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Transportation Nature during Mega-Events: Investigating Trip Characteristics of Umrah Performers during Umrah Peak-Seasons

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ABSTRACT
Mega-events held in a city, or multiple cities, within a limited timeframe require special attention to infrastructure and service provision. The Umrah and Hajj events, that are hosted in Makkah, Saudi Arabia, are considered excellent examples of religious mega-events. The substantial influx of Umrah performers places significant strain on transportation management systems. Given that transportation is a crucial aspect during mega-events, this paper focuses on the Umrah season during Ramadan as a case study to gather information about transportation process. To achieve this, a questionnaire was employed to collect data on various aspects of trip characteristics and demographic information about Umrah performers. Data collection was conducted through a specially designed electronic questionnaire and subsequently analyzed using quantitative methods. The resulting insights aid in the development of tailored traffic management plans and may also inform the design of security and safety measures for Umrah performers.

KEYWORDS
mega-events; transportation; trip characteristics; Makkah.

1. INTRODUCTION

Mega-events are large-scale events attended by huge numbers of visitors. There are mainly four categories of events, namely, sports, cultural and business, and religious festivities. In addition, they have been getting much attention as key ingredients in tourism for many destinations [1].

In general, a mega-event is held in a city, or more, for a limited time. It usually has a great impact on hosting cities, which requires special attention to the infrastructure and the provided services (Taha, 2020). Based on this definition, only three events can be considered as mega-events: the Olympic Games, the World Expo and the Football World Cup [2], in addition to some religious festivities.

Among the important offered services during organizing a mega-event is transportation [3]. Organizing a mega-event, for example the World Cup and Olympic games, may serve as a nation's international showcase, and urban transportation may determine the success or failure of the event. In addition, due to the traffic congestion and the limited public transport infrastructure, a hosting city may face transportation problems. Thus, large scale transportation investments might be required, with the intension of making transportation more efficient during the event.

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These investments may include metro lines, tram and bus- systems, and a suburban railway [4]. The combination of transit modes offers potential benefits regarding accessibility, health, and sustainability. Several studies have investigated the user socio-demographic attributes and policies that encourage integration modes [5].

The transport planning approach is important and critical for any city inviting large crowds to avoid congestion and any disasters [6]. The need for safe traffic and pedestrian tunnels and subways are a requirement for many major cities around the world that invite many guests. The safety of these tunnels and subways relies on a proper system that may be efficient to work swiftly in times of crisis like fire [7]. Massive congestion on the road and public occurs due to crowds' movements during their trips from home to work and other routine travel. Assembling people in an area has numerous positive social and economic significance together with different adverse outcomes such as an increase in the rate of crime, injuries, illness, pollution, etc. [8,9]. Scientific technologies have been widely used, nowadays, to manage crowded places, and various simulation models have been developed and assessed to control the crowds and their needs [10,11].

Among the Islamic world, Saudi Arabia holds a unique position as it accommodates the world's highest mass gathering [12]. The Umrah and Hajj events, hosted in Makkah KSA, are clear examples of religious mega-events. Hajj-event occurs once a year; but Umrah occurs throughout

the year. The Umrah peak occurs during the month of Ramadan.

Since the transportation sector is considered one of the sensitive elements in the organization and success of any mega-event, in this paper, The researchers focus on Umrah seasons during the months of Ramadan as a case study to get insight into transportation during mega-events.

Ramadan is a unique month for Muslims as they fast in this month and prayers and Umrah during this month hold a special value in the religion. The Umrah in this month is regarded as equivalent to Hajj; hence a high number of Umrah performers are expected to arrive in Makkah during this month. According to the Prophet Mohammad (PBUH), the Umrah in Ramadan (the 9th month of the Hijri calendar) is equal to Hajj in terms of religious value. Therefore, it is expected that a larger number of people would prefer performing Umrah in Ramadan [13].

The arrival of Umrah performers at the Holy sites in Makkah has a great impact on the daily life of local residents. This influences the demand for services in several sectors. For example, more visitors to the city increases the demand for electricity, water, food, supplies, etc. Moreover, it increases traffic congestion and traffic jams. On the other hand, the arrival of Umrah performers at the Holy sites is important as it not only helps in boosting local business, but it generates funds for maintenance and repair. Moreover, the social impact on the locals is also very positive for meeting people of different nationalities, cultures, and races. Hence proper planning and adequate management of the crowd are important for the success of such visits [14]. Certain mishaps such as getting lost, losing certain belongings, or even identity cards are most common in large gatherings and crowds. Hence a proper model is required to manage such mishaps [15].

