure demonstrates that Al-Hilla province is the highest percentages of trips generating from other provinces. Figure (6) represents the percentages of people doing trips to the university. More than 90% of these people are students.

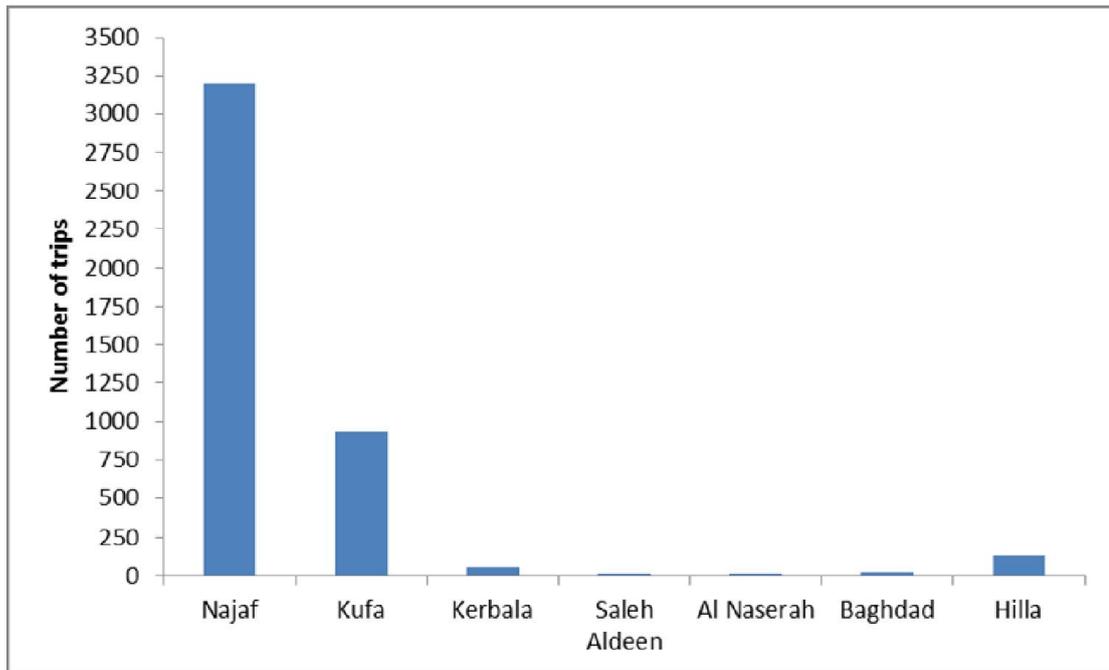


Figure 5 Number of trips coming from different locations –University of Transportation modes used by trip makers.

According to Figure (7), the flow rate is carried by this road is close to 4000 veh/hr just in two lane because the third lane is always blocked (occupied) by stopped vehicles to board or alight passengers. Therefore, such flow rate causes congestion for the roadway.

The mix of traffic stream for Najaf-Kufa roadway could be presented by Figure (8). It was obvious that the percentage of MTR is approximately high. The MTR could be defined as a three tires vehicle. The existing of such slow vehicles creates a bottleneck. Therefore, one of the suggested management by this study is to prevent the MTR together with the truck vehicles from using Al-Najaf-Kufa roadway. This will help more in increasing the speed of the roadway and its capacity.

There are another types of data were collected during this survey. These types are: flow rate for vehicles from the four gates of the university and flow rate of pedestrian crossing the arterial roadway (Najaf-Kufa roadway) facing the main gate of the university. It was noted that for the main gate has subway (driveway) as indicated in Figure (9). However, stopping the mini-bus and other cars (private or taxi) on Najaf-Kufa roadway creates a bottleneck due to missing more than one lane from this roadway. Consequently, there is a need for the prohibition of vehicles from stopping at least at peak-period which has been determined from field data (from 7:30-8:30).

