



Faculty of Science,
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Crowd Control and Management Enterprise Modelling (CCMEM) utilising the MECCA (Mega Event Coordination and Control Architecture) Framework

A thesis submitted in Partial fulfilment of the requirements of
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By:

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ABSTRACT

Crowds are often an integral part of an event or an activity that may potentially be overlooked, yet present a substantial threat to the health and safety of all those attending such an event. In the majority of crowd control situations, the importance of managing the event will not simply rest with the event managers themselves, but is likely to involve having to create efficient enterprise wide systems which several third parties would need to interact with, in order to deal with difficulties, should they arise, such as the need to liaise with the police or fire service, as appropriate. This research focuses on the practices of crowd management and the way in which those involved in crowd management should potentially change their approach, in order to enhance safety, but also to enhance the efficiency of managing and controlling the crowd, something which is becoming increasingly important, given the economic impact that large-scale events can have on a region.

To enable the above a Crowd Control and Management Enterprise Modelling (CCMEM) framework was developed. The first stage of this was the synthesis of the appropriate components within various existing crowd management models found in literature. This synthesis, formed the basis of the theoretical components from which the Mega Event Command and Control Architecture (MECCA) framework was developed. This framework was evaluated with two case studies involving very large or mega events, namely the Hajj to Mecca and the London Olympics 2012. A research study that used both qualitative and quantitative methods to collect primary data was designed, which further developed and validated the CCMEM and the MECCA frameworks. The application of MECCA framework with the two case studies was evaluated using the Crowd Management Evaluation Components (CMEC). When looking at the results of the data collected and the case studies in this particular research, it became apparent that the enterprise wide view understanding of mega event management enabled the effective mapping of and development of associated integrated systems for each of the components of the framework. This in turn leads to more efficient and effective crowd management. Also this better understanding enables officials to react much more effectively and much more quickly to changes in the crowd dynamics. Further work can

be carried out to develop the various integrated information systems which will be required and this will be based on the enterprise wide CCMEM - MECCA framework.

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CHAPTER 1 - INTRODUCTION

1.1. BACKGROUND

The issue of crowd management involves so much more than simply ensuring that a group of people can come together in such a way that does not create a substantial conflict. Also, with the increasing availability of new technologies, as well as greater opportunities for individuals to travel and come together, the issue of developing frameworks for crowd management that are both effective and safe is unlikely to go away.

Crowd management has several different aspects associated with it and, over the years, an increasing use of technology has emerged, in order to better facilitate crowd management situations and also to enable those involved in hosting large-scale events to gather information from the crowd, which is not only useful for that individual activity, but also potentially useful, in the future. For example, consider a situation such as a large event that takes place, on an annual basis. Not only is it important to ensure the safety of the individuals involved in the event being managed and that there is a relatively free-flow of people and resources throughout the event, but it is also possible for the organisers to gain a large amount of information; for example, when individuals tend to arrive at the event and their movement, as well as how long these individuals stay at the event, and the types of facilities that are used during their stay.

Naturally, however, the main focus of crowd management is likely to be, initially, to achieve public safety and this is the primary activity that those involved in these events will be focused on, before beginning to look at the extra benefits that can be achieved through strong crowd management initiatives (Lin, et al., 2001). Although crowd management principles can be used in a wide range of situations, it is worth noting that the precise way in which the crowd is dealt with, will depend on a wide variety of factors. Therefore, analysing the precise, underlining factors that may be relevant to the crowd management facility is one of the crucial background aspects that need to be done in any event, or any situation, where crowd management is deemed to be applicable. In this particular thesis, two different events are studied and this will immediately highlight the need to consider the background factors, looking at how crowd management should

take place. For example, issues such as the characteristics of the facility, the demeanour that the crowd is likely to be displaying, and the size of the crowd, as well as issues such as whether queues will be necessary or, as is often the case in sports events whether there needs to be crowd partitioning.

1.2. RATIONALE BEHIND THE RESEARCH

The issues associated with crowd management fall in two very different categories and, when attempting to establish an overall model that allows for those involved in event management to look at how they should be dealing with the types of crowds that they are likely to experience (Le Bon, 1997), each of the factors need to be considered, although they will naturally be more important in some events than another. Firstly, the very essence of crowd behaviour needs to be understood, completely. In order to have an effective plan in place, those involved in creating the plan must be aware of the types of characteristics that the crowd is likely to display. In its most basic sense, information such as the size of the crowd and the likely emotional position of the crowd will be important to determine the chance of conflict. Consider, for example, a situation where there is a sporting event between two rival teams. Both would be looking to enter the area, at a specific time, which will be the start of the game. Management issues will, therefore, consist of ensuring safety when there is a large amount of footfall, during a relatively short space of time, and ensuring that appropriate security is put in place to maintain a difference between the two teams, where appropriate. By contrast, where there is an event that is ongoing, for several hours, with no specific start time, the way in which the crowd moves is likely to be less obvious; but, equally, requires less of a crowd in a concentrated area, at a specific time, and the focus is more likely to be on ensuring that there is a maintained free-flow, with little or no queuing (Helbing, 2008).

Although, clearly, there needs to be a focus on the event itself and the crowd make-up for that individual situation, there are also generic issues which arise, when it comes to crowd manipulation. Public education, to a certain extent, creates its own problems. For example, in many cases, difficulties may arise amongst the crowd, due to rumours or the perception of danger that may not, in fact, be the case. This has become particularly relevant, in recent years. As a result of increased terrorist threats, the mere suggestion that there might be a terrorist attack could potentially create problems, within a crowd management environment, that has nothing to do, in itself, with the movement of the

crowd. The availability of alcohol and drugs has also created a challenge for those involved in crowd management, e.g. for those responsible for having to draw a line between infringing privacy and practical issues, such as how to search all members of the crowd, with the need to reduce the amount of reliance that is placed on alcohol, during these events (Andre & Koonce, 1991).

In the majority of crowd control situations, the importance of managing the event will not simply rest with the event managers themselves, but is likely to involve having to interact with several third parties, in order to create an efficient service and certainly deal with difficulties, should they arise, such as the need to liaise with the police or fire service, as appropriate (Reicher, et al., 2004). All of these could be important issues that need to be dealt with, when it comes to crowd control and crowd management, immediately indicating that the system is so much more than simply making sure that there are appropriate queues in place, and that there is somewhere for everyone to stand. It is these complexities that are going to form the primary parts of the discussion, here, with a view to establishing a framework for crowd management, in the future. The current study aims to develop a framework for crowd management which considers two main case studies: crowd management in Hajj and crowd management in Olympics.

The primary statement of the problem, here, is developing a suitable crowd control framework that can be used, from start to finish, including during the planning stage, and in the aftermath, and that is suitably flexible and can be used, regardless of the nature of the event in question; it must also have a sufficient contingency plan put in place to deal with emergencies, such as terror attacks, which have become more prevalent, in recent years.

1.3. AIMS AND OBJECTIVES

The underlying question for this thesis is to consider a crowd control and management enterprise modelling framework (CCMEMF), using two key case studies, in order to make recommendations for the future of crowd control and management. One of the issues that exist, when establishing an overall framework for dealing with crime management issues, is the fact that no two crowds are the same and the slightest change in circumstances or in the group itself can have a dramatic impact on the way in which crowd management should be undertaken. With this in mind, a framework needs to establish that can be followed and is relatively commonsensical, in terms of allowing

crowd management teams to operate, effectively; however, it also needs to provide the teams with sufficient flexibility, so that they can use the framework, regardless of the type of event and issues in question.

As part of this analysis, therefore, two specific events will be looked at, both of which presents different challenges to the organizers. This will enable the author to consider a wide variety of frameworks that could potentially be used and the way in which they could be developed, through every phase of an event, to create a robust framework for future use. The problem, therefore, is to gain a suitable understanding of crowd management issues and frameworks, with reference to the case studies, as well as looking at literature reviewing this area and considering the wider issues, such as political factors and economic issues, as these will have a direct bearing on how crowd management takes place, before looking at establishing an appropriate framework that can be used, in a wide variety of circumstances, and can be adapted for future use.

