



# Modeling ground access mode choice behavior for Hamad International Airport in the 2022 FIFA World Cup city, Doha, Qatar

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## ABSTRACT

The Hamad International Airport (HIA) in Doha, Qatar is the only international airport operating in the country. The airport was officially opened in 2014 to function as the engine of the country's economic growth. Due to the anticipated high passenger demand of this airport, especially to account for the 2022 FIFA World Cup and in support of Qatar National Vision (2030), it is important to analyze, model, and evaluate the current and future airport ground access and traveler's modal choice. As such, the aim of this study is to analyze the current HIA ground access mode choice characteristics and users, examine the importance of introducing the Doha Metro to airport mode choice, and identify the preference of air travelers for this new mode. A revealed- and stated preference face-to-face interview survey was conducted at the airport to collect data related to trip and user characteristics. Quantitative and qualitative methods were used to analyze the data. Binary logit mode was used to the current access mode choice, and a multinomial logit model was used to model the future access mode choice after introducing the Doha Metro. The models results showed that current and future access mode choice is significantly affected by the trip and socioeconomic characteristics of the HIA users.

## 1. Introduction

The connection service between metro systems with urban airports is significant, particularly for Qatari government, who must invest in constructing linkages between public transportation systems and airport hubs. Adequate transport infrastructure is a prerequisite for receiving, accommodating, and processing visitors of the 2022 FIFA World Cup; a well-designed infrastructure is the basis for the development of Doha as a destination. The trend of having a metro and airport nexus has gone global because it enhances international competitiveness and potential in the international tourism industry. Many metropolitan areas have invested in the connection systems between airports and cities by constructing rapid transportation systems to expand their tourism industry (Liu et al., 2013; Lohmann et al., 2009), for example, the “Heathrow Express” at the London Heathrow International Airport, “Airport Express” at the Hong Kong International AirPort, and the “East–West Line” at the Singapore Changi Airport. Combined with new sustainable transport solutions such as the Doha Metro (the Metro), an integrated transportation system in Qatar may offer a significant opportunity to connect visitors with the attraction and accommodation bases by ensuring easy ground access to destinations. In addition, connecting airports with public transportation including the Metro can

reduce carbon emissions and contribute to sustainable development in the country, which ranked highest in the MENA region in carbon emissions.

Airports are an essential element for contemporary living and represent a vital resource for moving people and shipping goods around the globe (Gokasar and Gunay, 2017; Alhussein, 2011; Budd et al., 2011). The increasing demand for air travel has contributed to increased volumes of surface traffic, because airports connect air commuters with the modes of ground transportation (de Neufville, 2006; Budd et al., 2011). Airports and ground travel are connected and affect each other.

Airport surface access is highly dependent on private vehicles for a significant number of the trips in cities worldwide (ACI, 2013; Alhussein, 2011). In Europe, approximately 65% of surface access journeys to the main airports are completed using private cars, and 99% of the surface access journeys to smaller secondary and regional airports are undertaken by private cars (ACI, 2012). These journeys could generate substantial revenues for airports through car parking fees (Oxford Economics, 2011). Notably, the significant amount of traffic has also contributed to congestion on access routes, overcrowded car parking facilities (Hofmann, 2012), decreased quality of local air (Akar, 2013), and increased emissions (Tam et al., 2011).

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Assuming the predictions about the growth in global air passenger traffic are accurate (Tsamboulas and Nikoleris, 2008), this situation is likely to increase in severity. Surface access policies mainly target accommodations for private cars (Alhoussein, 2011), and land limitations and developing pressures from the environment are the impetus for change by encouraging access through modes of public transportation (Coogan, 2008). More importantly, approaches that explicitly address the effects of airport surface access traffic have become an accepted part of the procedure for obtaining approval for airport expansion (Gosling, 2008; Clark and Lam, 1990). For example, the permission for Stockholm's Arlanda Airport expansion was contingent on the construction of a new dedicated train link (i.e., the Arlanda Express) from the Stockholm city center (Coogan, 2008).

The development of surface access policies that allow for the effective use of surface access capacity, which is presently dominated by private car journeys, is a significant challenge for airport managers. In addition, these policies must conform to the environmental and business objectives of the airport (Coogan, 2002). This task is difficult because of the numerous issues that airport managers must consider regarding the nature of surface access traffic, the changing requirements and characteristics of airport users, environmental issues, car parking, and the new conditions of the market in which airports function. Ground traffic problems such as traffic congestion can have a negative impact on the management of air traffic; therefore, airport administrators and authorities are increasingly managing problems related to ground traffic at and around their airports. According to Jou et al. (2011), managing ground traffic is important for travelers and airport administrators because the quality of ground access to an airport can influence the demand for airport air services.

In the context of realizing Qatar's National Vision 2030, the State of Qatar is increasingly receiving national and international attention as a safe, hospitable investment area, and the potential for rapid, even explosive, growth has increased dramatically. With Qatar's multibillion-dollar government fund for development projects and transport infrastructure over six years, Qatar is expected to experience rapid economic development that requires a sustainable transportation system that should function as the engine of the country's growth.