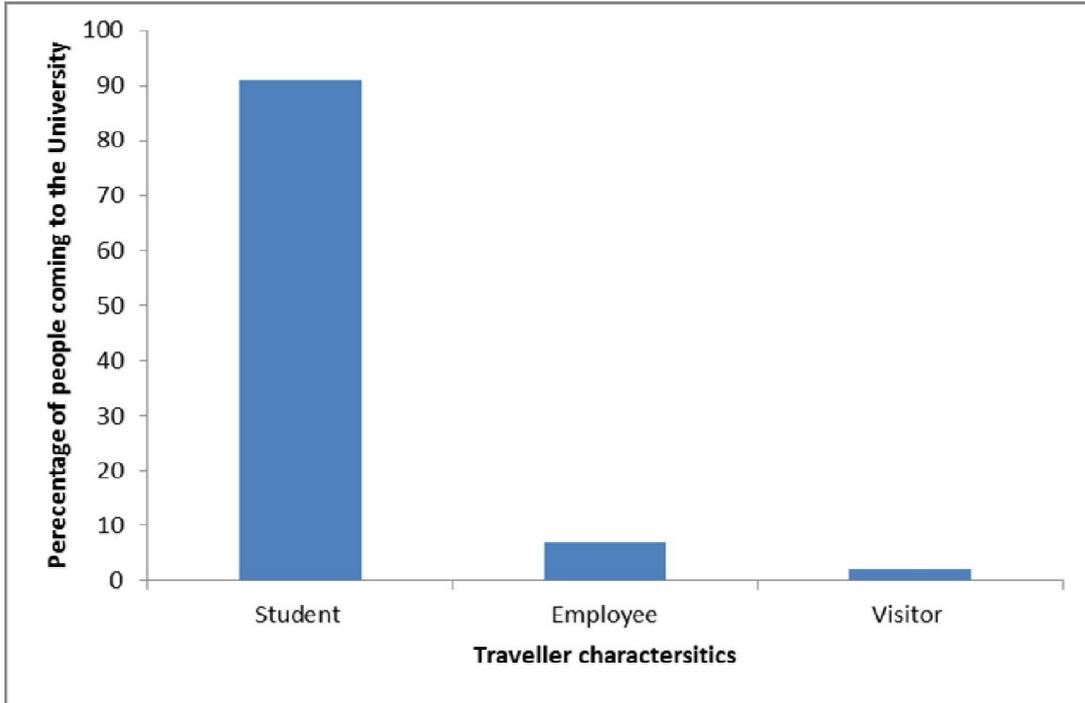


Figure 6 The percentage of people coming to the university for different purposes.