The primary challenge which is likely to be faced, in this regard, is the fact that there are such considerable complexities associated with crowd management. Many of these involve both parties and factors which may or may not be beyond the control of those involved in managing the event. Whilst it has already been accepted that a large proportion of crowd control involves dealing with contingency plans and having processes in place to deal with a wide variety of situations that may never arise, this ability to react quickly, where necessary, is an important part of the framework and it cannot be so rigid that certain adaptations cannot take place.

The framework will take into account all aspects of crowd management, from planning and to how it interacts with third parties, to dealing with a wide variety of contingency situations that may arise, as well as looking at issues such as debrief and how the framework can potentially be used to establish lessons from existing events, for a future event. This latter stage is particularly important, as, in many cases, events will be run several times, often on a regular basis; therefore, the crowd management framework should not only ensure that the one event runs smoothly, but also allow the team to draw on information, for future events (Thalman&Musse, 2007).

As part of the framework, one of the main issues that will be dealt with is the fact that there are a wide variety of individuals who will be involved in crowd management.

Therefore, being able to ensure that they all work together, in the most efficient manner, will be a key factor to gaining success for any form of crowd management. It is also likely that different individuals will have a different definition of what success actually involves. For example, consider an event which involves several suppliers providing trade stands, the definition of success from a trade stand holder's point of view is likely to be the amount of sales that they make; whereas, the definition of success for the event manager is more likely to be reflected in the amount of income it receives, overall. On the other hand, the security teams are likely to see success based on how many breaches of security take place. Simply being aware of all of the different individuals that could gather in order to achieve a successful event and to understand the demands of the individuals that are likely to be involved in a crowd management framework, as well as understanding the fact that different individuals will have different agendas, is a crucial underlying factor in the success of establishing such a framework.

This research aims to establish a framework that would be useful, in a wide variety of circumstances, and one which enables all of the different aspects of crowd management to come together, for it to be an overall success. However, there are likely to be some factors which will require further research, or aspects that may need to be adapted, depending on how society evolves, in the future. For example, there has been a dramatic increase in the use of information technology, in recent years; this has naturally changed the way in which crowd management can take place, as well as changing the availability of travel for those wishing to participate in events, all of which will change how crowd management operates and based on the future challenges which require the framework to be adaptable.

1.4. RESEARCH QUESTIONS

The questions raised by this study are several-fold. Firstly, a detailed understanding of the various different issues associated with crowd management control needs to be had, ideally in the context of a wider framework so that when the framework for crowd management is being established; all aspects of the crowd management process can be drawn on, to establish the ultimate framework. From this, two case studies will be looked at, as they both present very different issues associated with crowd management. The theoretical framework that has been established associated with crowd management and the types of factors that need to be taken into account will form

the basis for the discussion, throughout this thesis. There are several specific questions which have been identified as relevant for the purposes of this research. These are:

- a) What specific factors are relevant, in terms of undertaking crowd control and management, as part of the wider enterprise management framework for crowd management, and what further risk factors need to be taken into account, from the generic point of view, without needing to refer to a specific situation, but rather as a starting point for any situation in which crowd control is likely to be relevant?
- b) What are the primary risk factors that are identified with any crowd control situation and how can these potentially be worked into a framework for those involved in establishing crowd management processes, regardless of the nature of the crowd involved?
- c) What are the best ways in which a framework can be established, with the use of technology, where appropriate, as well as the use of any other facilities which may be relevant, such as working with third-party resources, e.g. emergency services and how the interaction should take place? It is expected that information systems will be particularly relevant, in this case, as they are now more widely available than they were several decades ago.
- d) How can the framework then be applied to specific situations, with the use of two particular case studies, in order to draw together the theory established in the first three questions, with the practical reality of implementing a crowd control management framework?
- e) Finally, the question of how crowd management control can be worked together with other aspects of an event organisation such as marketing and finance will be considered, with a view to ascertaining how the framework can be extended to be of greater use to the management team, not only from a crowd control point of view, but also from a wider commercial perspective.

By breaking down the study into these various different questions, it can be seen how the inductive process will take place, from beginning with general theories and facts and finally establishing a conceptual framework which will be applicable, in a wide variety of

situations, and will also allow a wider application of the facts to be helpful, from a commercial point of view, in the long-term.

1.5. CONTRIBUTION TO KNOWLEDGE

The decision to undertake research in this area has come from a wide variety of backgrounds and reasons. Firstly, it has been identified that information systems are becoming so much more influential, when dealing with a wide variety of situations, including the management of large-scale events. Therefore, there are increased opportunities made available to those involved in the running of events to ensure that crowd management is undertaken, in a much more efficient manner and also to support commercial objectives. As a result, there is a general recognition that CCMEMF can be particularly influential for establishing more efficient crowd management controls, and that these frameworks will not only be useful for reducing the risks to those involved in large events, but also in making the process more efficient, while also making it more appealing to visitors, in the future, something which is particularly important when it comes to commercial events such as the London Olympics 2012, where concerns over excessive crowding could potentially put customers off visiting a particular event. Therefore, ensuring that strong frameworks are in place will be some of the fundamental factors that can lead to the success of large-scale events such as the Olympics.

Clearly, there are several different approaches that can be taken to issues relating to crowd management, with some specialists considering mathematical models which would look at aspects of growing safety, such as determining how the crowd is likely to move, based on density, in particular areas. While this type of research is invaluable, in terms of crowd control, crowd management cannot be looked at, in isolation, and individual behaviours cannot be broken down to such an extent that they can be modelled on a mathematical basis. Individual preferences and emotional approaches to situations, such as being in a crowded area, will vary, depending on the individual in question. Moreover, whilst it may be possible, to a certain extent, to model mathematically the way in which these individuals are likely to move, there will always be a subjective element, based on the perceptions of the individuals involved, which need to be taken into account, to establish an effective framework (Cronin and Reicher, 2006).

By looking at how officials and, in particular, individuals such as the police force deal with crowd management it can be seen that there is an increasing reference being made on the psychology of individuals and how they manage crowd control situations. With this in mind, it is appropriate to establish a framework that will allow not only data such as crowd density ground movement to be taken into account, but also to deal with the more subjective issues such as modeling individual behaviors. It is, therefore, contended that establishing a framework which will offer strategic suggestions to those involved in crowd management will be beneficial to all involved in public events, whether they be for commercial purposes, or for some other gatherings, such as a religious gathering of Hajj to Mecca. With this type of framework in place, not only will there be increased safety within a crowd management environment, something which is particularly important from a human life point of view, but it will also enable the public authorities to deal, more effectively, with crowds situations and to ensure that suitable manpower is put in place and resources are made available to deal with a crowd, based on a more comprehensive understanding of how the particular crowd in question is likely to behave. When looking at one of the chosen case studies, namely the Hajj, it can be seen that there have been particular risks to public safety, during these events, with numerous disasters having taken place, where large-scale crowds come together. Although the specific case studies of the Hajj and the London Olympics, in 2012, will be looked, at in more detail, below, it is worth noting that the annual Hajj which involves a mass gathering of crowds, in the Jamarat Bridge area, has recently suffered several fatalities, due to bottlenecks taking place, as well as stampedes and crushes. For example, in 1990, a stampede that took place inside the pedestrian tunnel which led away from Mecca resulted in the deaths of 1,426 pilgrims, showing just how disastrous poor crowd management can be. This type of research is, therefore, important, when it comes to establishing better frameworks to prevent similar loss of life taking place, in the future; it will also offer substantial information to those involved in other events which could result in crowd management issues, such as the London Olympics 2012. Although, on the face of it, these two events are very different, they do present the organisers with similar challenges. Both these events have different underlying characteristics which make them interesting, from a crowd management point of view and, by drawing these two together, it will be possible to establish how CCMEMF can be used, for the long-term, in a wide variety of events.