2. TRANSPORT CHALLENGES IN MAKKAH

Makkah is the center point for Muslims around the world, where the holy sites there offer Hajj once a year and Umrah all the year-round. The last few years have witnessed a tremendous increase in the number of Umrah performers. Indeed, the visitors to the Holy site amount to about 2.8 million during Hajj and about 5 million for Umrah season. In general, performing Umrah and praying in Haram is very favorable to Muslims as they seek to get more rewards. Doing acts of worship in Ramadan, worshipers get more rewards, as in (Quran 2:185). Therefore, the most important Umrah season is the Holy Month of Ramadan, in which a huge number of Umrah performers arrive from different cities of the Kingdom and also from different countries. Makkah has become a state of art model with its expansion of the Holy Mosque and other mega projects within the city, including the vast array of transportation systems and hosting capacities. The expansion is still in process to accommodate the increasing number of Umrah performers. Currently, most of the locations are crowded with prayers and Umrah performers, as can be seen in Figure 1. Due to this increase, the infrastructure of the Makkah city has been transformed in terms of its capacity to host Umrah performers in large numbers and to ensure the safety and efficient movements of Umrah performers from the Holy Mosque to the hotels and vice versa. However, the planning and implementation of the mass transportation system for the convenience and efficient transfer of Umrah performers to and from the Holy Mosque is not an easy task [16]. Traffic congestion is the most common problem in major cities in the world. In Makkah, not only the congestion but also the traffic jams and accidents increase due to the large number of Umrah performers moving to the Holy sites [17].

Apart from the Umrah performers coming from outside, the city Makkah is a resident for more than 1.5 million people, and its population might reach 2.5 million by 2029. The city transport system relies mainly on private cars, taxis, and charter buses. These buses pose problems of severe congestion, noise, air pollution, and visual intrusion. To address these issues, the city of Makkah requires the development of a transportation strategy. The most challenging aspect for implementing a transport strategy is routinely and daily managing the high influx of Umrah performers during peak hours from and to the Great Mosque during Ramadan. In this context, hierarchical modes with people population, using pedestrian movement at the top of the hierarchy, followed by metro, then a bus and finally car or Taxi. It is suggested that the movement from the Mosque to metro stations and bus terminals, which are located at about 600 meters, is to be on foot [18].

Transport planning in Makkah is very different from any other city in the world as it is highly dependent on the nature of trips on different days. The traffic network consists of numerous vessels that move toward the Holy Mosque. It is important to measure the occupancy of the vehicles in the city of Makkah to overcome congestion and

Figure 1 – Crowds of Umrah performers and prayers performers

to evaluate the efficiency of the road system [19]. Moreover, it has been reported that the movement of people to and from the Holy Mosque and the overcrowding during Ramadan may influence the level of temperature. Moreover, congestion in the area may raise humidity levels [20]. It has also been reported that air pollution on normal days increases during the morning traffic peak hours, and road traffic is the main source of emission. Respiratory and contagious diseases spread very quickly in densely populated areas [21]. Hence, it is important to understand the trip characteristic as it may have not only an impact on the temperature, but also on the air pollution and the health of a population. As any negligence, in this case, may lead to a burst of an epidemic or a disaster.

2.1 Traffic regulations and policies during the Umrah events in Ramadan

In Ramadan, there is a special traffic regulations and policies during the Umrah events. The traffic plan, during the Umrah event, aims to manage, monitor, and control the flow of traffic at the level of the whole area of Makkah. The plan is based on managing the entry of vehicles of pilgrims, organizing, and managing their parking - lots, regulating and controlling traffic flows in the central area around the Grand Mosque, and protecting pedestrian paths by completely isolating the movement of vehicles. It prohibits regular traffic in the central area and replaces it with public transportation and shuttle buses. Moreover, it increases the operation of the control points outside and inside Makkah to control the entry of vehicles according to the regulations and instructions.

This paper deals with the trip characteristics of crowds in Makkah city during Ramadan and, also, discusses some of the demographic data of the crowds such as education level, age, and sex of the Umrah performers. The demographic data are important for assessing crowd behavior and managing and designing facilities to prevent any disaster. The analysis of the characteristics and pattern of pedestrian walking concur any kind of risks on time. These trip characteristics help to manage and plan the pedestrian traffic in various scenarios [22]. This study is important as it may be helpful in designing the security management plans and other safety plans related to the crowd.