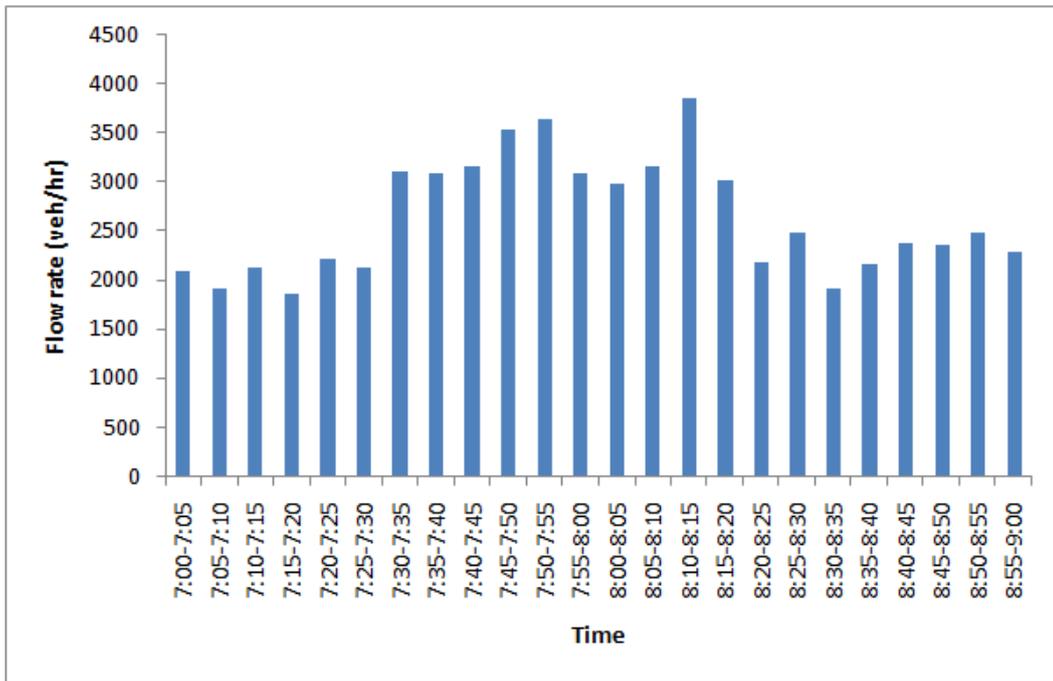


Figure 7 Peak hour flow rate for the university main gate.

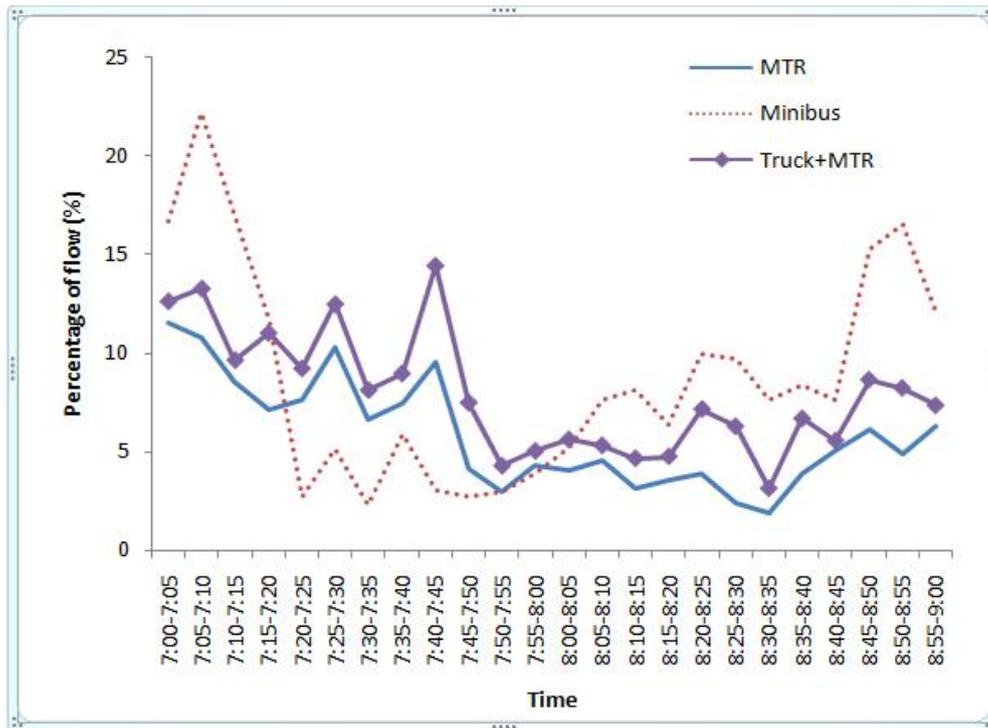


Figure 8 Percentages of MTR, minibus and truck and MTR.

Another suggestion, could be more suitable for such area, is to allow for taxi and private cars from using the subway and preventing such vehicles from using the Najaf-Kufa roadway (preventing boarding and lighting passengers on roadway).