This is deemed to be particularly important, in the context of the increasing use of information systems. Crucially, as the systems are now becoming increasingly available, it would seem appropriate to undertake this research, now, so that existing crowd management theories can be drawn together with information systems, to establish the most effective framework possible to be used by a wide variety of individuals, in the future. This will not only reduce the risk to human life, but will also allow organisers to be more efficient, drawing on commercial needs alongside the need to take into account health and safety.

1.6 OVERVIEW OF THE THESIS

This thesis is potentially far-reaching, both in terms of its analysis and the questions that it aims to answer. With this in mind, the structure of the thesis is particularly important, if the appropriate level of focus is to be retained, throughout the thesis, and the most appropriate conclusions and recommendations reached. The brief outline of this thesis is presented in the following diagrammatical illustration Figure 1.1 below :

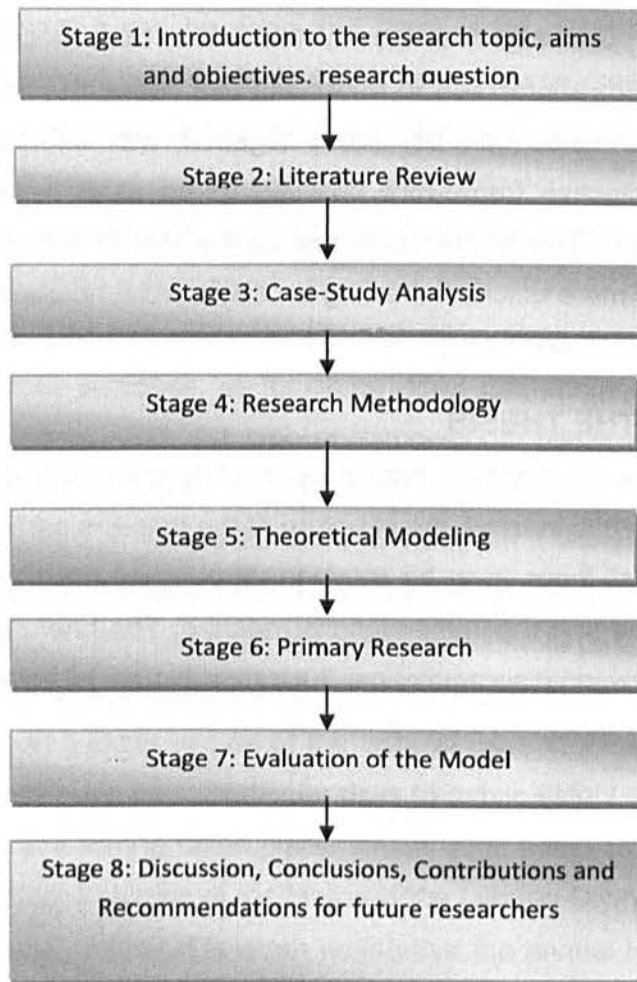


Figure 1.1: Overview of the thesis

The first stage of the research has been undertaken, and looks at a broad introduction to the issue of crowd management and focuses, in particular, on why this type of research is deemed to be important, in the current situation, and what it hopes will be gained from undertaking this research. By breaking down the objectives of the research, into several specific questions, it can be seen that the research starts relatively broadly with general theories and concepts on crowd management, before moving on to looking, more specifically, at the two particular case studies that have been determined as relevant for this discussion.

The second part of the thesis involves an extensive literature review; this is split up into several different sections, all of which will be important, when looking to draw the final

conclusions. The literature review looks, firstly, at a wide variety of crowd management theories, as well as discussing how information systems are now offering new opportunities to crowd management professionals, in order to establish a CCMEMF that is considerably more advanced, from a strategic point of view. This thesis will rely heavily on existing crowd management theories and will set out the background to the various different factors which may be relevant, when establishing a crowd management framework. This will allow the author to consider which of these factors can be dealt with, from an information systems' point of view, as well as looking at the various different factors that may no longer be relevant, in terms of crowd management, in modern society; or, conversely, factors which have emerged in recent years, that may be ignored by those involved in more traditional crowd management theories.

The literature review will then move on to look at two specific case studies, in detail. Firstly, the Hajj to Mecca will be considered, as there have been several large-scale disasters involved, in this event, on an annual basis. This event is particularly interesting, as it does not have a commercial basis; but, rather, is driven by religious demands. Furthermore, although the crowd density is particularly high, the members of the crowd are generally moving in the same direction, with the same ultimate aim; also, movement is relatively slow and consistent, suggesting that the crowd should move with relative ease and with relatively little risk. However, this has proven not to be the case, in this particular event; therefore, by spending more time looking at the way in which crowd management could be used, in this specific event, it is suggested that a more robust framework can be established which will be useful, not only for the Hajj, in years to come, but also for other events that have similar characteristics, such as large-scale protests. This could also provide information that may be relevant to the authorities, when determining how these events should be managed and whether or not the event should be allowed to continue.

The second case study will be the London Olympics 2012, as this event presents new challenges to those involved in crowd management and also offers the opportunity for the framework to be established, with greater use of information systems. These are likely to be inherent, in any event being managed within a developed region of the magnitude of the London Olympics. Consideration will also be given to the types of crowd management controls that are to be put in place, in advance of the event, as well

as looking at very different characteristics which may affect how crowd management is undertaken, as the event continues. It is envisaged that this particular case study will offer the opportunity for the author to take the lessons learnt from the previous sections of the literature review and to move forward towards establishing recommendations for a more sophisticated framework that is akin to the CCMEMF, which is the ultimate aim of this research.

Having undertaken these case studies, the next section of the thesis will be to look at the research design and methodology that has been used as part of the case studies. Consideration will also be given to the ongoing research design and methodology that is necessary, in order to draw these case studies into one overall set of recommendations that can be appropriate, in the establishment of a modern-day CCMEMF. Particular consideration will be given to the issues associated with information systems and how these could be worked into the findings of the case studies. In addition, consideration will be given to additional research that may be necessary, in the area, to supplement the case studies that have taken place. Whilst it is not clear that primary research would be advantageous to this analysis, it may be appropriate to discuss matters with the individuals who are involved in crowd management, for example, the police force, if willing to undertake such discussions. With this in mind the research methodology is looking to the possibility of interviewing a few key individuals, in order to gain a greater understanding of the case studies and also, to put the theories that have been established into a practical reality, and to identify any potential difficulties that may emerge when it comes to establishing a more robust framework, in the latter sections of the thesis.

The next formative stage of the research is to establish the modelling framework, which will pull together all of the above factors, into establishing a robust framework which can be applied, across a wide range of different events, where crowd management may be relevant. This section of the thesis will be broken down, firstly, into establishing the proposed framework, drawing on the factors that are relevant when planning events of this nature, before looking at how these frameworks will operate, in the context of the two case studies analysed, above. The framework will then be created, based on the theories that have been suggested, and then applying them to the case studies, with particular reference to any crowd management difficulties which have been identified as

being present, in the case studies. The validity of the chosen framework can be checked, to determine whether or not it meets with the aims and objectives of those involved in crowd management. This will then move on to look at the particular application of these frameworks, from an information systems' point of view, and how this can then be merged with commercial demands. This is particularly relevant to the London Olympics which is, effectively, a commercial event that aims to produce a substantial profit, for several different entities, as well as being an event which is considered to be the opportunity for London to showcase itself to the world as a region that is worthy of visit and is able to organise such an event, in an efficient manner. Any dramatic failures in crowd management that result in injury or death would be very detrimental to the London Olympics 2012; however, there is so much more to crowd management, in an event such as the Olympics, than simply ensuring no one is injured. By having an effective crowd management process in place, it may be possible to achieve greater commercial return from individuals who will be encouraged to visit the appropriate locations and spend money. Similarly, it may be the case that, by having a strong crowd management control system in place, the external perceptions that visitors gain of London will be considerably better, and this will have the long-term effect of encouraging more visitors to the area, in the future. By identifying the underlying aims of events, such as the London Olympics, it is possible for the author to look at the way in which a modelling framework can be established, in such a way that helps to achieve these aims, while not simply looking towards ensuring that everyone remains safe.

