CROWODING IN MINA BASED ON PILGRIMS' PERCEPTION OF SAFETY AND COMFORT IN HAJJ

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In the Name of Allah, the Compassionate, the Merciful, Praise be to Allah, Lord of the Universe, and Peace and Prayers be upon His Final Prophet and Messenger.

To the pilgrims and visitors of Makkah.

To my Family.

This thesis is dedicated to them.

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ABSTRACT

Crowding perception has been studied in various settings to alleviate the effect of the crowded conditions on participants' well-being. These include festivals, outdoor recreation, tourism and retail settings. However, very few researches have addressed the crowding perception in religious settings that include a large number of populations such as during the Hajj. More than two million pilgrims perform their Hajj every year. The Hajj process involves staying at the holy site of Mina from four to five days. In Mina, the pilgrims require a peaceful atmosphere to perform their Hajj rituals. A large number of pilgrims and Mina's spatial constraints led to crowded conditions that affected the pilgrims' peaceful atmosphere and created serious safety and comfort concerns. It appears that little research consideration has been given to alleviate the impact of the crowded conditions on the pilgrims. Therefore, the research aim is to establish parameters that affect pilgrims' levels of crowding perception toward enhancing their perception of safety and comfort in Mina during the Hajj. Accordingly, a systematic literature review was employed to develop a conceptual framework that considers the possible influential factors that might affect the pilgrims' and the effect of their perceived crowding on perceived levels of safety and comfort in Mina. Then, this research used a quantitative research design and data were randomly collected from 1243 pilgrims of seven pilgrim groups representing seven Hajj establishments. The data were analysed using the SPSS and AMOS software. The findings revealed that for all pilgrims, one socio-demographic factor (education), one personal factor (expectation), two social factors (provision of information and activities) and three physical factors (routing strategies, disorientation causes and coding and signage) are observed to have significant impact on the pilgrims' crowding perception, which significantly affects their levels of perceived safety and comfort in Mina. The findings also indicated that the impact of influential factors on the pilgrims' crowding perception varies according to their pilgrims' group. Based on the findings, this research recommended eight parameters that affect the pilgrims' levels of crowding perception to enhance their levels of perceived safety and comfort in Mina. Furthermore, this thesis suggested some theoretical and practical implications as well as important avenues for future research.

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ABSTRAK

Persepsi kesesakan telah pun dikaji dalam pelbagai persekitran untuk meredakan kesan keadaan kesesakan terhadap kesejahteraan peserta. Persekitaran ini termasuk waktu perayaan, rekreasi luaran, pelancongan dan persekitaran perniagaan. Walau bagaimanapun, hanya sedikit penyelidikan yang membincangkan persepsi kesesakan dalam persekitaran keagamaan yang melibatkan sejumlah besar populasi seperti waktu melaksanakan haji. Lebih dari dua juta jemaah haji melaksanakan haji mereka setiap tahun. Proses haji melibatkan Jemaah, di Mina selama empat atau lima hari. Di Mina, jemaah haji memerlukan suasana aman untuk melaksanakan ibadah haji mereka. Jumlah jemaah haji yang besar dan kekangan ruang di Mina menyebabkan keadaan penuh sesak. Ini memberi kesan kepada suasana damai para jemaah serta mewujudkan kebimbangan yang sreius terhadap keselamatan dan keselesaan jemaah yang serius. Ternyata hanya sedikit sahaja usaha penyelidikan yang telah diberikan untuk mengurangkan kesan kesesakan pada jemaah haji. Oleh itu, penyelidikan ini bertujuan untuk membina parameter yang mempengaruhi tahap persepsi kesesakan para jemaah yang boleh meningkatkan tahap persepsi mereka terhadap keselamatan dan keselesaan di Mina semasa haji. Justeru, kajian literatur yang sistematik digunakan untuk membina rangka kerja konseptual bagi mempertimbangkan faktor berpengaruh yang berkemungkinan boleh menjejaskan jemaah haji dan kesan kesesakan yang mereka anggap boleh menentukan tahap keselamatan serta keselesaan di Mina. Selanjutnya, kajian ini menggunakan reka bentuk penyelidikan kuantitatif dan data secara rawak dikumpulkan daripada seramai 1243 jemaah dari tujuh kumpulan jemaah haji yang mewakili tujuh pertubuhan haji. Data telah dianalisis menggunakan perisian SPSS dan AMOS. Dapatan kajian menunjukkan bahawa bagi semua jemaah terdapat satu faktor sosio-demografi (pendidikan), satu faktor peribadi (harapan), dua faktor sosial (penyediaan maklumat dan aktiviti) dan tiga faktor fizikal (strategi penghalaan, penyebab disorientasi dan pengekodan dan papan tanda) yang diperhatikan mempunyai impak yang signifikan terhadap persepsi kesesakan jemaah haji, yang memberi kesan ketara terhadap tahap keselamatan dan keselesaan mereka di Mina. Penemuan juga menunjukkan bahawa kesan faktor berpengaruh terhadap persepsi kesesakan jemaah berbeza mengikut kumpulan jemaah mereka. Berdasarkan penemuan ini, penyelidikan ini mencadangkan lapan parameter yang mempengaruhi tahap persepsi kesesakan untuk meningkatkan tahap keselamatan dan keselesaan mereka di Mina. Seterusnya, tesis ini mencadangkan beberapa implikasi teoretikal dan praktikal serta cadangan penting untuk penyelidikan masa depan.

