

Urban Logistics Associated With Religious Tourism: The Case of the Hajj in Mecca, Saudi Arabia

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Except for the height of the COVID-19 pandemic in 2020 and 2021, millions of Muslims travel each year to Mecca, Saudi Arabia, for the Hajj pilgrimage, which is one of the 5 pillars of Islam. While much work has been done on the spiritual dimensions of the pilgrimage, this is not the case for its logistical dimensions. Yet, hosting millions of pilgrims in a confined urban space and for a short period of time –a few days– introduces enormous logistical challenges. This article’s objective is to highlight the importance of 2 key dimensions in the context of the Hajj: the challenges of the massification of pilgrim flows over the years; the correlative urgency of crowd control to avoid potentially tragic stampedes. More broadly, it is essential to examine the implications of the democratization of religious tourism for sustainable urban logistics, which is a research topic that has not been much investigated in management for the moment, despite the importance of pilgrimages on a global scale.

Keywords: COVID-19 pandemic, Hajj, Mecca (Saudi Arabia), pilgrimage, religious tourism, sustainability, waste

INTRODUCTION

Saudi Arabia is Islam’s cradle and “nerve center” (Commins, 2015). From an economic viewpoint, the Kingdom is also the world’s largest exporter of crude oil, with 7 million barrels per day in 2022. While the gigantic financial resources derived from crude oil clearly strengthen the Kingdom’s religious leadership over the *ummah* (i.e., the community of believers), the monarchy knows that it must also preserve its legitimacy as the “guardian of the holy places” (Niblock, 2006). This explains the enormous efforts made to ensure the smooth running and security of the recurrent pilgrimages on its territory. The logistical, health and security challenge is significant. Indeed, 2 to 3 million pilgrims make the Hajj every year as the fifth pillar of Islam. It is the apotheosis of the believer’s life, washing away all his/her sins. It is also a moment of reunion of Muslims worldwide, a factor of unity and a unique space of exchange. But it is also a place where mercantile dimensions are not absent, as Zaidi (2002) states. Her paper deals more specifically with introducing a “Hajj lottery” by Saudi Arabia in June 2022 for pilgrims from Europe, the Americas, and Australia (50 countries in all). The lottery is based on a random draw—via a government website—of pilgrims who will be allocated an entry visa. The website also offers personalized travel-accommodation packages, attempting to replace the services offered by travel agencies for decades.

However, there was a revolt in many countries because only 50,000 visas were allocated for the 50 countries in the lottery. Indeed, many Muslims had planned their pilgrimage for a long time and found

that their (life) project could not be realized, because of the low number of visas and the malfunctioning of the website itself. As for the pilgrims who were able to arrive in Saudi Arabia after all, some of them found that their paid-for hotel rooms were no longer available or were overbooked. In short, Zaidi (2022) concludes religious tourism is not exempt from managerial issues. In the case of the Hajj, would the 2022 lottery not implicitly be a means of regulating flows to limit the number of pilgrims? For it must be admitted that their growth over the past decades poses a real problem in logistics, particularly in urban logistics. This essential dimension is often underestimated, although it deserves in-depth attention; this will be even more the case during the 2023 Hajj with the removal of any limitation on the number of pilgrims announced in early 2023. Thinking about the logistics of pilgrimages means planning and carrying out transportation, accommodation, and food operations for thousands of pilgrims (Grondys *et al.*, 2014; Ambrósio, 2019; Mittal & Sinha, 2022), an essential condition for the success of the religious experience.

As stated by Koshak & Nour (2013), the Hajj is probably one of the biggest logistical challenges one can imagine given the massive flow of pilgrims it must manage within very strong spatial and temporal constraints. To face this challenge, the authors suggest the use of RFID technology, widely developed by the retailing industry, to provide real-time information on pilgrims' movements and thus better plan urban logistics operations. More recently, Aljohani *et al.* (2022) have highlighted the importance of logistical healthcare services during the Hajj. The authors focus on the pilgrim's need for healthcare following an illness or accident during the pilgrimage, requiring transfer to a hospital. Beyond the purely medical issues related to the pilgrim's treatment, logistical procedures are essential to manage the different phases of his care. Aljohani *et al.* (2022) suggest implementing an integrated platform for logistical health services involving public authorities and private companies involved in the organization of the Hajj. The growing body of work on the logistics of the Hajj confirms the primary importance of the topic, and the findings could be extremely useful for other pilgrimages, as well as for cultural or sporting events attracting a very large audience (Currie & Shalaby, 2012).

The present contribution wishes to identify key points that may constitute research avenues for the coming years, focusing on aspects related to the flow of pilgrims to the sacred site itself, and less on the routing of these same pilgrims from their regions or countries of origin, as Chevrier (2016) did, for example, with the visit to the Sanctuary of Our Lady of Lourdes in France. When the flow of pilgrims represents several hundred thousand, or even several million believers, in a compressed temporal sequence of a few days, it is easy to imagine the critical dimensions at stake. Indeed, as Saghi (2010) points out, "the Hajj is framed by a temporal boundary since it takes place each year only on specific days, and by a spatial boundary, which embeds in several concentric circles the areas of sacredness." To address the question, this article is organized in 3 sections. In the first section, taking the case of the Hajj in Mecca (also called Makkah), it is emphasized that religious tourism involves increasingly large masses of pilgrims, highlighting specific capacity and organizational difficulties. As indicated in the second section, one of the major challenges is the security of the flow of pilgrims, who constitute a crowd whose movements must be controlled to avoid a deadly wave phenomenon. Finally, in the third section, still taking the case of the Hajj, a discussion is initiated on possible innovation strategies to provide efficient solutions in terms of urban logistics, as part of a "smart city" policy.