The next step involves primary research which involves the collection of primary data through questionnaires and interviews. The data that is collected through this primary research will be analysed using quantitative and qualitative data analysis software.

Having established a framework, the next step will be to evaluate the model, based on the aims and objectives which had been laid out, in the first part of this thesis and the primary research conducted in the subsequent stage. This evaluation will not only consider whether or not a suitable framework has been established, but will also look to see whether or not the aims and objectives have been met, or whether there are aspects of the thesis which remain unanswered. Where it is determined that there are areas which remain unanswered, consideration will be given as to whether or not these

issues could be dealt with, through further research, or whether it is simply a matter that is beyond the scope of a modelling framework.

Finally, conclusions and a summary will be reached, detailing everything that has been learnt, during this research, as well as identifying areas that are potentially useful, for future research.

By following this process, in a detailed manner, and ensuring that every aspect of the thesis is explored, at the relevant stage, it increases the likelihood that the aims and objectives of the research can be met, and all questions identified, in the initial chapters, will be answered, in the most comprehensive way possible, given the underlying facts and theories that are available for analysis.

1.7. Summary

The first chapter discussed the introduction to the research area and topic, as well as the main aims and objectives of research. The chapter also gave the outline of the dissertation report. Crowd management has several different aspects associated with it and, over the years, an increasing use of technology has emerged, in order to better facilitate crowd management situations and also to enable those involved in hosting large-scale events to gather information from the crowd, which is not only useful for that individual activity, but also potentially useful, in the future. The underlying question for this thesis is to consider a crowd control and management enterprise modelling framework (CCMEMF), using two key case studies, in order to make recommendations for the future of crowd control and management. The following chapter in the dissertation report gives a detailed literature review and then the whole study follows it to determine the theoretical framework and analysis from previous research.

CHAPTER 2 – LITERATURE REVIEW

2.1. INTRODUCTRION

The issue of crowd management, from a safety point of view, as well where the effective commercial management of events is concerned, has been considered by a wide range of different entities, both academic and professional, over the years. Whilst there is a clear urgency to understand ways of making crowd management safer, there is also a growing urgency to ensure that crowds are managed in a way that ensures effective management of an event or activity. This chapter of the paper will look at the existing literature, in the area, as well as identifying relevant factors associated with the two case studies identified, which will allow for an on-going discussion as to the use of information systems to establish the crowd management modelling framework (HSE, 1993).

This chapter will first look at the underlying principles of crowd management and how those principles have evolved over the years, based on the literature available. It will then identify the factors relevant to crowd management, both currently and potentially, for the future, before going on to consider how this will assist in the development of a crowd control management enterprise modelling framework (CCMEMF), drawing on modern technology, where appropriate. It is simply impossible to look towards establishing a modelling framework of crowd management without first fully understanding the very different attributes associated with how a crowd behaves in a rudimentary form. Theorists dealing with crowd management have looked at various aspects of crowd control, including the way in which individuals behave within a crowd environment. This includes the motivation and social identity that is associated with crowd behaviour and how certain entities look towards controlling crowd behaviour through the use of cliques or security individuals. Some researchers also looked at psychological issues, such as the crowd behaviours, something which is likely to be particularly important when it comes to sporting events. By drawing on all of the principles of crowd management that have been discussed, in previous literature, it will be possible to look, in more detail, at how CCMEMF can be developed to assist with crowd management, in the future.

2.2. DISCUSSION OF THEORY

The starting point for research in this area is to consider what exactly is meant by a crowd. It is interesting to note that there is no single definition of what precisely a crowd is, as potentially a wide variety of different crowd types exists and this will have a direct bearing on the way in which they should be managed. Typically, however, a crowd will involve a group or collective in one physical location, although it could also potentially be referred to as a psychological crowd, i.e. a group of people who share a common entity or common identity, which makes them feel like they are part of that social crowd, without necessarily being physically close to one another. Regardless of the various different types of crowds, on the whole, certain attributes will always emerge when it comes to a crowd of any type. Firstly, the size of the gathering and, in general terms, a crowd is thought to be a sizeable gathering of individuals in order for a crowd to be deemed to exist and this needs to be with a relative amount of density, i.e. all individuals need to be located within a particular area, at roughly the same time or within the same timeframe. There also needs to be an element of collectivity, suggesting that to form a crowd, members should be coming together for a specific reason, or for a common goal or interest. Bearing this in mind, gatherings of around 20 people who are all in roughly the same geographic location, looking to observe a particular event, over a defined period of time, would be deemed to be a crowd, despite the fact that they are actually strangers to each other. However, although they are strangers to each other, they act together socially in a coherent manner; this is crucial to the understanding of crowd behaviour (Graat, et al., 1999).

It also has been identified that, although there are numerous factors which will impact on crowd behaviour, there are three key areas that are particularly relevant to planning a crowd situation, from the point of the emergency services. These factors are the focus when it comes to looking at the principles of crowd management and how they have been dealt with, over the years, in particular by the emergency services, although this could also extend to organisers of events, in the wider context, of crowd management for commercial purposes. By breaking down the analysis and looking at the theories as they have developed and considering the problems which arise with crowd management it is possible to identify the factors which will impact on the behaviour of the crowd. The crowd type will typically be defined by the environment, the demographic

of the crowd, whereas the crowd mood looks more at the psychosocial factors that may drive behaviour, within the group.

Over the years, different crowd theories have been developed with some academics taking the approach that, when an individual becomes part of the large group, they lose all self-responsibility. This theory is used to explain the fact that many individuals will behave, differently, when in a crowd environment, than if they were acting alone (Reicher, et al., 2004). Turner and Killian established the emergence of the theory which suggests that collective behaviour takes place, as a result of emerging norms; for example, remember rumour and general milling amongst the group will ultimately dictate the way in which the rules of behaviour change, within the group. This theory is useful when trying to determine how individual behaviour will merge into the behaviour of the group, and the way in which information will translate itself throughout the group and will encourage certain collective actions. However, it does not necessarily explain how they would come together, in the first place and where the true influences come from within the group (McPhail, 1991).

A slightly more developed theory was put forward by Reicher and Potter (1985) which looked at filling in the gaps established by the earlier theories of Turner. They looked to answer the question that had been left out by previous theorists, in relation to how the dynamic process of coming together as a crowd and what motivates the crowd to form, in the first place, was looked at in more detail. This research indicated that there was a distinct difference between the in group and the out group. An in-group refers to a cluster of people who come together with a shared social position over a common purpose; for example, a group of supporters of a particular sporting team, whereas, an out group refers to an individual or group of individuals who do not share this social grouping, the most common example being the supporters of the opposite team. An out group could also emerge, when there is any form of resistance within the group; for example, when peace and security forces are attempting to control the behaviour of the group, they themselves could form an out group. This theory offers an understanding as to how the dynamics within a large group may change; in such a way that discontent or friction may occur. However, by defining the wider group as those within the in group and those within the out group, the way in which difficulties may emerge becomes a lot

clearer and easier to control, from the point of view of those involved in crowd management (Reicher, et al., 2004)..

Waddington, et al. (1997) focused on the concept of disorder and how it impacts on crowd behaviour. They looked at six different levels of disorder that they perceived to exist regarding group dynamics and how disorder can impact on the group behaviours involved, particularly when there is a high level of disorder present.