3. METHODOLOGY

It is important to understand the behavior of crowds at different times, their mode of travel, residence locations, etc., and understand the trip characteristics so that in case of any emergency, suitable procedures can be followed [23]. The effectiveness and efficiency in managing the crowd are dependent upon pedestrians' behavior. Hence information regarding the actual pedestrians' behavior is essential. This pedestrian behavior is, in turn, influenced by demographic data factors such as age, gender, and origin. The insights into these factors can be beneficial for management in these regions [24].

This paper uses a questionnaire to collect data about different aspects of the trip characteristics, in addition to some of the demographic information, of the Umrah performers.

3.1 Data collection and processing methodologies

Concerning the questionnaire validity, several arbitrators, who are experts in the field of Hajj and Umrah and academic experts in evaluation and quantitative/qualitative research, are consulted and their views are used to verify the final version of the questionnaire.

In terms of the data collection mechanism, data were collected using a specially designed electronic questionnaire available in both Arabic and English. The questionnaire link is distributed to the hotels where Umrah performers stay. Additionally, trained data collectors proficient in the most common languages spoken by Umrah performers—such as Arabic, English, Urdu, Turkish, Indonesian, and Malay—were available to assist in filling out the questionnaires.

The total number of Umrah performers during the month of Ramadan is approximately 5 million. The study was conducted on 3156 responses covering all five obligatory prayers, as well as Taraweeh and Tahajud prayers at the Haram area in Makkah. Data collection took place throughout the entire month of Ramadan. The sample size was determined primarily by resource availability [25]. In the conducted study, the sample size could be affected by the potential low number of questionnaire replies, due to the visitors' busy schedules (mainly religious activity-related), in addition to the restricted amount of time available (the month of Ramadan). However, a statistical tool is employed to make sure that the data is informative and that an adequate level of accuracy is estimated. For a population size of 5 million, with a desired confidence level of 95%, and a sample size of 3156, the margin of error is assessed at 1.744%, which is reasonable.

Regarding data processing, and based on the objectives of the study, statistical methods are employed. The Excel software was used for preparing data for processing (purifying, classifying, and sorting data), while IBM SPSS Statistics (Version: 28.0.0.0 (190)) software was used in the analysis of the data.

4. RESULTS

Statistical analysis of the collected data was performed, and some of the findings and observations are as follows.

4.1 Gender and age-group of Umrah performers

In total, 82% of Umrah performers who visited the Holy Mosque for prayers were males, as obligatory prayers for males are required to be performed at Mosques in the Islamic religion, as shown in *Figure 2*. On the other hand, only 18% of females were found to be present in the Mosque for prayers. This difference may be attributed to the household responsibilities of women, prompting them to opt for prayer in nearby locations.

As expected, the overwhelming majority, i.e., 52% of young Umrah performers (20-40 years), visited the Holy Mosque during Ramadan. Only 8% of Umrah performers were older than 60 years, while 7% of Umrah performers were very young (less than 20 years), as can be seen in *Figure 3*. This may be the case since older Umrah performers can easily pray in nearby places to avoid congested places around the Haram area and avoid walking while they are fasting. As the majority are young people and walking is easy for them, it is recommended to develop more walkways that lead to the Holy Mosque, in addition to allocating buses for serving the elderly and people with special needs.

4.2 Education level of Umrah performers

Only 4% of illiterate people visited the Holy Mosque for payers while 34% of the Umrah performers are university graduated. And 10% of Umrah performers who visited during Ramadan have higher education, as can be seen in *Figure 4*.

As most of the Umrah performers are highly educated, they can use technology such as intelligent transportation systems. They can also use mobile applications that can help in organizing the entry to the Haram.