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Crowding could be said to be a subjective and psychological state. This state can be motivated when the available space is less than an individually preferred space (Stokols, 1972b). Furthermore, it is generally a negative perceptual experience in situations where high-density is associated with spatial limitation (Rustemli *et al.*, 1992). The socio-psychological effects of crowding can be immediate or long-term, direct as well as indirect, and harmful (Marshy, 1999).

In a crowded situation, the perceived levels of crowding vary among individuals. Some individuals may feel crowded whereas others could feel uncrowded even though they are in the same setting. Environmental psychologists found that many factors have led to such variations in the perception of crowding (Gharaei *et al.*, 2012; Gifford, 2007; Whiting and Nakos, 2008). These include personal (such as expectation and affiliation), social (interpersonal similarity) and physical (in the case of density, place variation and weather) factors (Gharaei *et al.*, 2012). This means that the effect of crowding can be predicted in any situation. For example, according to Hutton, *et al.* (2013), understanding particular cultures and their possible predispositions can result in a better understanding of individual motivation, and how that might impact on their behaviour at a certain event.

Understanding a crowd is beneficial for event management authorities, planners and designers (Turris *et al.*, 2014). It contributes to the overall comprehension of crowds and crowd behaviour. This, in turn, might increase the safety and comfort for the event participants. Safety and comfort are crucial in any event, especially in events characterised as mass gatherings.

At mass gathering events, the effects of overcrowding have become a major concern for participants, organisers and scientists in terms of crowd safety. One such concern is that large crowds often lead to particular types of accidents. It has been argued that an increase in crowd population is associated with a rise in the potential of certain accidents and incidents, such as tramplings, stampedes and deaths (Illiyas *et al.*, 2013; Hsieh *et al.*, 2009; Turris *et al.*, 2014). Reviewing the history of mass gatherings has shown that there have been fatal crowd disasters (Soomaroo and Murray, 2012; Hsieh *et al.*, 2009). Some of these have resulted in a high number of deaths. For example, a stampede in 1982 at a stadium in Moscow claimed 340 lives. Similarly, another stampede in Yemen in 2006, also at a stadium, resulted in 51 deaths (Krausz and Bauckhage, 2012). The disaster of 2010 in Germany occurred at a musical event and resulted in 21 people dying, with more than 500 injured (Krausz and Bauckhage, 2012). Furthermore, occasional stampedes have occurred in Mina, during the Hajj. Since 1987, there have been more than nine crowd accidents, resulting in more than three thousand deaths.