The six levels of disorder are: firstly, looking at structural disorder, where there are issues in relation to the distribution of power or resources amongst the group. Secondly, there are political or ideological issues, where the activities are related to political ideologies and where pressure groups may come together. Cultural disorder may also emerge when there are differences in the way in which groups of people view the world in which they live and, more importantly, where they fit into this world. Contextual disorder may also emerge as a result of rumour or media speculation and not necessarily being based on any factual grounding, but rather how information is spread throughout a potential group. Contextual disorder can commonly emerge when it comes to the actual situation or special context of that particular gathering. This may be simply down to lack of physical space or some other external influence which has an impact on the level of disorder within that group. Finally, where there is some form of interaction between members of the group, which breaks the unwritten contract between group members and results in some members behaving in a way that is unacceptable to other group members, there can be interactional disorder, even amongst the group that had originally formed for a common purpose.

As well as looking at the various issues associated with how difficulties arise within the group, research has focused on what makes an individual become part of the group, in the first place, as it is believed that understanding this underlying factor will give more information, in terms of how the crowd is likely to behave and how it can be appropriately managed (Cronin & Reicher, 2006). In accordance with Turner, et al. (1994), the social identity theory is deemed to be particularly important. This involves individuals self-categorising themselves into a particular group to which they feel affiliated; again, a key example would be supporters of a particular sporting team, although it could be on the basis of any other factor of which they believe themselves to be a member. This type of theory could also be used to explain how social groups

emerge for example where groups of friends are seen together, on a regular basis, the way in which an individual may become part of that group because they perceive themselves to be somebody who should be part of that group rather than any physical reason (Cronin & Reicher, 2006).

Drury and Reicher took this one step further in what is referred to as elaborated social identity theory. This theory suggests that the situation will change with the group dynamics and the way in which the various encounters arise as the group develops. This area can also be used to bridge the gap between social identity theory and any instances of conflict, as it may be the case that the group comes together due to a central social identity, in the first place, but conflicts begin to rise within the group as the smaller inter-group sections emerge and conflict arises between these smaller intergroups. Despite the fact that this theory looks at how conflicts emerge within a larger group, the authors acknowledge the fact that these intergroup dynamics allow individuals to understand their position within the group and their role, in this respect, as well as how they are likely to behave, on this basis. This may even involve individuals choosing to leave the group or establish their own out group (Young, 2002).

A second set of theories, which also emerged in relation to crowd behaviour, is looking at the psychological factors which will impact on the mood of the group, as a whole, and the collective behaviours of the individuals within that group, depending on the mood they experience (Cronin & Reicher, 2006). As part of the research in this area, it has been established that crowd mood and behaviour were in fact potentially influenced by a wide range of factors which are likely to be relevant in any given situation. Factors such as the personalities of the individuals within the group and external factors such as the environment in which the group has gathered will all have a dramatic impact on how the crowd behaviour cannot always be predicted with total accuracy. Therefore, any model crowd behaviour needs be flexible enough to adapt to these external factors as they change (Vider, 1999).

Several studies have emerged that focus on the way in which disorder has emerged in sports grounds and how social identity can play an important role in either worsening the disorder experienced or, indeed, improving the disorder experienced (Young, 2002; Cronin & Reicher, 2006). Research has also indicated that the stronger the group identity is within the game group, the less likely there is for any display of solidarity. This

will typically reduce the chance of conflict arising within a specific group, although it may potentially increase the chances of disturbances between the in group and any out group which has emerged. By looking at these theories, it is clear to see that there is a theme indicating that crowd behaviour will necessarily be explained by looking at intergroup interaction and the different perspectives that different individuals within the group display, whether this be individuals within the in group or those that are within the out group (Cronin & Reicher, 2006). This can be seen by looking at how the different groups interact with each other. This can be seen to be related to a particular activity and by taking statements from various different members of the group, in terms of how the crowd behaved during a particular period of time, it can be seen that there are discrepancies in what individuals believed to be legitimate group actions and what they did not. Other underlying theories are clearly important, as they feed into these perceptions. The way in which individuals self-categorise themselves as being a member of a particular group or having a particular social identity and the strength of feeling in relation to this categorisation will drive how their role within the group develops (Slepicka, 1995).

These theories have been pulled together in order to look at ways in which the crowd can be measured, and how the emergency services or those involved in providing resources for group gatherings can measure the crowd, in order to gauge accurately how the crowd is likely to behave. Most notably, the Health and Safety Executive, in the UK, has established a safety guide for the management of groups during events (Health and Safety Executive, 1999). This guide looks at ways in which the organisers can profile the likely group, to identify how the crowd is likely to behave. For example, the guide suggests that, by identifying the mix of family groups, the number of teenagers likely to be present, and the elderly, as well as young children, the group itself can be analysed to the extent, that it becomes easier to anticipate the behaviours that are likely to be displayed. Other theorists have drawn on other issues, such as the level of verbal noise, the level of physical movement and the level of participation being displayed by the audience, when attempting to identify how the crowd is likely to behave (Zeitz, et al., 2005). Looking at all of these factors and identifying how they are likely to impact on crowd behaviour, offers those involved in crowd management a starting point to determine the way in which their particular crowd is likely to behave; however, it is unlikely to be accurate, in every single situation, as there are external issues which can

impact on crowd behaviour, in a way that cannot be modelled in an entirely objective manner (Zeitz, et al., 2007).

Broadly speaking, it is argued that groups can be looked at as passive, active or energetic, with the passive crowd experiencing very little interaction, with almost no physical movement, or talking as a group, in a generally co-operative approach, which is open to crowd management with relative ease. An active group would experience moderate degrees of physical movement and contact, as well as a degree of audience participation, but will still be co-operative towards crowd management techniques. It may take slightly longer for these crowd management techniques to bear fruit. An energetic crowd displays a much greater degree of interaction and, while this can be beneficial when it comes to crowd management, as the meeting will be active, it is also more volatile and potentially open to disorder, because there is a high level of interaction to start with; therefore, the difficulties with disorder is likely to spread, at a much faster rate (Reicher, 1996).

By looking at the various different crowd theories which have emerged and the different approaches that have been taken by theorists, in this area, it can be seen that the issue of crowd management has several different facets associated with it; all of which need to be understood, to at least a certain extent, in order for crowd management frameworks to be developed in a way so that they will be applicable, across the widest possible range of crowd situations. The psychological aspect of crowd management is considerably more influential than some of the earlier theorists may have suggested; therefore, this needs to be a particularly important aspect of any crowd management framework which emerges, as a result of this research. These theories will be looked at, in more detail, in terms of how enterprise frameworks are involved, in relation to crowd management, and then will be applied in the context of the two case study situations which have been identified as relevant for this analysis.

2.3. DETERMINANTS FACTORS OF CROWD SAFETY (RISK)

The issue of crowd risk and danger associated with crowds coming together is something that has gained considerable focus, in the last 20 years, with there being a number of disasters related to crowds, all of which can add important information to this discussion, in terms of looking at different ways of modelling crowd behaviour, so that crowd management can be more effective for managing crowds, in the future. By

considering the specific disasters that have taken place in recent years, it is also helpful to analyse the reasons why certain disasters took place. Some of the more notable crowd disasters have been identified below:

Year	Disaster	Reason
1989	96 deaths – Hillsborough	Too many people
1994	266 deaths – Saudi Arabia in a pilgrimage	Too many people
1999	51 deaths – Kerala India	Reaction to fear of weather warnings
2002	10 deaths – Japanese shopping mall	Reaction to handout information
2010	14 injuries – Johannesburg	Forged tickets at entry barriers

Table 2-1 Disasters that have taken place in recent years(Frank- 2009)

Table 2.1 shows Whilst there are many different disasters that have not been mentioned, here, it can be seen that, on the whole, these disasters took place as a result of a design flaw in the crowd modelling itself; for example, the inability to allow sufficient throughput of individuals in a small physical location, or as a result of information being given to the crowd, which may have been false, or as a result of a specific reaction from the crowd, such as information relating to a potential weather disaster. This gives us an important understanding in relation to crowd modelling of the types of issues that need to be central to any attempts to minimise crowd risk. Also, it is crucial to pay particular attention to the fact that the issue of risk is dynamic, in nature, and may change from minute to minute, when a crowd comes together. Therefore, understanding the way in which a crowd can change, as the event progresses, is the first step to achieving a truly accurate crowd modelling situation.