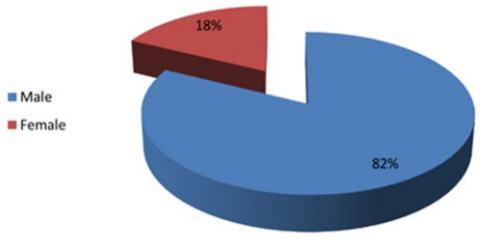

Figure 2 – Percentage of the gender of Umrah performers

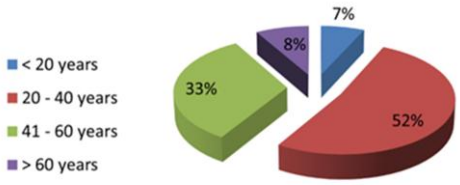

Figure 3 – Percentage of age-group of Umrah performers

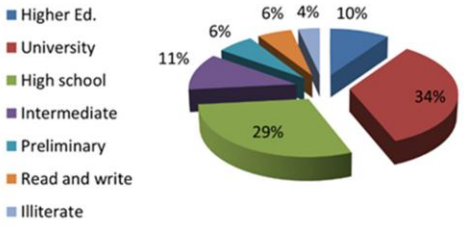

Figure 4 – Education level of Umrah performers

4.3 Country of origin and stay duration of Umrah performers

Most Umrah performers come from Pakistan, Indonesia, and Egypt. The vast majority of Umrah performers are also domestic, who come from different cities in KSA to Makkah, in addition to the residents of Makkah itself [26]. It is observed that 45% of Umrah performers stay in Makkah for more than 6 days and it is assumed that they do not belong to Makkah city. For 4 to 6 days duration of stay, 25% of Umrah performers stay in hotels in Makkah while 19% stay for 1 to 3 days, as can be seen in *Figure 5*. As observed, most of the Umrah performers spend a long period of time in Makkah. Therefore, they need more tourist activities (historical, cultural, and entertainment) in addition to religious activities. Furthermore, luggage transportation is considered an important issue. This requires a suitable management process, depending on travel mode and luggage capacity of the associated mode.

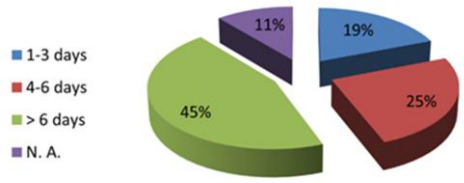

Figure 5 – Duration of stay of Umrah performers

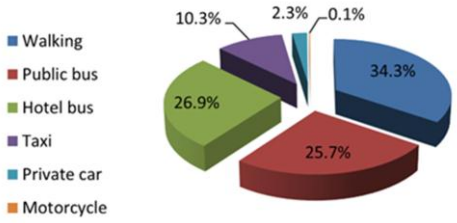

Figure 7 – Transport mode from the Holy Mosque to hotels

Figure 6 – Transport type used by Umrah performers

4.4 Transport type used by Umrah performers

In terms of the transport mode used to arrive at Makkah, 44% of Umrah performers prefer to use public buses, while only 1% come by rented cars. This is due to the parking issues at peak times around the Holy Mosque. Most hotels also provide transport, and 21% of Umrah performers use hotel buses. 13 and 19% of Umrah performers use passenger cars and taxis, respectively, as can be seen in *Figure 6*. As observed, during their stay, most of Umrah performers use public buses. Therefore, it's recommended to increase and develop bus systems to the Holy Mosque.

4.5 Transport mode from the Holy Mosque to hotels

Due to the presence of several hotels near the Holy Mosque, most of the Umrah performers, around 34.4%, use walking to attend prayers, while 26.9% use hotel buses. 25.7% of Umrah performers use public buses, and only 10.3% prefer to use Taxis, as can be seen in *Figure 7*. As most of the of Umrah performers prefer walking and using buses, it's recommended to develop efficient bus systems and dedicated walkways between hotels and the Holy Mosque.

4.6 Duration of time spent in the Holy Mosque after the prayer

About 34% of Umrah performers return immediately from the Holy Mosque to Hotels, while 21% return after 15 minutes. Similarly, 20% of Umrah performers return after 30 minutes, and only 12% return after 1 hour, as can be seen in *Figure 8*.

It can be noticed that the whole number of performers do not leave the Mosque at the same time. Hence, the transportation system can be designed to accommodate, almost, evenly distributed numbers of people over a time by developing efficient transportation plans that prevent the occurrence of crowdedness and sharp peak hours during the entire time of Umrah performers.

4.7 Travel time from hotels to the Holy Mosque

About 29.5% of Umrah performers take 11 to 15 minutes to reach the Holy Mosque. An almost similar Umrah performer's pattern (i.e., 28.7%) spend 6 to 10 minutes to reach the Holy Mosque. Around 18.7% and 15.3% of Umrah performers take 1 to 5 minutes to reach the Holy Mosque. Only 6.8% of Umrah performers take 21 to 30 minutes, as can be seen in *Figure 9*. In general, around 93% of Umrah performers take about 20 minutes or less to get the Holy Mosque. The reason for such moderate duration is that most of the hotels are close to the Haram area. Moreover, many hotels have their buses that help Umrah performers in reaching the Haram at a reasonable time.