Understanding crowds and crowd behaviour is essential for ensuring safety and comfort at mass gatherings such as the annual pilgrimage, the Hajj. In addition, building upon this understanding of the nature of a crowd can assist in the implementation of certain crowd management and crowd control strategies. According to Berlonghi (1995), the ability to understand and predict crowd behaviour allows for an effective and competent management of a precise activity. However, an absence of understanding and ability to foresee a crowd's behaviour leads to mere random attempts to manage and control the crowd. In fact, such unplanned attempts might result in a serious loss of life, property and money, and a decline in health (Berlonghi, 1995). Moreover, foreseeing and understanding the behaviour of a crowd is not limited to event preparation. It is a continuing process that includes observing crowd behaviour during the event itself (Shuib *et al.*, 2013).

The individual perception of crowding offers an opportunity to understand and predict the effects of a crowded situation at mass gatherings. In addition, understanding the behaviour of individuals will minimise the effects of the problems caused by the negative perception of crowding. According to Zeitz, *et al.* (2009), at mass gatherings, the changes in crowd behaviour are subject to two important

elements. The first one is called the seed, which describes the process of deviation from what might be classified as 'normal' individual behaviour. This shift in individual behaviour might be caused by the effect of the crowding levels and possibly an individual's perception of crowd control. The second element is the adaptation of unpleasant behaviour. Zeitz, *et al.* (2009) claimed that these elements offer new research opportunities to manage crowds, such as by assessing and monitoring crowd behaviours in the pre-event and during the event.

The Hajj is considered to be one of the largest annual, human mass gatherings in the world (Alnabulsi and Drury, 2014). It takes place in the holy place of Makkah (also known as Mecca), Saudi Arabia. The Holy sites are Mina, Arafat, Muzdalifa and Makkah. Since 2000, over two million Muslims, from all over the world, visit these holy places to perform the Hajj. Muslims from different countries, races, cultures, genders and ages come together at these holy locations to perform their Hajj obligations. They form one of the largest multicultural mass gatherings. However, with the development of transportation, the number of pilgrims is increasing. For example, in 2000, the recorded number of pilgrims performing the Hajj was 1.9 million. By contrast, the number of pilgrims in 2010 was 2.8 million (Siddiqui and Gwynne, 2012). This represents a 30% increase in the total number of pilgrims since 2000. In addition, it is forecasted that this figure will reach more than four million by 2040 (Siddiqui and Gwynne, 2012).

1.2 Problem Statement

Consequently, this increasing number of pilgrims creates a movement problem at the holy locations, especially at the holy site of Mina because of its spatial constraints. Mina is described as a valley with a total area of 7.67 km^2. This valley consists of a 53% flat area, with a total area of 4.07 km^2. It has a 47% mountainous topography, with a total area of 3.60 km^2. According to the Ministry of Municipal and Rural Affairs (MoMRA, 1985), approximately 68% of Mina's plane surface is used to accommodate the pilgrims whereas the rest is used for public buildings (7%) and road networks (25%). This means that there is almost 1 km^2 of

available area that is dedicated to the movement of more than two million pilgrims. This is less than half a square metre for each pilgrim, or rather it equates to 3 to 4 persons per square metre. Consequently, Mina has become a very dense location. In certain situations, the density at Mina reaches up to 6 persons per m^2. Thus, Mina is considered to be a crowded location during the Hajj such that safety has to be a high priority for the Hajj organisers. According to Johansson, *et al.* (2008), in large crowds, densities higher than 3 to 4 persons per m^2 is an indicator of a threat to crowd safety. From this discussion, therefore, it is evident that density has to be a priority. However, density, for Stokols (1972b), is limited to the physical state of crowding experienced by the pilgrims, and does not reflect the psychological state, which seems to be an essential part of their experiences.