Existing literature in this area suggests that crowd safety falls into two specific areas. First, ensuring that the design of the area is developed in such a way that it adequately supports the size of the crowd and the types of movements that are likely; the second issue being to ensure that there are systems in place to deal with the crowd, throughout

the duration of the event, in question (Rowe and Ancliffe, 2008). Crowd safety also requires the recognition that crowds will behave in different ways, whenever major events and several people are coming together. Safety is central, particularly where there is any instance in which pedestrian volumes will increase, at a rapid rate, such as entrances and exits as well as bridges or ticket gates. Fundamentally, therefore, regardless of the type of crowd, identifying these flashpoints within a crowd situation will always be useful, when attempting to maintaining crowd safety. In establishing a modelling framework for crowd management, therefore, one of the first steps will be to identify the areas in which pedestrian movement is likely to be at its highest, and the density of such movement is likely to be at its greatest (Mounsey, et al., 2007).

By looking at crowd disasters, as identified above, it can be seen that, in many cases, the disasters occurred because there was a large number of individuals in a small space. Although, similarly, disastrous situations can arise where there are smaller number of individuals who are moving, at a quicker rate, or are in an even smaller space. With this in mind, guidance in relation to encouraging individuals to crowd movement, within the venue, so that all individuals are able to move freely without crowding around one specific facility. For example, where there is a limited number of ticket gates made available at a sporting event, this is likely to create a crowd situation, as too many people are trying to go through to the facilities. Other safety risks which have been identified as being particularly relevant include situations where the individuals have less physical ability to move or where there is a particular risk such as terrorist threats.

A safety guide was established by Lincolnshire County Council (2009), with a view to assisting those involved in establishing situations where crowds are likely to come together and suggested that specific controls should be put in place, in order to minimise the chance of disaster, in a crowd situation. Example suggestions included making regular safety announcements, so that all individuals who are participating in the event and make up part of the crowd understand the procedures that are put in place to deal with an emergency situation, in the event that there is a need to evacuate the area, quickly. Communication between staff members was also seen to be vitally important, particularly for ensuring that staff members involved in stewarding have strong communications between themselves, to deal with any emerging issues, and to deal

with any changes in the dynamics of the crowd. Risk assessments were also deemed to be a vital part of crowd management and they should be undertaken, prior to the event taking place and, also, if the event changes, with the types of security being put in place, with reference to the level of unrest and not necessarily purely based on the number of spectators or participants. Training of staff members is also seen to be an area that was often lacking, yet would be crucial to achieving strong crowd management as the reactions of the staff and the officials involved in the crowd situation was fundamental to mitigating any disasters. Suggestions have also been made that computer simulations can be very effective for identifying the way in which crowds are likely to behave and also present an opportunity to train staff, in terms of how they should deal with specific events that may take place, when a crowd comes together. By offering those involved in delivering crowd safety, the opportunity to practice tactics that could be used in the event of a disaster, it is more likely that these situations would be identified, at an earlier stage, and if they are allowed to escalate the negative effects will be minimised. It may also be possible to use this type of simulation to identify bottleneck areas other types of situations that are likely to prove problematic. Other guidance and research in this area has looked at ways of controlling crowds, based on identifying the areas that need to be controlled, and these need to be controlled through the use of stewards or ticket collectors or any other official or form of crowd management (HSE, 1999). By using this approach, a more objective viewpoint is received, as it identifies the physical areas to focus on. Furthermore, although the behaviours of the individual may be variable, the specific locations that are identified as being potential problem areas will remain consistent. Therefore, focusing on these areas and ensuring that specific attention has been paid to mitigating any problems, in these areas, will ultimately prove a strong crowd management technique, regardless of the way in which the individuals themselves behave.

By addressing these issues all the difficulties and the way in which crowd risks are consistently dealt with, in certain situations, a deeper understanding of the importance of ground modelling can be ascertained, which will ultimately support the model established in the dissertation.

2.4. ENTERPRISE MODLLING

As the theories associated with understanding how crowds behaviour develops so, too, have the different modelling frameworks which are now available to those involved in crowd management processes. For example, technology has increased its ability to assist these matters, e.g. basic principles such as the availability of computerised selling of tickets to events, as well as allowing those involved in crowd management to develop much more robust frameworks that will enable them to develop systems for crowd management, in a wide variety of situations.

This analysis will look, firstly, at enterprise modelling and the general approaches taken by enterprise modelling, before identifying how these approaches could potentially be used in a crowd management scenario (Fox and Gruninger, 1998).

Modelling is more commonly looked at, from a commercial point of view and as a way of attempting to understand the processes that an enterprise business goes through, when it is attempting to improve its performance. By representing, describing in defining the structures and processes that have undertaken, during a particular business process, improvements can be more readily understood and identified. Whilst this is more commonly looked at, from a commercial point of view, particularly for achieving greater efficiencies, during times of economic difficulties, it also has an important role to play with situations such as crowd management. By breaking down the various different processes that occur when a crowd comes together, it is expected that the theories discussed, above, can be seen in a way that offers information on how they can come together (Aranow, 1991).

Enterprise modelling involves establishing a model over the entire situation, or part of the situation, based on resources, processes, data, or any other factor which may be relevant, in that particular instance. For example, when it comes to enterprise modelling, in relation to the coming together of crowd, the movement of individuals and the decision-making process that individuals make as part of coming together in a crowd, will all add up to part of the understanding of the processes, including any physical restraints that may be placed on individual, such as gateways or barriers. Therefore, by modelling all of these different individual factors, the overall picture can be seen, with greater accuracy. The original theory associated with enterprise modelling was established by Ulrich Frank (2009), who stated that the idea of this type of modelling

was to “offer different views on an enterprise, thereby providing a medium to foster dialogues between various stakeholders – both academia and in practice...the views should complement each other and thereby foster a better understanding of complex systems by systematic abstractions”. The history of enterprise modelling has been almost entirely based on the organisations that have processes as inherent within them, such as manufacturing companies or in companies where processes are part of the day to day workings (Lillehagen and Krogstie, 2008); for example, a service-based organisation, where several different aspects of the business will come together to produce the overall service to the customer. Similar processes can be used for managing the crowd, from a safety point of view, as well as from a commercial perspective. For example, consider the individuals visiting a specific event, such as a sporting event, the process from an overall point of view can be broken down into several different sections, all of which ultimately make up the overall map of the process. This type of enterprise modelling can be used to understand fully how crowds will move around a sporting venue, such as a stadium. One of the processes is likely to be the way in which tickets are allocated to individuals and how individual spectators are allocated to a specific region of the stadium that they are meant to frequent, as well as any information in relation to parking facilities, considering the flow of people from the point of entrance to the point of getting to their seats, or to their standing area, etc. Another relevant part of the process may be in relation to refreshments, where these would be located, so as to attract the most passing trade, but also as a means of predicting crowd behaviour, so that emergency services can be appropriately located and any evacuation procedures can be suitably managed (Vernadat, 1996). Movements throughout the event itself can also be looked at as a separate process, considering factors such as how often individuals are likely to go for refreshments, during the game, or if they are looking to move around the stadium, at all. Processes relating to how individuals will move, after the game, will also be considered, as well as looking at processes in relation to activities that would not necessarily happen, during every event, but need to be planned for, such as an emergency event, e.g. a fire. By modelling the ways in which crowds are likely to behave, based on various different activities that are going to be undertaken by the crowd, a better understanding can be had of how these different events interlink. This makes it considerably easier for those involved in crowd management to look at means whereby the crowds can be manipulated, and how

emergencies can be dealt with, if necessary. With this in mind, it is argued that enterprise modelling frameworks can offer a useful approach for those involved in crowd management. Moreover, when using this type of modelling framework, i.e. breaking down the factors that are likely to lead into certain crowd behaviours, it becomes much more possible to look at methods and mechanisms for managing crowd behaviour. This is particularly true, given the fact that it has already been established that a crowd will often acted in unpredictable ways (Gustas and Gustiene, 2003), due to the personalities of the individuals involved. Therefore, by having a robust framework in place, at least these movements can be understood and, if necessary, controlled, from the outset. Consider a situation where a fire breaks out within a crowded area. If the typical types of movement of the crowd have already been modelled, the emergency services are going to be much better placed to understand the way in which individuals are likely to travel, and this could provide vital information that will allow the emergency services, to be more appreciative of the necessary response and to ensure that all individuals are able to get to safe areas.