MASSIFICATION OF PILGRIM FLOWS

The birthplace of the prophet Muhammad, Mecca is home to the Kaaba, an aedicula about 49 feet high, covered with a black and gold hanging, and towards which all Muslims go for the 5 daily prayers. Considered the symbolic house of God on earth, the Kaaba would have been built by Adam, to whom the Archangel Gabriel would have brought the cornerstone of Paradise, of an original bright white but blackened with time. According to tradition, the earthly Kaaba is a replica of the heavenly Kaaba, where angels devote themselves to the worship of God. Destroyed during the Flood, the Kaaba was rebuilt by the prophet Abraham and his second son Ismail, the genealogical ancestor of the Arabs and the tribe from which the prophet came: the Quraysh. Now housed in the heart of the Holy Mosque (Grand Mosque), the largest in the world, the Kaaba is the center of a series of sacred sites located a few feet away, including the Maqam Ibrahim, where the

footprints of Abraham are revered, the tomb of the prophet Ismail, the well of Zamzam and the procession gallery between the rocks of Safa and Marwa. Pilgrims must make the journey between these places 7 times, in commemoration of the wandering of Hagar and her infant son Ismail, who were abandoned by Abraham on the present site of the Holy Mosque at God’s command.

The area around Mecca is home to several sacred sites that are part of the obligatory stages of the annual pilgrimage, called Hajj, between the Holy Mosque, Arafat, Muzdalifah and the surrounding areas (see Table 1, adapted from Namoun *et al.* [2018]). Hajj is one of the 5 pillars of Islam and an obligation for all able-bodied and financially capable Muslims to perform it once in their lifetime. The pilgrimage, which usually—but not always—begins in July (from July 7 to July 12 in 2022), in fact during the month of Dhul Al-Hijjah, is based on a set of rituals to be performed in a particular order (otherwise the Hajj will not be accepted by God), and according to specific rules. It takes about 5 to 6 days to perform the Hajj. Most pilgrims also visit the holy city of Medina and the Masjid Nabawi, but this is not mandatory. In the years before the COVID-19 pandemic (which brought pilgrimages to a virtual halt with 1,000 pilgrims in 2020 and 59,000 pilgrims in 2021), more than 3 million people from all over the world performed Hajj each year. The number has continued to grow as transportation technology has advanced, making long-distance human migration easier and cheaper.

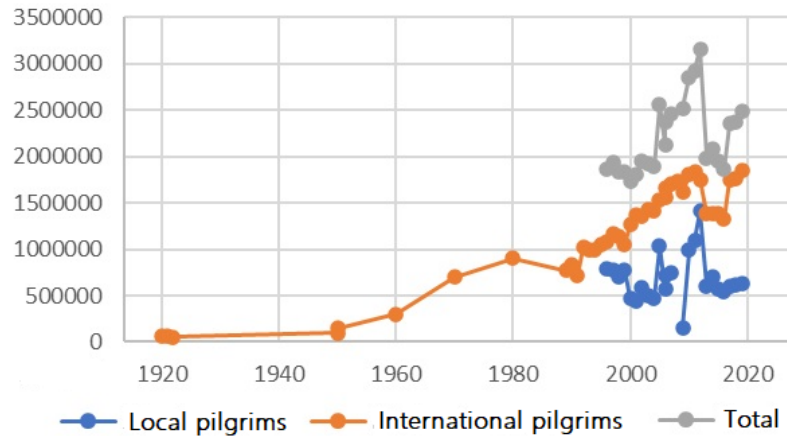
TABLE 1
HAJJ SACRED PLACES AND THEIR MAIN CHARACTERISTICS

Sacred place	Characteristics of the sacred place
<i>The Grand Mosque</i>	<i>Area:</i> 15,800,000 square feet <i>Facility type:</i> buildings
<i>Mina</i>	<i>Area:</i> 7.7 square miles <i>Facility type:</i> 45,000 Air-conditioned tents, streets, vehicles
<i>Arafat</i>	<i>Area:</i> 7 square miles <i>Facility type:</i> air-conditioned tents and open spaces, streets, vehicles
<i>Muzdalifah</i>	<i>Area:</i> 7 square miles <i>Facility type:</i> air-conditioned tents and open spaces, vehicles
<i>Jamarat</i>	<i>Area:</i> Part of Mina <i>Facility type:</i> bridge, and open spaces

Source: Adapted from Namoun *et al.* (2018).

As Zaidi (2022) states, the invention of the steamship thus played a central role in the development of the mass pilgrimage to Mecca in the 19th century, with the annual number of pilgrims increasing from about 112,000 in 1831 to 300,000 in 1910. The greatest benefit would be derived from the European steamship companies that controlled the main pilgrimage routes by sea, linking the sacred site of the Hajj with colonial areas. As an anecdote, the British government called upon Thomas Cook & Son in 1886 to become the official travel agent for the Hajj. More broadly, the colonial authorities of various countries, including France, would manifest their tutelage by rigorously supervising the flow of pilgrims (Chiffolleau, 2015). Figure 1, adapted from the contribution of Oumoudden & Al Zahrani (2021), indicates that we are now in an *era of massification* which, quite naturally, raises questions related to the reception of thousands of pilgrims in a confined urban space. Other tourist areas in the world are indeed in a similar situation, but the specificities of the Hajj create a set of constraints that must be considered. For example, while Czestochowa in Poland, located in an area close to a place of worship of Mary, receives more than 4.5 million pilgrims each year, complicating the daily life of the inhabitants, traffic congestion is limited by the constant smoothing of the flow of arrivals (Nowak *et al.*, 2014), which is not the case for the Hajj.

FIGURE 1
DEVELOPMENT OF THE NUMBER OF PILGRIMS TO MECCA (1920-2020)



Source: Adapted from Oumoudden & Al Zahrani (2021).