With such spatial or physical constraints as a result of the density, the increasing size of the crowds could lead to a disaster at the holy places for the Hajj, such as at Mina. In fact, historical records of Mina contain a number of crushing accidents. Since 1987, there have been more than nine major stampeding incidents that claimed the lives of more than three thousand pilgrims. There are several researchers who claim that these incidents have been caused by a high density flow of pilgrims (Moussaïd *et al.*, 2011; Johansson *et al.*, 2008; Helbing *et al.*, 2007).

According to Edrees (2006), the crowding incidents at Mina happened at the Jamarat area. The Jamarat area includes three pillars, which are viewed as the main destination for pilgrims in Mina. Pilgrims have to move from their tents and walk towards the Jamarat to perform the Stoning of the Devil as one of the Hajj rituals during their stay. However, after an accident that occurred in 2006, the Saudi Arabian government revealed a new development project to increase the old Jamarat Bridge capacity from a single tier to five-storeys, thus allowing a total of 4.5 million pilgrims. This new project significantly enhanced the pilgrims safety at this particular location (Alnabulsi and Drury, 2014). Edrees (2006) had discovered that the Jamarat was not the only crowded place in Mina. This crowding extended into the roads and pathways[1] between the tents blocks, especially the eleven roads and

[1] Roads are designed for cars and used for pedestrian movements during the Hajj, and cars are not allowed to use these roads during the Hajj. Whereas, pathways are originally designed for pedestrian movements.

pathways approaching the Jamarat Bridge (see Figure 1.1). The density of pilgrims in these roads and pathways increases as they get closer to the Jamarat Bridge.