The Hamad International Airport (HIA) has an annual capacity of 50 million passengers and 2 million tons of cargo. The capacity of the airport is 8700 passengers per hour. The HIA has an essential role in the 2022 World Cup and is a milestone on the path to 2030. The anticipated passenger load from the 2022 World Cup is expected to transform the airport into Qatar's gateway to the world. Thus, understanding the current characteristics of ground access modes used by air travelers who arrive at HIA would be valuable to effectively designing a connected airport city and better manage ground traffic and represents a priority.

This study also facilitates the analysis of integrating the Metro as a new mode of transportation and effectively promoting the its use as the primary choice of travel. The Metro, a major transport project, is being built by Qatari government to transform Doha, its capital city, into a world-class economy that can sustain economic and social development. The goal of this infrastructure project is to address the rapidly growing transportation demands in Doha and the surrounding areas and prepare for the Qatar 2022 FIFA World Cup.

The Metro network has four main lines (Blue, Gold, Green, and Red) and 100 stations, with a total length of approximately 300 km (Fig. 1). Each line has the capacity for 8000 passengers per hour per direction. The HIA will be connected with the West Bay and Al Wakra City by the Red Line (known as the coastal line) (Fig. 1). The Red line is approximately 42 km long and has 18 stations. The construction of the Metro began in 2012, and the first phase is expected to be completed in 2020—in time for the 2022 FIFA World Cup.

## 2. Literature review

10. Regarding the types of airport access vital to the management of airports, several studies have analyzed air passenger ground access modes, which have continually changed for more than 40 years (Gosling, 2008). Most of the research in this field has been performed in Western cities. The comprehension of the link between the characteristics of airport users and their selected mode of ground access is undoubtedly a key part of any efficient plan to improve the airport ground transportation system. In several airports, this planning has included acts to alleviate the necessity for private vehicles. Any efforts with respect to that link are required to comprehend the nature of airport users' ground travel.

The literature has investigated elements that influence air passenger's ground access mode choice, and Table 1 presents examples from these studies. Time and cost of travel to the airport are two factors that have been considered as the main concerns of air travelers when selecting the ground access mode for airport access (e.g., Harvey, 1986; Hess and Polak, 2006; Foote et al., 2007; Cirillo and Xu, 2010; Alhoussein, 2011; Tam et al., 2011; Akar, 2013; Johnson et al., 2014; Yazdanpanah and Hosseinlou, 2016; Gokasar and Gunay, 2017). Tam et al. (2011) concluded that business travelers are more sensitive to travel time than other travelers.

Another crucial element in determining ground access mode for air travelers is their socioeconomic characteristics, which have been demonstrated to vary (e.g., Gupta et al., 2008; Cirillo and Xu, 2010; Jou et al., 2011; Alhoussein, 2011; Tsamboulas et al., 2012; Akar, 2013; Choo et al., 2013; Yazdanpanah and Hosseinlou, 2016). Alhoussein (2011) concluded that income, luggage, travel access time, and nationality significantly affect mode choice to access King Khaled International Airport in Riyadh, Saudi Arabia. Gupta et al. (2008) found that the socioeconomic characteristics of travelers that affect ground access mode choice in New York City were age, gender, and income level.

Psaraki and Abacoumkin (2002) classified air travelers into groups based on their socioeconomic and trip characteristics (e.g., trip purpose, trip destination, and residence status) to study ground access mode choice at the Athens International Airport in Greece. Modeling ground access mode choice revealed differences among these air-traveler groups. Their results demonstrated that Athens residents are more likely to drive and park on domestic business trips, whereas passengers on international nonbusiness trips are more likely to take taxi cabs or be dropped off.

Trip purpose is also considered one of the basic and fundamental elements in ground access mode choice for air passengers. Business and nonbusiness trip purposes have been considered in the literature (e.g., Psaraki and Abacoumkin, 2002; Hess and Polak, 2006; Tam et al., 2008; Choo et al., 2013). Harvey (1986) found that income level and gender were significant factors for nonbusiness passengers when selecting ground access mode choice and not significant for business passengers; some of these studies had developed discrete mode choice models for these two categories of travelers (i.e., Hess and Polak, 2006; Choo et al., 2013).

Amount of luggage and traveling group size have been found to affect ground access mode choice by travelers (Harvey, 1986; Tam et al., 2008; Budd et al., 2014). Harvey (1986) and Akar (2013) found that the amount of luggage encourages travelers to avoid using public transit. By contrast, Budd et al. (2014) stated that passengers with checked-in luggage tend to use public transit more often as their main mode to access airports. Regarding traveling group size, it has been observed that the larger the group size the less tendency to use public transit and choose a private automobile (Tam et al., 2008; Akar, 2013).

Promoting public transit as the main mode of airport access has been investigated (Gupta et al., 2008; Budd et al., 2011; Merkert and Beck, 2016, 2018; Gokasar and Gunay, 2017). Budd et al. (2011) recommend replacing the share of private automobiles (drop-off and auto) with public transit with the help of airport managers. Gupta et al.

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