The massive flow of pilgrims requires an expansion of both religious and logistical capacities, which is the responsibility of the Ministry of Hajj (see Figure 2). Thus, to accommodate pilgrims during the Hajj in better conditions, the Holy Mosque has undergone a succession of expansions: 4 additional minarets between 1955 and 1973; an outdoor prayer space between 1982 and 1988; 18 new gates and 3 domes between 1988 and 2005; an increase in the building's surface area by 3,230,000 square feet between 2008 and 2011, to bring the capacity to accommodate 770,000 worshippers to more than 2.5 million; and finally, 5 mega-projects with a surface area of 4,900,000 square feet launched in July 2015 (the progress of which was slowed by the COVID-19 pandemic). Thus, between the 1950s and the 2010s, more than 100 billion U.S. dollars were invested by Saudi Arabia in infrastructure, both including work related to the Holy Mosque, but also the construction of hotel projects and urban facilities, sometimes destroying the historical heritage of Mecca, including the alleged house of Khadija, the first wife of the prophet, replaced by public toilets, or the house of Abu Bakr, companion of the prophet and first caliph of Islam, replaced by a Hilton hotel. One of the possible explanations for these destructions is not necessarily logistical since it is a Wahhabi interpretation of Islam: opposing anything that might encourage the faithful to worship idols.

FIGURE 2
LOGISTICS TOTALLY UNDER "OFFICIAL" CONTROL

A powerful Ministry of Hajj orchestrates the annual Hajj. Upon arrival at Jeddah airport, foreign pilgrims hand over their passports to their guides in exchange for an identification bracelet whose color designates their region of origin. In Mecca and Medina, they are accommodated in hotels, booked well in advance, but in Mina they are accommodated in tents. This narrow valley, where pilgrims perform the rite of sacrifice, is transformed each year for 3 days and 3 nights into a gigantic camp for more than 3 million people. The tents are provided by Saudi Arabia; they are numbered and organized by country or region, and again identified by color. To ensure the movement between the different sites where the rituals take place, Saudi Arabia also manages a huge fleet of buses that must adapt to the very restrictive time requirements of the Hajj. A delay can lead to the invalidation of the Hajj. These impressive logistics are now computerized, but despite the efforts made, there are a variety of possible frauds to make the pilgrimage outside the legal organization.

Source: Adapted from Sylvia Chiffolleau, *La Vie des Idées* [online], April 29, 2014. <https://laviedesidees.fr/Le-pelerinage-a-La-Mecque-une>

In addition to being a “logistical headache” to accommodate and feed the growing mass of pilgrims, the Hajj is a challenge for the environment (Abonomi *et al.*, 2022), especially in terms of the tens of thousands of tons of waste of all kinds that must be treated. For a long time, the environment has not been a central concern of the Saudi authorities (Henderson, 2011), the only concern being accommodating the largest number of pilgrims, hence the capacity investments previously mentioned. In 2018, however, the Mecca municipality decided to launch a waste sorting program, with a progressive recycling objective, along the lines of what is seen in a growing number of cities in Europe, and which is giving rise to much work (Wilson *et al.*, 2012; Bing *et al.*, 2016; Saucedo Martinez *et al.*, 2019). Signs in several languages have been posted to encourage pilgrims to sort their waste, and the municipality has deployed more than 13,000 cleanup workers to the sacred sites, equipped with hundreds of dumpsters and other cleaning equipment. By voluntarily investing in sustainability and adopting green practices, the goal is to combine religious rituals with respect for nature. Still, as Elgammal & Althohali (2021) state, the lack of communication between public and private stakeholders prevents moving as quickly as desired in the direction of sustainable city logistics based on effective waste management. More generally, the operationalization of sustainable logistics remains difficult and is most often based on sequential approaches that are both long and complex (Verma, 2014).

CROWD MOVEMENT CONTROL

The increase in the number of pilgrims desired by the Saudi authorities during the Hajj poses the logistical problem of managing the flow of pilgrims and regulating the movement of crowds in a small urban space. The memory is still vivid of some 2,400 pilgrims who perished in 2015 in a huge stampede (and more than 400 reported missing), the worst tragedy in the history of the Hajj (Ganjeh & Einollahi, 2016) (see Figure 3). This will lead the Saudi authorities to launch a research program on how to prevent a similar tragedy from happening again (Haase *et al.*, 2019). The physical forces generated by a considerable mass of people’s movement in one direction can cause serious or even fatal injuries due to the momentum generated. Crowds act like a gas, with individuals moving freely like particles, but if too many people are added, the crowd becomes more like a liquid (Leonard, 2022). A small push from the bottom of the crowd becomes stronger as it spreads through the group like a wave, and if it finally reaches a person next to an obstacle, like a wall or barrier, it has nowhere to go. With no way out, this force can then crush people in its path, and although special teams are in place along the route to prevent injury when a pilgrim falls while moving through the crowd, the presence of bottlenecks remains a major concern in how to block a deadly wave. However, research conducted by Alnabulsia & Drury (2014) in the context of the Hajj highlights the presence of a moderation effect based on the social identification of an individual with the crowd, which reduces the violence of the potential wave. Each pilgrim believes that he/she will be able to benefit from the support of other pilgrims, members of the same community, in the event of a stampede, and the resulting feeling of security has a positive impact on the level of stress felt.

While the stampede in September 2015 was impressive in terms of the number of victims and has given rise to a substantial literature devoted to understanding the causes and lessons to be learned (Khan & Noji, 2016; Musa *et al.*, 2017; Amoudi *et al.*, 2022), it was far from unique. For example, on the night of October 29-30, 2022, more than 150 people died in a stampede at a Halloween party in Seoul (Korea), with several thousand participants “crammed” into narrow streets. A few weeks earlier, in an Indonesian football stadium on the eastern island of Java, a crowd movement led to the deaths of 130 people, including some 40 children, after police tried to repel fans with tear gas. Most panic-stricken victims were crushed or asphyxiated as they tried to escape through closed or narrow exit doors. Finally, to return to a religious context, in October 2013, a stampede near a temple in Datia district in the Indian state of Madhya Pradesh left at least 115 people dead, trampled or drowned, and over 110 injured. At the time of the accident, 20,000 people were on a bridge spanning the Sindh River, and according to local authorities, rumors of a possible collapse of the bridge generated a deadly crowd movement. In short, the Hajj pilgrimage is not the only mass event to pose crowd movement control problems.