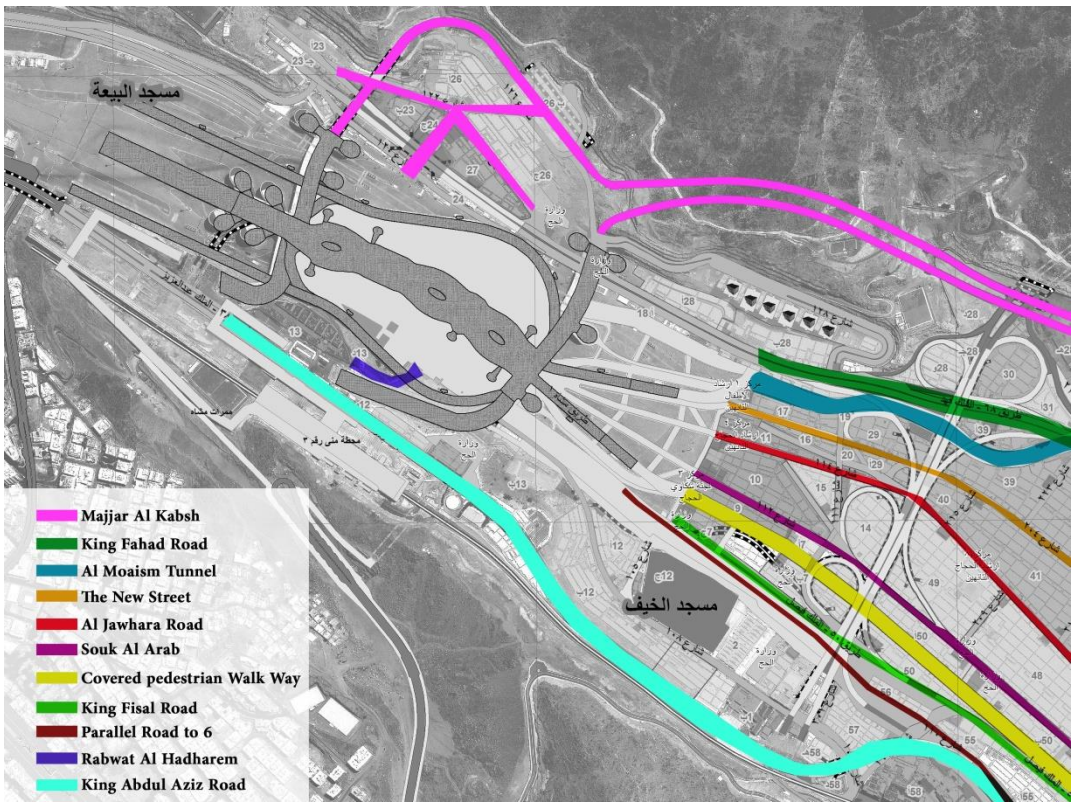

Figure 1.1: Eleven roads and pathways leading to the Jamarat Bridge become crowded during the Hajj, especially when they approach the Jamarat area.

After opening the new Jamarat Bridge, the pressure is now on the roads and pathways leading to the Jamarat. However, there has been no improvement in the capacity of these roads and pathways. This might create a potentially overcrowded area, especially with the current width and maximum flow of these routes (Table 1.1). Considering the narrowness of these routes, there is a high possibility of creating overcrowding conditions at these locations. This might influence the pilgrims' behaviour and affect them negatively, particularly as the roads and pathways arrive at the Jamarat. Moreover, such crowding conditions could have a detrimental effect on the peaceful atmosphere of the Hajj. Pilgrims need to concentrate on their religious duties without any disturbances caused by possible overcrowding. Hence, the problem of crowding and its effects on the pilgrims'

behaviour is considered a critical issue during the Hajj with respect to the pilgrims and the authorities.

Table 1.1: Names, widths and flows of roads and pathways at Mina

	Route	**Width (m)**	**Max Flow (ppl/h)**
1	Majjar Alkabsh	16.15	72675
2	King Fahad Road	30.00	135000
3	Al Moaism Tunnel	25.00	50850
4	The New Street	13.29	59805
5	Al Jawhara Road	13.00	58500
6	Souk Al Arab	11.20	50400
7	Covered Pedestrian Walk Way	28.60	128700
8	King Fisal Road	11.65	52425
9	Parallel Road to 6	13.80	62100
10	Rabwat Al Hadharem	18.00	81000
11	King Abdul Aziz Road	30.50	137250
	Total	211.19	888705

1.3 Research Gap

There has been little discussion on the crowding aspect of the Hajj even though enhancing crowd safety is a major concern for the Hajj authorities and researchers. Many studies have been previously implemented with the aim of optimising the safety levels of the Hajj and provide better crowd management. They include mathematical and virtual simulations (Mulyana and Gunawan, 2010; Abdelghany *et al.*, 2012; Curtis *et al.*, 2013; Shuaib *et al.*, 2013), engineering and architectural studies (Siddiqui and Gwynne, 2012; Gad-el-Hak, 2011) and the advance technological implementation of tracking and positioning systems (Muaremi *et al.*, 2014; Wirz *et al.*, 2013; Amer, 2011). These studies principally looked at the issue of crowding and its effects from a technological perspective. According to Alnabulsi and Drury (2014), the current body of the Hajj safety literature has overlooked the psychological aspect of the crowd. For example, simulations, as adopted by previous studies, deal with the human as a subject or as an element in space without considering their psychological state. They only offer behavioural

predictions of what might happen during a crowded event from a physical perspective.

The importance of the psychological aspect of mass gatherings has been highlighted by a recent review. Zeitz, *et al*. (2009) conclude that there is a limitation to crowd psychology research at mass gatherings in terms of their theoretical and practical bases. Shuib, *et al.* (2013) point out the need to study the psychological aspect of the crowd in order to make a significant contribution to the Hajj management. He further argues that while there are several studies examining the psychological aspect of crowds in different settings, such as musical festivals and rail settings, this is still missing in studies about the religious contexts such as the Hajj.