2.5. EXTERNAL DISTURBANCE

In order to look at the issues associated with brand management, in more detail, two specific case studies are being analysed, the first being the Hajj to Mecca, and the second being the London Olympics 2012, both of which provide extensive crowd management issues, albeit in slightly different circumstances. Firstly, the Hajj will be considered, as one of the largest pilgrimages in the world in which every able bodied Muslim views as part of their religious duty, that every able-bodied Muslim needs to take part in, at some point during their lifetime; it is viewed as a vitally important pilgrimage, which must take place and where the individual needs to show solidarity for the Muslim faith and submission to their own God, Allah. Given the deep religious importance of this pilgrimage, this puts the individuals who are likely to be part of the crowd into a category of potentially single-minded and almost desperate individuals in their desire to complete the pilgrimage, regardless of the potential danger to their safety. Furthermore, the pilgrimage needs to take place within a specific four-day period, thus further restraining the crowd that wishes to travel during a specific time period. During the Hajj, pilgrims will join the procession together, in order to converge simultaneously on one particular location, which is a large building.

Figure 2.1: Hajj pressure point for the crowd(Source: Hajj Research Institute 2012)

Figure 2.1. shows the location in which a wide variety of rituals and gatherings will take place, before the individuals travel back to the regions that they came from. While there are multiple different rituals taking place, during the period, the fundamental issue, from a crowd management point of view, is the fact that so many individuals converge on one geographic location. For example, in 2010, approximately 3,000,000 pilgrims took part in the pilgrimage, showing just how crucial crowd control is likely to be. Interestingly, even though pilgrimages are religious, in nature, many of the processes have become more stylised, in order to attempt to minimise issues of crowd control management, although there are still a wide variety of incidents associated with the Hajj, where several people have been killed or injured, as a result of the sheer volume of individuals travelling to the same area.

By looking at the locations where the various different tragedies happened and the years, in relation to the pilgrimage, it becomes apparent that, although these disasters happen at different pressure points, throughout the pilgrimage, the general theme which creates the problem remains consistent. For example, back in 2006, when over 360 people died, it was as a result of the crash that took place at a location where the ritual stoning of the pillars was taking place. Effectively, it could be seen that wherever a large group or event takes place, as part of pilgrimage and the flow of individuals change in direction or speeds difficulties will eventually arise. In the last few years, there have

been fewer disasters relating to the pilgrimage and it has been argued by the Dresden University of Technology who considered crowd management technologies that this was down to greater planning. In this report it was stated that: "This Hajj, in contrast to many previous ones, was very safe, without any panics or incidents, even though it was expected to be the most critical ever and there were about 800,000 more pilgrims than the expected 3 million... big unit anywhere in which individuals are taking place and the individual success was due to a completely different organization of pilgrim flows" (Transportation Research Board, 1985).

Figure 2.2: Hajj Route taken(Source: Hajj Research Institute-2012)

Figure 2.2. shows the route that is followed by those performing the Hajj. An analysis is undertaken when looking at the disaster that took place in 2006 and what crowd management individuals have done, in order to prevent this happening again to prevent the crush around the pillars from happening again, in Mina, which is approximately 4 miles away from the ultimate destination of Mecca. Recognising that there is likely to be a large number of people gathering at these pillars, those responsible for the pilgrimage are now replacing the stoning pillars with larger elliptical shaped ones and also improving the access to these pillars, by offering two ways of access to the region. This effectively creates a much smoother flow of traffic for people coming towards the pillars, as they have two ways of getting to the pillars and prevents a major blockage as well as having a larger destination area to target, thus preventing the crush towards a smaller

location. Although these changes have been deemed to be successful, in terms of reducing the number of disasters, in this area of the Hajj, the number of people who have taken in the pilgrimage has steadily increased, over the years. This shows that there is a continuous need to involve crowd management techniques, particularly where the event happens, regularly, and is continuously gathering more support, as well as the changing dynamics of the crowd itself because different individuals will have different dynamics, in that they have a different long-term agenda. As part of the improvements that are taking place, the Saudi government is putting a large amount of investment into ensuring that it is able to gather data in relation to this pilgrimage and to potentially reduce the disasters, in the future. By setting up cameras at every stage of the Hajj, the Saudis are able to gather data, in terms of where the congestion points are taking place and also looking at crowd movement and crowd behaviour, particularly with relation to the reaction of the crowd and where the panic broke out (Lee and Hughes, 2006).

When undertaking this analysis, it became apparent that a slight change was necessary in the way that the pilgrimage is being analysed, at its fundamental stage. The additional analysis looks at how individuals move past each other, at the key locations, namely corridor areas and intersections and analyses how jams took place, particularly when a large number of individuals were attempting to move through a single door, with single access. This type of analysis could then be used to develop computer models, by looking at how individuals can ultimately repel each other when trying to go through a small space and how this would cause a panic.

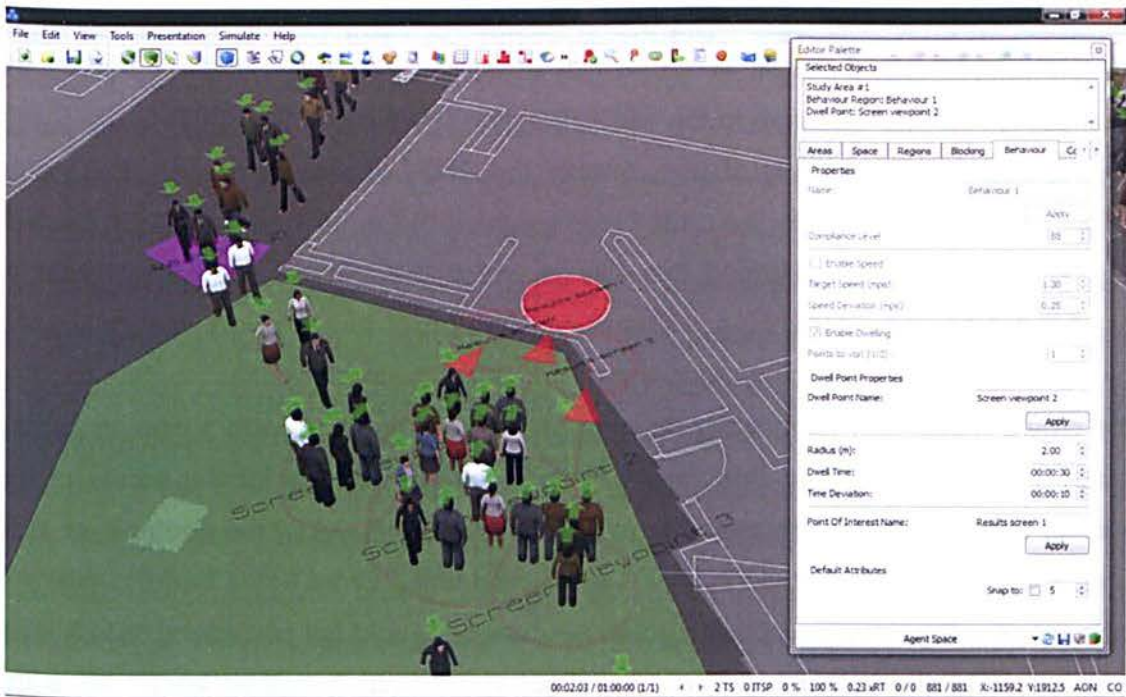


Figure 2.3. An example of crowd management simulation software(Hijazi-2009)