FIGURE 3
THE DRAMATIC STAMPEDE OF SEPTEMBER 24, 2015

A tragic stampede plunged the Hajj into mourning on September 24, 2015, the day of the Eid holiday. As on 6 occasions since 1990, it was the valley of Mina, where the ritual of stoning takes place—the faithful must throw stones at steles symbolizing Satan—that was affected. The meeting of 2 streams of pilgrims, one leaving the site of Jamarat where the ritual takes place, the other arriving in the opposite direction along a street 40 feet wide, caused a disaster with an extremely heavy toll. “The entry of pilgrims to the site of Jamarat is the most delicate moment to manage”, admitted a spokesman for the Ministry of Interior, interviewed by the Wall Street Journal. “We need to understand that, in Mecca, we are dealing with very high concentrations of people. Now, phenomena of violent turbulence appear beyond the 7 pedestrians in 10 square feet,” confirms Guy Theraulaz, director of research at the French National Centre for Scientific Research (CNRS). The tragedy of September 24 reproduces the worst-case scenario, that of a shock between 2 streams of people who collide. During the 2006 stampede, which killed 364 pilgrims, the crowd density was estimated at 10 people in 10 square feet. For comparison, the comfort limit during a rock concert is 4 people in 10 square feet. It is therefore the ability of the Saudi authorities to regulate travel that is questioned by many analysts.

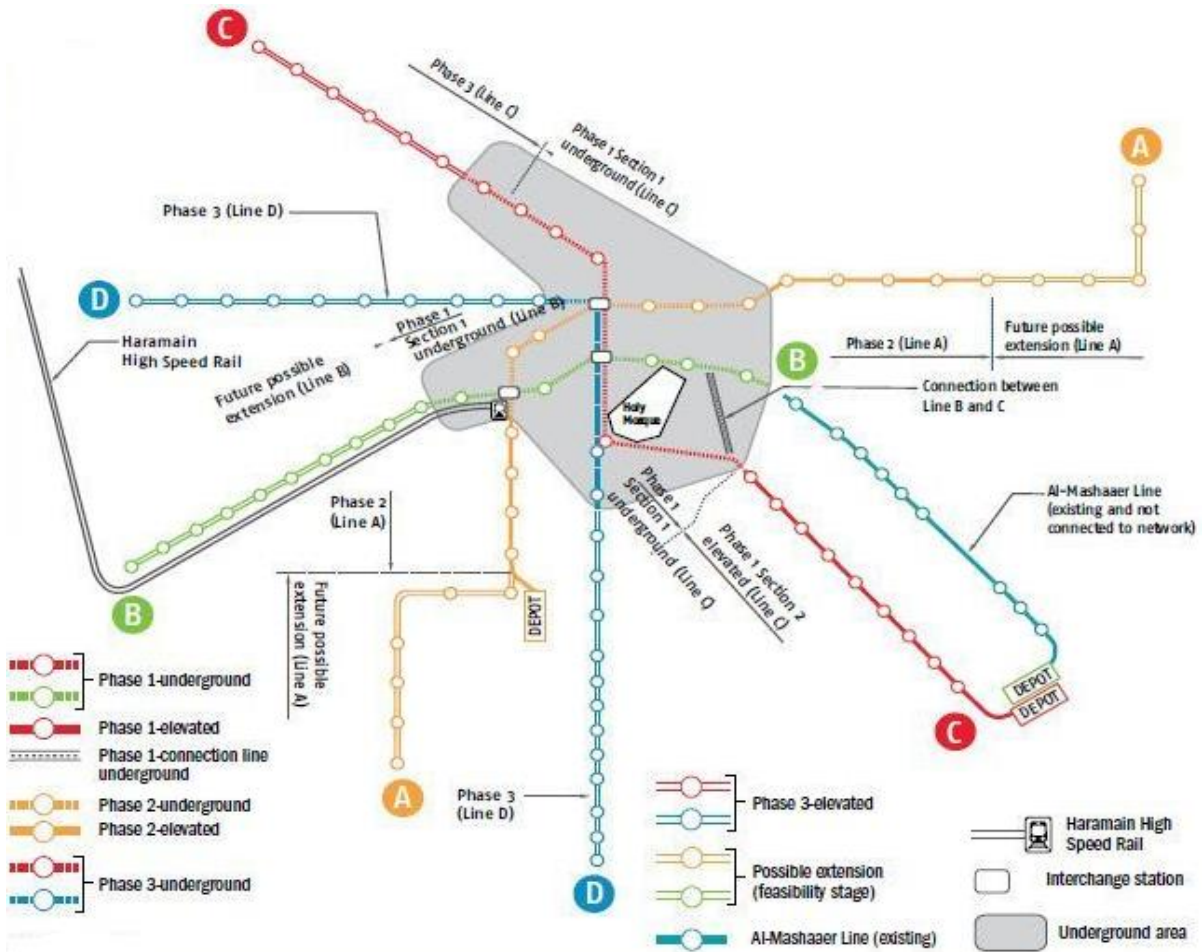
Source: Adapted from *Le Monde* [online], September 25, 2015. https://www.lemonde.fr/les-decodeurs/article/2015/09/25/la-mecque-les-raisons-d-une-bousculade-meurtriere_4772055_4355770.html

In the perspective of “urban analytics” in crowd management (Alabdulkarim *et al.*, 2016), combined with big data technologies to detect abnormalities in crowd videos (Bhuiyan *et al.*, 2023), the redevelopment of the Jamarat bridge in Mecca, completed in 2009, is a significant example of engineering efforts to avoid this type of stampede. As each pilgrim had to pass through a specific area of circular design and perform a certain ritual activity, the resulting non-flow problem was the presence of a barrier that caused uncontrollable movement into and out of the area. A significant number of crush injuries were directly related to the pedestrian traffic pattern. Using satellite technology, an infrared study revealed the areas of highest human concentration. The bridge and wall were then redesigned to be built on multiple levels, with an elliptical shape, thus eliminating the incidence of crush injuries in the area. This example is interesting because it highlights that topography is a key element to consider in urban logistics optimization, especially in mathematical models such as the one proposed by Tayan *et al.* (2014). Now, regarding Mecca, the cutting of mountains to facilitate access to the central area around the Holy Mosque is a major challenge. Due to their height and structure, these mountains constitute a natural barrier that is difficult to circumvent. As a side effect, year after year, thousands of buses, which emit large amounts of CO₂, have formed endless traffic jams at all hours, making the air unbreathable, especially around Mount Arafat, one of the main stages of the Hajj, forcing many pilgrims to wear protective masks.