However, there are existing studies relating to psychology at the Hajj. These include Ghani, *et al.* (2014), who measured Malaysian pilgrims for: observable crowd, emotional and cognitive behaviours, as psychological components of crowding during the Hajj. In addition, Alnabulsi and Drury (2014) focused on crowd density and safety, using social identity theory, to claim that crowding has a positive impact on pilgrims when they are in a group that shares the same social identity. Halabi (2006) considered worshippers' behaviour from the social perspective at the Grand Mosque in Makkah, inside and outside the building. Nevertheless, these studies do not address the issue of how crowding can affect the pilgrims' behaviour, and what factors control their perception of crowding.

Hence, there is a need to study the psychological aspect of the crowd during the Hajj by focusing on the individual. In particular, this study concentrates on the effect of the pilgrims' perception of crowding whilst performing the Hajj. The setting of this event provides an opportunity to study the varied levels of the perception of crowding, and how it relates to the different factors associated with it.

1.4 Research Aim

The aim of this research is to establish the parameters that affect the perception of crowding to enhance the pilgrims' perception of safety and comfort in Mina during the Hajj.

1.5 Research Objectives

In order to achieve the research aim, the following research objectives have been formulated:

i. To identify possible influential factors that might affect the pilgrims' perception of crowding in Mina.
ii. To evaluate the impact of the identified influential factors in the way that they affect the pilgrims' perceived notion of crowding in Mina during the Hajj.
iii. To assess the effect of this perceived crowding on the pilgrims' safety and comfort at Mina.
iv. To recommend parameters that affect the crowding perception in the Hajj so that they can become amenable to control by the Hajj authorities.

1.6 Research Questions

The research questions for this study are:

i. What are the factors that might influence the pilgrims' crowding perception in Mina?
ii. To what extent do the identified influential factors affect the pilgrims' perception of crowding in the context of Mina during the Hajj?

iii. What is the relationship between the perceived crowding and the pilgrims' experience of safety and comfort?

iv. What are the attributes related to the pilgrims' perception of crowding that will enhance safety and comfort at Mina during the Hajj?

1.7 Research Methodology

This research starts with an extensive systematic literature review (SLR) to develop a conceptual framework of potential socio-demographic, personal, social and physical factors that can influence the pilgrims' crowding perception, and hence influence their perception of safety and comfort in Mina. The research employs quantitative methods to identify factors influencing the pilgrims' crowding perception and their perceived safety and comfort (Creswell and Creswell, 2017). The chosen research design in the present study is a combination of a descriptive and a correlation research design (Dimitrov, 2008). This study adopts a quantitative approach because it offers a non-experimental method in which to collect the data from the pilgrims, and it allows this study to explore the relationship between the variables (Meadows, 2003). In this research, the research process includes: instrument development, a sampling process and data collection (Bhattacherjee, 2012). The questionnaire was selected as an instrument to obtain responses from the pilgrims; it also offers a higher chance of receiving an authentic reply from the respondents as it ensures their anonymity (Nicholas, 2010).

At the end of the field survey in Mina during the Hajj, a total of 1,432 questionnaires were collected from the pilgrims in Mina. The data was screened through case screening and variable screening (Gaskin, 2016). After screening, a total of 1,243 usable responses were analysed by using the Statistical Package for Social Science (SPSS) for descriptive findings. After that, the data was analysed using the Analysis of Moment of Structure (AMOS) for Structural Equation Modeling (SEM).

1.8 Scope of the Study

This study focuses on the holy location of Mina. The main reason for selecting Mina is linked to the duration of the pilgrims stay since they stay for a minimum of three days, as part of the Hajj rituals (Al-Kodmany, 2013). In addition, this study only investigates the pilgrims' perceived crowding at the routes between the tent blocks in Mina, especially the routes leading to the Jamarat Bridge where most of the overcrowding could occur.