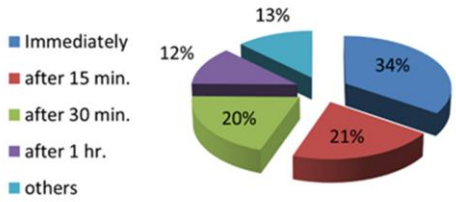

Figure 8 – Duration of time spent in the Holy Mosque after the pray

4.8 Mode of transportation for visiting the Holy Mosque

A considerable number of Umrah performers go to the Holy Mosque walking (34%), whereas 29% use hotel buses, 24% use public buses, while 11% use Taxis. Only 2% use their own cars, as can be seen in *Figure 10*.

The observations show that most of the Umrah performers prefer walking and using buses. Therefore, it's recommended to develop efficient bus systems and dedicated walkways leading to the Holy Mosque.

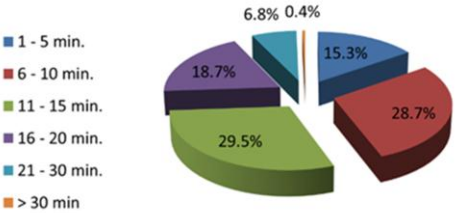

Figure 9 – Travel time from hotels to the Holy Mosque

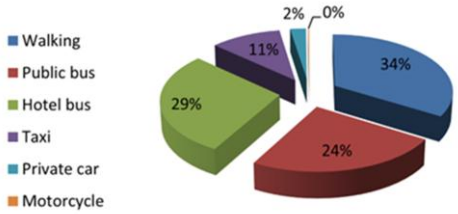

Figure 10 – Mode of transportation for visiting the Holy Mosque

4.9 Time of travelling for praying in the Holy Mosque

Most of the Umrah performers (37%) prefer to reach the Holy Mosque one hour before prayers' time to avoid the possibility of crowdedness. Similarly, 32% of Umrah performers reach before 30 minutes, while 20% come 15 minutes before prayers time, as can be seen in *Figure 11*. Therefore, there is a good opportunity to design suitable travel demand plan to avoid sharp peak hours, as around 70% of the users come to the Holy Mosque 30-60 minutes prior the prayers' time.

4.10 Umrah performers' preferred type of prayer

Finally, very interesting trends have been observed about the prayers' time at the Holy Mosque. For obligatory prayers, a favorable trend appeared in the prayers performed at night times (e.g., Fajar, Maghrib, and Isha). It is due to the fact that performing such prayers secures more rewards for the person who performs the prayers at that time, as in (Quran 17:78). Another reason is due to the hot weather as well as the fasting times. Umrah performers of older ages might prefer day time's prayers at hotels to avoid walking in hot weather during their fasting time. According to the results, 54%, 63%, and 71% of Umrah performers do their Fajar, Maghrib, and Isha prayers, respectively, at the Holy Mosque. On the other hand, Duhur and Asar prayers are performed in the afternoon, and 32% and 35% of Umrah performers do these prayers at the Holy Mosque, respectively.

The last ten nights of Ramadan are a good example that represents the most crowded period in the whole month. The reason is that Taraweeh prayer is performed after Isha prayer during the

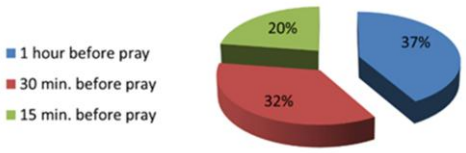

Figure 11 – Time of travelling for praying in the Holy Mosque

entire month of Ramadan, while Tahajud prayer is performed only during the last ten nights of Ramadan. The Tahajud prayers are performed at midnight before the start of fasting. The results show that 61% of Umrah performers offered Tahajud prayer at the Holy Mosque, while 70% of Umrah performers offered Taraweeh prayers. Umrah performers who attend Isha prayer also prefer to attend Taraweeh prayers as revealed by approximately the same percentage, i.e., around 70%, as can be seen in *Figure 12*.