To take up this challenge, an urban logistics strategy must be developed that meets the daily needs of Mecca and is also capable of handling the very large flows to and from the Holy Mosque during the Hajj. A hierarchy of transportation modes must be established based on the density of people that can be accommodated, with pedestrian travel at the top of the hierarchy, followed by metro, then bus and cab. More broadly, as Kadi & Selim (2022) state, a new governance system must be designed to better manage the crowd, and especially the critical touch points. Following an ongoing reflection conducted by the Saudi authorities, it emerged that the initial dispersal from the Holy Mosque should be on foot, with the metro stations and bus terminals located about 2,000 feet from its periphery. The key idea is to ban cars and cabs from the central part of the city during peak hours, with an exemption system for disabled persons. With this idea in mind, a metro linking 3 Hajj stops was inaugurated in 2010 to operate during the pilgrimage. Step by step, the metro line has been extended to reach 12 miles, with 9 stations, and the progressive creation of new lines is planned in the coming years (see Figure 4). More than 70,000 pilgrims are transported every hour to different destinations in its 1,000-foot-long railcars, which have one of the highest

safety standards in the world. Weber *et al.* (2023) note that a major effort is being made to reduce waiting times at stations and thus increase user satisfaction.

FIGURE 4
PLANNED EXTENSION OF THE MECCA METRO



Source: Mecca Mass Rail Transit Company.

In a continuing effort to improve pilgrim travel, Mecca is gradually becoming a “smart city” with applications to support a technologically advanced transportation system. For example, the Mecca Region Development Authority now relies on 400 smart buses, connected to a Wi-Fi network, fully green and equipped with automated navigation, collection, and payment systems. Likewise, the air conditioning, audio and video information, security systems, and electronic displays have been designed to be as sophisticated, modern, and informative as possible. Carried out by the Saudi holding company Nesma and the Spanish Transport Network Company at a total cost of 850 million U.S. dollars, the 400 smart buses transport both pilgrims and residents of Mecca, ensuring maximum fluidity of traffic, which is extremely dense during the Hajj. However, it is only one piece of a much larger puzzle for optimized mobility. 3,000 smart cameras have been installed in the Holy Mosque and the main sacred places to regulate the flow of pilgrims, especially in the city’s central area. The environmental dimension is not forgotten with a system that helps track cleanliness, with smart containers, smart cleaning equipment, and an automatic vehicle location tracking system (Doheim *et al.*, 2019). The choice of the Saudi authorities to position Mecca as a smart city is not surprising. It corresponds to a trend that is very present in urban development today, as some experts estimate that 70% of the world’s population will be living in smart cities by 2050 (Khalifa, 2019).

DISCUSSION

Religions have always encouraged the faithful to travel, but in recent decades, especially with the improvement of transportation and hotel accommodation, pilgrimages have multiplied. The growing success of religious tourism is largely due to a search for values and spirituality in a post-modern world that refutes theories claiming to hold absolute truth based on science and reason. “The 21st century will be religious, or it will not be at all,” André Malraux, General de Gaulle’s Minister of Culture, once said, and even if doubts persist as to whether he really meant this prophecy, it must be admitted that the quest for spirituality is very present in modern societies. In this context, the development of religious tourism destinations has allowed many pilgrimages to regain their former notoriety in the Judeo-Christian world, knowing that pilgrimage is today certainly the most frequent configuration of religious tourism. From a logistical point of view, any pilgrimage implies a flow of faithful towards a place of devotion or a sacred place according to one’s religion, and where various activities (prayers, celebrations, etc.) are carried out. This is obviously the case of the Hajj, with a specific set of constraints given the concentrated space and time, and the rigorous sequencing of the rituals it implies. Insofar as the Hajj has become a lucrative business for a huge number of actors, it is thus impossible not to question the logistical dimensions of its exercise, including when sensitive corruption issues are at stake (Heaton, 2023).

As the second largest source of revenue after oil, religious tourism brings tens of billions of U.S. dollars to Saudi Arabia each year. As the country’s oil revenues fell sharply with the decline in oil prices at the end of the 2010s, Crown Prince Mohammed bin Salmane launched the ambitious “Vision 2030” plan in 2016, followed by the 2020 National Transformation Program (NTP), aiming to diversify the country’s economy by directing it towards a knowledge-based and sustainable society (Alshuwaikhat & Mohammed, 2017; Nurunnabi, 2017) (see Table 2). To achieve this, Saudi Arabia plans to increase the number of pilgrims from abroad from 9 to 30 million by 2030, Hajj and Umrah combined. The COVID-19 pandemic has put a damper on “Vision 2030,” but, likely, the goal will eventually be achieved. To accommodate the growing number of worshippers, the centuries-old sites in the old city have been replaced by luxury hotels and huge buildings. Saudi Arabia is also investing in inter-urban transportation infrastructure, having inaugurated in October 2018 the Haramain High-Speed Rail that connects Mecca and Medina (via Jeddah), 280 miles apart, in just 2 hours. As far as Mecca is concerned, it is a large and growing city with a population of nearly 2 million by 2020. The city is expected to reach a population of between 2.2 and 2.5 million by 2030 and attract over 3.9 million Hajj pilgrims. In addition, 5 to 10 million international visitors and many visitors from other Saudi Arabian cities are expected to come to perform Umrah rituals and worship, with a peak during Ramadan.