This study employs the official Hajj authority classification of a pilgrim for this study. During the Hajj, it is difficult to classify pilgrims based on their nationalities. Pilgrims come from more than 183 countries (Siddiqui and Gwynne, 2012). In addition, adopting Hajj authority classification enables this research to have different responses from different cultural groups, and so enabling a better understanding of the pilgrims' perception of crowding and their perceived safety and comfort levels. Moreover, pilgrims move around the area known as the Jamarat, which creates different perceptions of crowding. According to Ministry of Haj and Umra (2016), the pilgrims at the Hajj are classified into seven groups. Six out of these seven groups are organised by six establishments, which are:

i. The Southeast Asian (such as Indonesian, Malaysian and Singaporean) pilgrims.
ii. The (non-Arab) African pilgrims.
iii. The Arab Pilgrims.
iv. The Turkish and Muslim pilgrims from Europe and America.
v. The South Asian (including Indian, Pakistani and Bangladeshi) pilgrims.
vi. The Iranian pilgrims.
vii. The Interior pilgrims

The Interior pilgrim group involves residents of Saudi Arabia. It is not only limited to Saudi Arabian citizens, but it also includes pilgrims from other nationalities who are living in Saudi Arabia.

1.9 Significance of the Study

The significance of this study is derived from the subjects and their perception of crowding:

i. Understanding what crowding perception is at mass gatherings: there is a significant need for further research into recent crowding contexts such as during the Hajj to fill the theory-practice gap in the setting of mass gatherings (Hutton *et al.*, 2011; Zeitz *et al.*, 2009);
ii. The number of visitors coming to perform the Hajj: this religious event attracts more than two million visitors every year from all over the world. Few studies have investigated the pilgrims' crowding perception (Alnabulsi and Drury, 2014; Shuib *et al.*, 2013);

With this notion of subjects in mind, this study assists in refining and establishing a conceptual framework of perceived crowding at mass gatherings, as part of a theoretical contribution to the field. It identifies the combined influence of personal, social and physical factors on the perception of crowding.

In addition, the results from this study can offer a better understanding of the influential factors affecting the pilgrims' perceived crowding. From a practical perspective, it contributes to defining the pilgrims' crowding perception, and thus supports the development of an effective and competent management of the Hajj crowds. This will, in turn, enhance the safety and comfort levels of the pilgrims.

Moreover, for Muslims, the importance of this research is increased as it focuses on the performance of the fifth pillar of Islam, the Hajj. The Hajj is important for every Muslim in the world. The provision of safety and comfort in the Hajj is a major concern for more than 1.2 billion Muslims over the world. This study plays a major role in enhancing the levels of safety and comfort at the Mina by providing certain parameters that affect the crowding perception during the Hajj so that they can become amenable to control by the Hajj authorities.

1.10 Structure of the Thesis

Figure 1.2 presents the main contents of the six chapters in this thesis. The first chapter contained an introduction of this study that covered the research background, problem statement and the research gap. The research aim, objectives and research questions are determined in this chapter. A brief description of the employed methodology, scope and significant of this study were also provided in this chapter.

Chapter Two reviews the related literature of the Hajj. It provides an overview of the Hajj, describing Mina and its crowding conditions as a study site for this research. Further to this, Chapter Three provides a systematic literature review (SLR) on the notion of crowding perception. It covers the related concepts, dimensions and measurements. This chapter also reviews and discusses influential (socio-demographic, personal, social and physical) factors on the perception of crowding, and the impact of this on the perceived safety and comfort levels of the pilgrims. This chapter also proposes a conceptual framework for this research.

Chapter Four explains the research methodology used to address the research questions. It also includes the instruments, sampling techniques, data collection, data screening, data validity and preparation for analysis. Chapter Five provides a detailed account of the data analysis, findings and discussions. It illustrates the descriptive and the multivariate analysis employed in the analysis. This chapter presents an examination and discussion of several structural models related to all pilgrims and the different pilgrim groups. Chapter Six summarises the previous chapters and the main findings. It also presents the research contribution, limitations of this research and directions for future research.