For the Engineering Gate as indicated by Figure (10), it was observed along queue reaches up to 100 vehicles in front this gate on the subway. On the other hand, the number of the stopped vehicles to alight passenger is a high number. Whereas, the queue of vehicles at Al-Mutinabi gate extends to interact with surrounding roadway creating a bottleneck location at both entrance of the university and this surrounding roadway. This bottleneck makes the surrounding roadway suffering from congestion which already has about 3000 veh/hr according to field data obtained by this study.

Field data collected from Messan gate show that the traffic volume is about 300 veh/hr. This low flow with long storage length of roadway connecting this gate with the surrounding roadway makes this gate operates under capacity.



Figure 9 The details of the main gate of the university.



Figure 10 The details of the Engineering gate.

4. Discussion

The main characteristics of the travel behavior and travel patterns could be summarized in the following main points:

1. Mode of transportation: the collected data indicate that the only four types of transportation used such as minibus, taxi, private car and by foot. It is obvious that the percentage of taxi is 44% which is the highest percentage among other modes. On the other hand, the private vehicles, the public and the walking modes are 34%, 20% and 2%, respectively.
2. The collected data show that 95% of trips from the Al-Najaf province and 5% from out of the province. On the other hand, 73% from these trips comes from Al-Najaf city and 21.5% from Al-Kufa city.
3. The characteristics of the people making a trip to the university are obviously indicated that about 90% from the trip make by the student, 7% by employees and 2% by the visitors.
4. The distribution of these trips among different gates of the university varies from the highest number for the main gate to the lowest number from Al-Mutinabi passing by the moderate number by Engineering College gate.

After knowing the characteristics of travel behavior and pattern from the collected data, there are important improvements or countermeasures could be implemented according to these outputs. These are:

- For the planning process, it is essential to understand the travel behavior in order to get better plan for the transportation facilities. According to the data related to the modes of transportation, it is clear that more than 68% from the generating trips depend mainly on public transportation, taxi and walking. This is a good indication for the success of adopting public transportation such as scheduling bus or/and tram. The master plan for the Al-Najaf city (2007) suggests a tram line comes alongside the university. In light of the previous information, suggesting such tram line with capacity close to 10000 people per line seems to be the suitable solution at least for the 68% from all trip makers. However, more trip makers will be attracting according to the mobility and accessibility of such public transportation mode if it will be adopted.
- A huge number of trip makers coming from the main gate of the university create a congested area located on the Kufa-Najaf roadway. One of the suggested methods to mitigate the congestion is to encourage the public transportation and put as in the above suggestion by locating the tram station close to the Engineering gate.
- There is a need for two types of parking lots: one for employees which is already under parking capacity as observed by the authors for all colleges in the university campus. The existing parking lots in the campus are under capacity as observed in the field because the demand for parking is always higher than capacity. For example, parking lots in the Engineering College, parking lots in the Medicine College, etc. Second type of parking for the students. All vehicles belong to the students have to wait out in the temporary parking lot close to the Engineering gate. Therefore there is an urgent for planning for such parking lots in the campus of the university. Detailed study will be in the future for the university campus as the next step for the current study.
- There is a need for a taxi lane to boarding and alighting. It was observed that a length of more than 200m taken by taxi vehicles during the peak hour (from 7:30-8:30 A.M) which reduces from the capacity of the adjacent road close to the gates (main gate, Engineering gate and Al-Mutinabi gate).

5. Conclusions and Recommendations

The main conclusions and recommendations could be summarized as following:

1. There is a need for improving subway for taxi station to pick up and get off the passengers coming to and leaving the University for All Gates.
2. The percentage of 44% from the selected samples using the taxi is so high comparing with other modes of transportation. If the public transportation will be provided in the city in terms of tram or specific bus (BRT), this may encourage those people who used the taxi to turn to the public transportation.
3. There is a need for traffic management in terms of design storage length away from the surrounding roadway and also manage the pedestrian and parking facilities.
4. The next step of this study is to simulate the movement from all gates together with the surrounding roadways to introduce the best solution for traffic problems.

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