For decades, the Saudi authorities recognized that the city’s transportation system in its central area, relying on private cars, cabs, chartered buses, and a very limited public bus network, was inadequate to handle the massive flow of pilgrims. The consequences were identified through recurring problems, including severe traffic congestion, poor road safety, and high noise and air pollution. It was understood that these problems had a strong—and negative—impact on the spiritual experience of pilgrims, who were confronted with the worst excesses of modernism. In other words, the problem of desynchronization between flows and capacities, well known in logistics management, gradually led to organizational crisis during the Hajj. Research conducted by Hassan *et al.* (2022) tends to confirm the significant impact of the quality of services provided, particularly in terms of food, transportation, and accommodation, on the spiritual experience of pilgrims. The authors surveyed pilgrims who performed the Hajj under the supervision of 3 licensed agencies, and their results indicate that satisfaction with transportation services is a strong predictor of the quality of the spiritual experience. This result confirms the relevance of the pilgrim city development index proposed by Nowak (2015), which incorporates the logistical service of the sacred site, the transportation infrastructure, and the accommodation facilities as key components of service quality, besides the number of seats in restaurants and bars and the number of groceries within the area of pilgrims’ stay.

TABLE 2
MAIN FEATURES OF THE “2030 VISION” PLAN AND 2020 NATIONAL TRANSFORMATION PROGRAM (NTP)

Sustainable society indicators	Actions and strategies
<p><i>Personal development</i> <i>Healthy life</i> <i>Sufficient food</i> <i>Sufficient to drink</i> <i>Safe sanitation</i> <i>Education opportunities</i> <i>Gender equality</i> <i>Clean environment</i> <i>Air quality</i> <i>Surface water quality</i> <i>Land quality</i></p>	<p>To increase women’s participation in the workforce from 22% to 30% To increase the average life expectancy from 74 to 80 years *To improve integration and continuity in services provision by developing the primary care *To improve public health services with focus on obesity and smoking *To optimize the use of renewable water resources for agricultural purposes *To develop sustainable highly efficient production systems for plants, livestock and fishery and increase the value added of these target products to contribute to the diversification of the Kingdom production base *To provide education services for all student levels *To provide a healthy local environment *To enhance quality of life by providing cities with public facilities and infrastructure of high quality and efficiency</p>
<p><i>Well-balanced society</i> <i>Good governance</i> <i>Unemployment</i> <i>Population growth</i> <i>Income distribution</i></p>	<p>To lower the rate of unemployment from 11.6% to 7% To increase SME contribution to GDP from 20% to 35% To increase foreign direct investment from 3.8% to the international level of 5.7% of GDP To increase the private sector’s contribution from 40% to 65% of GDP To raise the global ranking in the Logistics Performance Index from 49 to 25 and ensure the Kingdom is a regional leader To raise the share of non-oil exports in non-oil GDP from 16% to 50% To increase the Public Investment Fund’s assets, from SAR 600 billion to over SAR 7 trillion To increase household savings from 6% to 10% of total household income To raise the non-profit sector’s contribution to GDP from less than 1% to 5% *To improve sustainable and balanced urban development and the level of quality of life in cities and regions of the Kingdom *To boost satisfaction level of population, private sector, and governmental agencies in their participation in the planning process *To improve in the population growth rate in small- and medium-sized cities compared to the population growth rate in major cities *To create job opportunities in SMEs</p>
<p><i>Sustainable use of resources</i> <i>Waste recycling</i> <i>Use of renewable water</i> <i>Resources consumption of renewable energy</i></p>	<p>To increase the capacity to welcome Umrah visitors from 8 million to 30 million every year To increase household spending on cultural and entertainment activities inside the Kingdom from the current level of 2.9% to 6% *To provide a healthy local environment *To enhance quality of life by providing cities with public facilities and infrastructure of high quality and efficiency *To contribute to ensuring sustainable food security for the Kingdom *To optimize the use of renewable water resources for agricultural purposes *To preserve, protect, and develop the environment *To rehabilitate the agriculture terraces and application of rainwater collection technologies in the south-western area of the Kingdom</p>

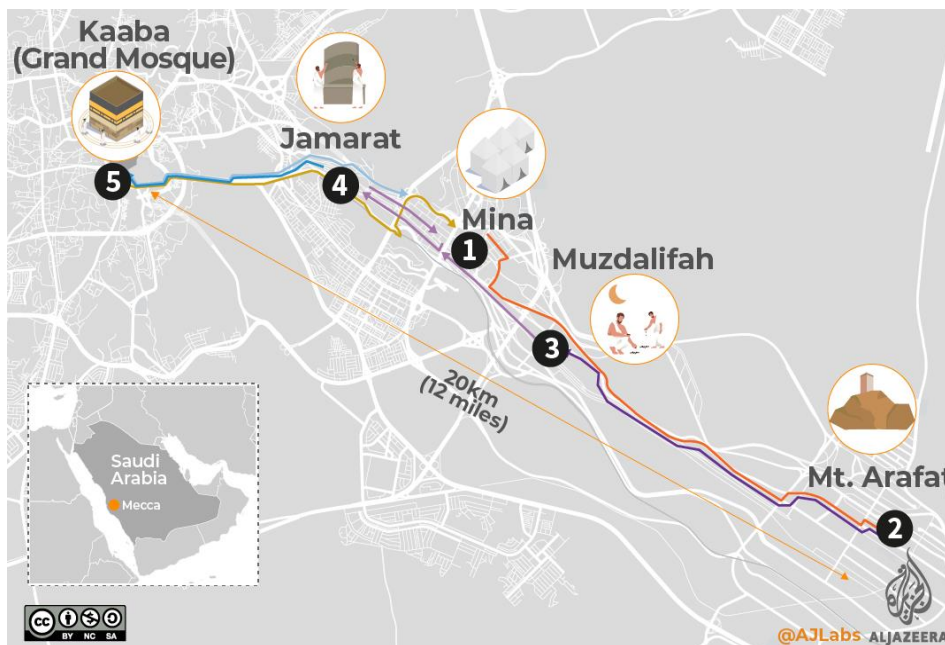
*Relevant National Transformation Program (NTP) strategic objectives.