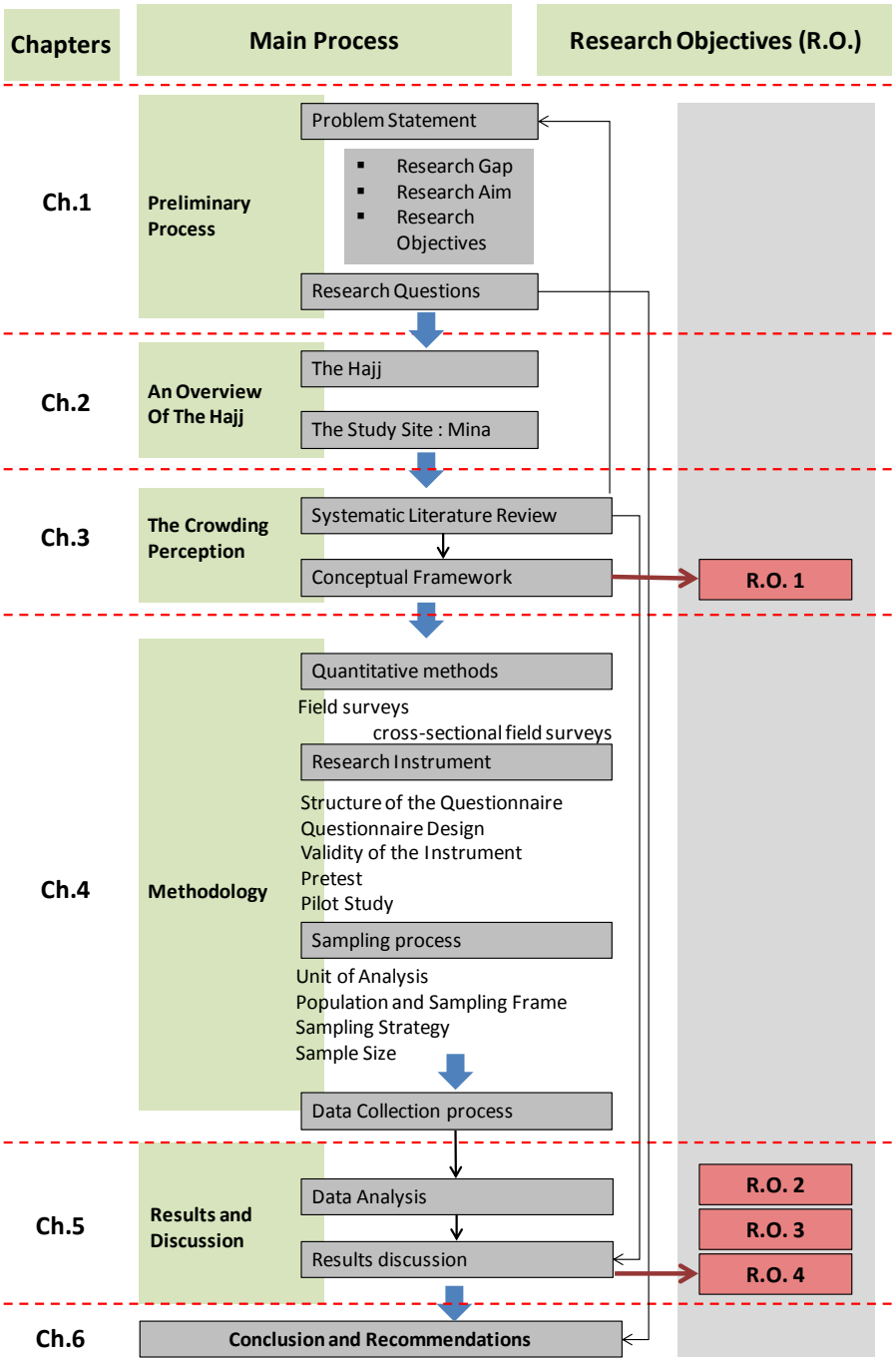

Figure 1.2: Thesis chapters and the flow of research.

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