The prayers at night times (Magreb, Isha, Taraweeh, Tahajud, Fajr) are more congested than the ones at noon and afternoon times (Dhur, Assr). Moreover, they are considered as peak periods. Therefore, more focus on traffic administration and operation should be considered at night times, in terms of increasing the number of buses and organizers.

5. DISCUSSION

Observations from the collected data can be summarized as follows:

- The area around the Holy Mosque suffers from high traffic volume, and limited roads and weak transportation infrastructure.
- The majority of Umrah performers are young people and walking is easy for them. It is recommended to develop more walkways that lead to the Holy Mosque, in addition to allocating buses for serving the elderly and people with special needs.
- Many Umrah performers use buses during their stay in Makkah. It is, therefore, advised to expand and improve transit systems to the Holy Mosque.

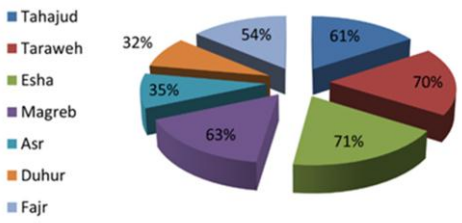

Figure 12 – The preferred prayer type of Umrah performers

- The majority of Umrah performers stay in Makkah for an extended period of time. Therefore, in addition to the religious activities, they require more tourism attractions (historical, cultural, and entertainment). Transporting luggage is regarded as a significant challenge as well. According to the related travel mode's luggage capacity and management process, this stands as a necessary issue.
- It is apparent that not all the performers leave the Mosque at the same time. Thus, by creating effective transportation plans that minimize the occurrence of high peak hours during the full period of current Umrah performers, the transportation system may be constructed to support, practically, uniformly distributed numbers of people over a time.
- Most of Umrah performers typically travel in less than 20 minutes to the Holly Mosque. The majority of hotels are located close to the Haram area, which accounts for the short period of time to get to the Haram. Additionally, several hotels have their own buses that assist Umrah performers in coming to the Haram.
- There is more congestion during the night-time prayers (Magreb, Isha, Taraweeh, Tahajud, and Fajr) than there is during the midday and afternoon prayers (Dhur, Assr). Additionally, the time of these prayers are regarded as peak times. Because there are more buses and organizers at night, there should be a greater emphasis on traffic management and operation.

5.1 Policy implications

The outcomes of the research in this paper are important as they provide useful insights into the Umrah performers (crowd) and their mode of trips along with their demographic information, which might have impacts on the following issues:

- Future planning and the management of crowds in the Holy Mosque area.
- The transportation infrastructure and traffic management.
- The expansion and improvements of the transit systems to the Holy Mosque.
- The tourism activities (historical, cultural, and entertainment) for the visitors of Makkah, besides the religious activities.
- Special services are provided by hotels to Umrah performers, especially transport services.
- The different effects of the arrival of Umrah performers in Makkah on the daily life of local residents (utilities, supplies, traffic congestion, economic and social impacts).

5.2 Limitations of the research

Although Umrah is an excellent example of religious mega-events that can be greatly used to get insight into transportation issue during mega-events, using such experience might have some limitations, which can be summarized as follows:

- The focus of the Umrah performers, sometimes, is on the worship and the religious activities, and this might limit their participation in this type of questionnaire.
- The educational and cultural level of the Umrah performers might limit the type of information that can be obtained.
- Some Umrah performers might not be interested in participating in questionnaires, which might reduce the amount of collected data.
- Many Umrah performers were concerned about the duration of the questionnaire and wanted to finish it as quickly as possible. This, unfortunately, hinders us from using qualitative research through questionnaires with open-ended questions to obtain deeper insight and more detailed information about the behaviors of the Umrah performers.

6. CONCLUSIONS

The Umrah and Hajj events, hosted in Makkah, KSA, are considered good examples of religious mega-events, that can be used as a case study to get insight into transportation during mega-events. This paper has focused on Umrah seasons during the months of Ramadan to discuss the trip characteristics and the demographic data of the Umrah performers. As Umrah is performed continuously throughout the year, more time is available for getting experience and planning for adequate enhancements.

Observations of the performed statistical analysis of the collected data shows that the area around the Holy Mosque suffers from high traffic volume, as that area is characterized with many shortcomings such as limited roads and weak transportation infrastructure. Therefore, there should be a greater emphasis on traffic management and operations.

This study is important as it provides useful insight into the Umrah performers (crowd) and their mode of trips along with their demographic information, which is helpful for future planning and the management of crowds in the Holy Mosque area.

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