Source: Adapted from Alshuwaikhat & Mohammed (2017).

As underlined earlier, the Hajj remains the largest (recurrent) mass gathering in the world. It involves 5 separate locations in the greater Mecca area, but with a significant portion in the heart of the city, with 3

to 5 full days of continuous movement for pilgrims (see Figure 5). While the number of participants distinguishes the Hajj from other gatherings, such as the one at the Sanctuary of Our Lady of Lourdes each August 15 (25,000 pilgrims in Lourdes on August 15, 2019, before the COVID-19 pandemic, and 16,000 pilgrims on August 15, 2022, after the COVID-19 pandemic), it is the movement of pilgrims from one location to another that requires significant logistical preparation. The planning and preparation effort is particularly acute because of the time constraint (massive movements of people take place around the time of the Hajj). It is also important to consider that a month in the Hijri calendar has 30 days, so the dates and seasons for Hajj are constantly changing. Depending on the season, the weather can be hot and humid, or on the contrary scorching, with different logistical issues depending on the prevailing conditions. For example, the 2010 Hajj took place from November 14 to 19, when rainfall in Mecca is at its highest. In a near future, it is possible to envisage that global warming will lead to unbearable levels of heat stress for pilgrims, making it difficult to perform the Hajj at certain times of the year (Kang *et al.*, 2019). Certainly, as one of the respondents in Caidi's (2019) research points out, logistics remains a secondary issue for the pilgrim at the time of the Hajj planning before the travel, at least in comparison to spiritual preparation, but this could change within one to 2 decades and impact the perceived experience.

**FIGURE 5
THE HAJJ JOURNEY**



Source: Islamicfinder.org.

Finally, when we look at the evolution of urban logistics associated with people, at least as problematic—but more traditional—as the urban logistics associated with the products to be delivered to feed pilgrims, it is impossible not to understand how religious tourism has been traversed by profound transformations of which the Hajj is a remarkable symbol. Mecca welcomes millions of Muslims from all over the world in an increasingly significant volumetric challenge. As mentioned, beyond the creation of a metro, Saudi Arabia has introduced buses that meet the highest ecological standards, but also public transportation shuttles, all of which contribute to the best possible service to the holy places (optimal number of buses and shuttles) (Hussain *et al.*, 2021; Owaidah *et al.*, 2023). Government authorities have formalized innovative ways, methods, and solutions to improve the functioning of urban logistics; by acquiring capacities and resources to improve its quality, operations are expected to be better managed, converging with a traditional supply chain management approach (Mwangola, 2018). However, much remains to be done in a kind of race

against time. Indeed, each Hajj creates increasing amounts of solid and liquid waste (see Figure 6), but it also uses large quantities of scarce fresh water, a key element in ensuring balanced urban development (Upshaw *et al.*, 2021), and it produces CO₂ emissions that remain at a very high level. In the early 2010s, El Hanandeh (2013) calculated that a Hajj pilgrim generated 60.5 kg CO_{2-eq} per day by combining transportation, accommodation, meals, and waste management.

FIGURE 6 THE PROBLEM OF WASTE MANAGEMENT STILL ALIVE

The Mamouniya camp, which hosts Saudi pilgrims or those residing in Saudi Arabia, is dotted with barrels of different colors, black for organic waste and blue for cans and plastic bottles or bags as part of an initiative to reduce the ecological footprint of the Hajj. According to the head of sanitation at the Mecca municipality, more than 42,000 tons of waste are produced during each Hajj: “We face real challenges, mainly the volume of waste produced, the number of pilgrims, the limited space around the holy sites, the different nationalities, and the weather. Islam, as a religion, does not encourage excess. Pilgrims can be friends of the environment. This starts with awareness in one’s country.” Saudi authorities aim to reduce the volume of waste by two-thirds by 2030, with a plan that considers both environmental ethics and religious beliefs. The waste collected and sorted at the pilgrimage sites is sold to companies that handle recycling, and the profits are donated to charitable organizations in accordance with the Muslim principle of Sadaqa Jariyah (voluntary giving).

Source: Adapted from *L’Express* [online], August 23, 2018. https://www.lexpress.fr/monde/proche-moyen-orient/pelerinage-a-la-mecque-le-defi-environnemental-de-la-gestion-des-dechets_2032136.html

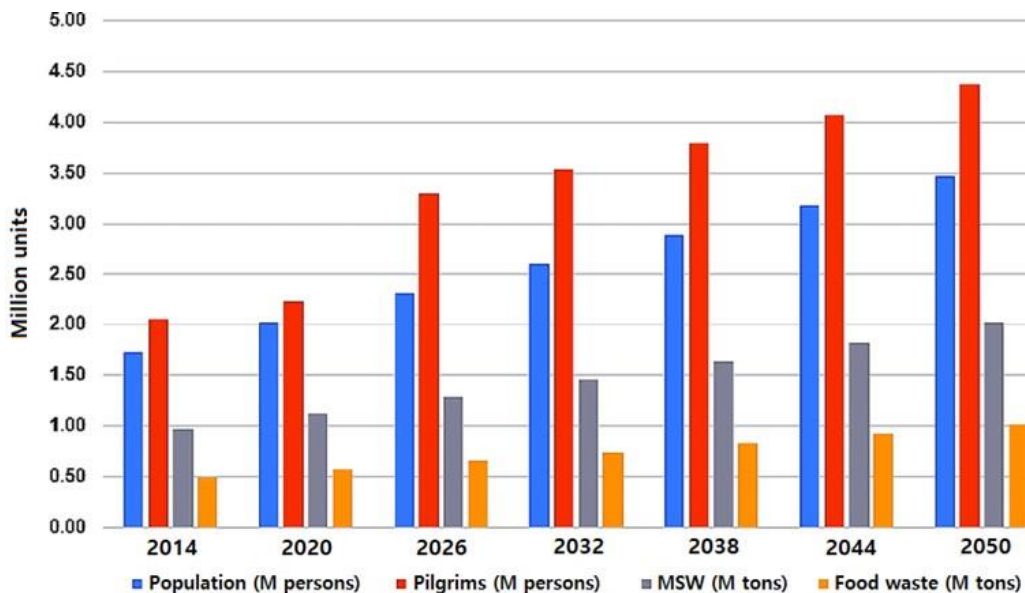
Ten years later, the investigation by Abonomi *et al.* (2022) confirms the extent of the problem regarding environmental impacts and how far we still must go to achieve carbon neutrality. A projection carried out before the COVID-19 pandemic had noted that the amount of municipal solid waste (MSW) and food waste by 2050 would not stop growing, given the continuing increase in the number of pilgrims (Shahzad *et al.*, 2017) (see Figure 7). Admittedly, the COVID-19 pandemic brought the flow of pilgrims to an abrupt halt for health reasons, but it is to be feared that in return to “business as usual,” this flow will increase sharply again in the coming years. In any case, Saudi Arabia is equipping itself with the infrastructure to welcome even more pilgrims to consolidate its role as the “nerve center” of Islam. As a result, the question of waste management will become even more pressing as the years go by. It is a real race against time between the continuation (and even intensification) of the massification of pilgrim lows, on the one hand, and technological innovation to achieve the goal of a more sustainable city and, more broadly, a “green Hajj,” to use the words of Elgammal & Alhothali (2021). In the absence of strong technological innovation, there is a risk of once again witnessing a *greenwashing operation* with disastrous effects in terms of image and communication.

CONCLUSION

Religious tourism is essentially based on having people travel to a place dedicated to devotion, memory, the appearance of a mystical presence, or a place important for the exercise of a religious tradition. Rinschede (1992) defines religious tourism as “a type of tourism whose participants are motivated either in part or exclusively for religious reasons,” characterized by specific factors such as the number of participants, the means of transportation used or the recurrence of trips. In the era of democratization of tourism, Rinschede (1992) defends the idea that in the specific context of industrialized countries, a travel is rarely undertaken for an exclusive purpose: “Pilgrimages and other religious journeys are tied to other types of tourism, perhaps more closely today than ever before. They are multifunctional journeys even when the religious factors seem to dominate in industrialized countries more so than in developing countries.” As research on the subject multiplies, a scientific journal dedicated to religious tourism was

launched in 2013: the *International Journal of Religious Tourism & Pilgrimage*. This recognition proves, if necessary that it is an economic and societal phenomenon of great importance whose stakes cannot be ignored, including in terms of logistical organization. Even for the uninitiated observers of large pilgrimages such as the annual Hajj, the question of the massive flows of pilgrims to be managed seems central. It raises major issues in urban logistics, a managerial theme that is becoming increasingly popular in the academic literature.

FIGURE 7
PROJECTION OF POPULATION, PILGRIMS, MSW AND FOOD WASTE FRACTION
(MILLION TONS) IN THE CITY OF MECCA FROM 2014 TILL 2050



Source: Shahzad *et al.* (2017).

Over the past 30 years, the number of works devoted to urban logistics has effectively exploded. Suppose a researcher enters the key words “Urban Logistics” on Google Scholar in May 2023. In that case, he/she will find more than 1.7 million references, which are certainly of very uneven quality, but which underline the fact that we are faced with a question that is deeply agitating the scientific community. These studies focus on the circulation of goods in the city, the location of stocks in urban distribution centers, and the optimization of delivery rounds in congested neighborhoods. On the other hand, the opening to the flow of people, which is at the heart of major economic issues, remains in the hands of researchers specializing in passenger transportation, human geography, and urban planning, particularly following the contribution of Merlin (1985), by highlighting the problems of mobility and accessibility. As with products, it is important to think about *flows* at the level of people, both to make their movements safer and to make them more fluid in urban space (Trono, 2016). This is what the present article focuses on the logistics associated with religious tourism in the specific context of the Hajj. While 2 doctoral dissertations were defended in the late 1970s and in the early 1980s by Bushnak (1977) and Yafi (1983) on this topic, it must be admitted that it did not arouse the enthusiasm of supply chain management researchers, which is particularly regrettable, even more so when Wiltshier (2011) considers it a key dimension to better understand the issues of religious tourism.

Suppose some research avenues are implicitly suggested here. In that case, it is urgent to continue the investigation by exploring the different practices and strategies insofar as, in Christianity alone, apart from the Sanctuary of Our Lady of Lourdes, there are pilgrimages as important as Jerusalem and the Holy Land (Israel), Rome (Vatican), Fatima (Portugal), Guadalupe (Mexico), or even Santiago de Compostela (Spain).

On a global scale, there are probably more than 500 million pilgrims per year, which is far from marginal. However, it does not seem to be of real concern to researchers in management science and management in its logistical aspect, no doubt because pilgrimages are still perceived from a spiritual perspective that can even lead the individual to experience pain as the ultimate form of “re-enchantment” (Cova & Cova, 2022). Such reasoning could then allow one to imagine that the suffering experienced in transportation and accommodation, or at least the discomfort felt, is a way of reaching God in a kind of asceticism, in the image of Saint Anthony’s departure for the Egyptian desert in the 4th century. Good (urban) logistical conditions seem to condition the satisfaction felt during a pilgrimage, as has been emphasized on several occasions in this article. It must be admitted that clarification of this point, which is still unclear, seems indispensable to advance knowledge for more effective action.

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