Simulation software such as the one shown in Figure 2.3 can be used to model, analyse and improve the crowd management. Although there was some wisdom in this basic rudimentary analysis, it became apparent, as result of the 2006 disaster, that the pilgrims were displaying different types of behaviour (Helbing, et al., 2007a). The pilgrims were tending to prefer one-way routes which they could then follow at a slow pace with them becoming part of a moving body which you can sense of security is a moving in the same direction and at the same pace as everybody else around them. As the disaster unfolded, in 2006, the first thing that became evident was that group stopped moving in the same direction, at the same speed, and in the same moving body of individuals, some moving at a faster rate than others, thus creating a crowd that was continuously stopping and starting and resulting in certain pockets of much denser parts of the crowd. Therefore, the model will need to change, in order to deal with situations where there were clumps of individuals coming together and acting in an unpredictable way, including being jostled and pushed in different directions, at these points. It became apparent that the pilgrims who were being pushed around and those individuals who did fall over were not able to get back on their feet, clearly resulting in further delays and trampling taking place. By looking at this situation, as a whole, it can be

seen that the groups were behaving much more as a fluid with crushes of individuals moving at speed taking place. This problem simply did not exist when all individuals were moving at the same pace, in the same direction (Helbing, et al., 2007b).

With a greater understanding of how exactly the 2006 disaster emerged, it became possible for those involved in the crowd management of the pilgrimage to look towards changing the route and changing the way in which the pilgrims moved, in order to prevent this type of bottlenecking taking place. As part of this analysis, the individuals involved looked for the warning signs that would allow them to identify the deterioration of the crowd movement, before the disaster actually takes place, with a view to putting in place an emergency plan that would allow those responsible for the safety of the crowd to prevent similar disasters from taking place. Studying the footage of how individuals were travelling through these pressure points, it was noted that the average number of people passing a specific point, per minute, would fall considerably to a level that is deemed to be below the critical threshold approximately half an hour prior to the turbulence taking place, a calm before the storm scenario was emerging and, therefore, any areas in which the particular calm was seen would immediately create concerns that turbulence was to follow. Using these techniques, in 2007, the monitoring team worked alongside the crowd management experts, in order to plan the route and to change the schedule that the pilgrims would be following, in order to offer those involved in the crowd management of this event, greater control over the behaviours of the crowd and also to allow them to deal with potential problems, before they arise. The authorities noted: "All 1.5 million registered pilgrims got a timetable and a route in order to distribute them uniformly in space and time" (Helbing, et al., 2002). Although this was a good first step, a large number of individuals attending the pilgrimage were not registered and thus did not conform to this timetable; it was therefore also necessary to use real-time data and to continuously monitor the movement of individuals, so that previous crush points could be relieved, prior to the crush taking place. As it happened, the 2007 pilgrimage passed without incident. Although the Saudi Ministry stated that it had learned many lessons from the 2006 analysis and, therefore, this technology would be put in place, as it could be particularly useful, in the future. A civil engineer who worked in the Saudi Ministry of municipal and foreign affairs, in Riyadh, stated: "We learnt a lot about how to organize the flow from the crowd simulations". It was noted, however, that many of the changes that were made in relation to the timetabling of

events had not previously been in relation to the pilgrimage, and were controversial, with many individuals concerned that placing these restrictions would, in fact, make matters worse, as the pilgrims were simply not used to being placed under these restrictions, when it came to crowd movement. Despite this, the scheme was ultimately a success; the one-way system, in particular, offered much greater security for the individuals involved in the pilgrimage, to the point that they were perfectly prepared to accept these changes, as it enhanced their own personal experiences. The Saudi Ministry stated: "Last year you had to push a lot to get to the camp...this year you could comfortably follow the stream all the way. Everyone was very happy".

Although, on the face of it, the main changes were in relation to the way in which the crowd moved and the one-way system, the real change was evident in that the authorities recognised that crowd management needs to take place and that control needs to happen from a central source. It was also established that technology plays an important role in these changes, despite the event itself being based on religious pilgrimage, in which it would be anticipated that there is little or no acceptance of technological advancement. Through the use of information technology, including sensors being placed at strategic points alongside the areas that were identified as being potential flashpoints, it was possible to measure crowd flow and the density, in real-time, and this will ultimately allow those involved in crowd management to deal with the issue. Prior to becoming an obvious problem for those involved in the pilgrimage, the central control room was set up, in order to monitor the flow of the pilgrims, on a constant basis, and this, in combination with the fact that it was recognised that a potential clash could be identified, up to 30 minutes before the actual danger arose (Pelechano, *et al.*, 2007). This would allow the officials to react much more quickly to changes in the crowd, and the impact of the behaviours of those involved in the crowd, to such an extent that the crowd did not happen.

It can be seen, therefore, that the success achieved, in 2007, was based on a two-stage approach; firstly, the actual route itself was changed and designed in such a way that bottlenecks did not take place as quickly as they would have done, if all individuals were left to roam freely. Secondly, a system was put in place, in order to predict and deal with potential problem areas, before they happen, rather than waiting for the crush and hoping that individuals will sort themselves out. By taking data from previous years, it became easier for the authorities to identify, not only the reason that crushes were

happening, but also the types of tell-tale signs that could alert to the possibility of such an action.

Collection of the data monitoring of crowd movement was seen to be central to the ongoing improvement, in relation to the pilgrimage. However, in reality, it was what was done with this information that became crucial to the success of the crowd management processes. It is all very well and good having a system that will warn of a newly built up crowd, but there needs to be a strong communication process in place, so that this can then be dealt with, within the necessary timeframe. Data acquisition is merely the first step; but, then, the data needs to be processed and the information managed and distributed, in such a way that would allow those involved in the management of the crowd to prevent any impending disasters. This ultimate management technique was then used, not only to alert the officials involved in the crowd management, but also to present information to the pilgrims, across large screens, in multiple different languages, that would allow them to understand the current movement of people and to issue any crowd safety management suggestions. This recognises the fact that it is not only the officials who need to adapt, as the crowd changes, but also that information needs to be given to the crowd itself, in order to encourage changes in movement and to impact on how the crowd itself is reacting to certain external stimuli. For example, by informing the pilgrims that a specific part of the pilgrimage was undergoing congestion, they were able to slow the pilgrims, at an earlier stage, and prevent dramatic bottlenecks from occurring, thus allowing for more consistent movement, at a more consistent speed throughout without the need to stop and start.

Another event which is likely to create challenges in crowd safety and crowd management is that of the London 2012 Olympics and, unsurprisingly, the issue of maintaining crowd safety is deemed to be a crucial factor, in terms of achieving success for this international event. The Olympic and Paralympic Games will commence on 27 July and end of 9 September, 2012, during which time there will be 26 sports and 20 Paralympic sports, across a multitude of different venues. It is expected that approximately 450,000 people will be given access to these venues, where around 11 million tickets have been sold across both the games. This type of large-scale event will naturally require a large amount of planning and also by looking from a practical point of view, but also in order to ensure the safety of the individuals involved and the

spectators. In preparation for this event, the government undertook an audit and review of game safety and security, which was led by the Minister of State for Security and Counterterrorism, showing that the focus is not only on maintaining safety for the crowd, but also dealing with any terrorist threat that may arise (Cabinet Office, 2010). Accountability was deemed to be a particularly important issue, when it came to safety and crowd management, during the 2012 Games, primarily due to concerns that, if clear lines of accountability were not laid out, at the outset, certain tasks simply would not take place. The entities that were being drawn together, in order to ensure that crowd safety is maintained, included the Home Secretary, the Minister for Security and Counterterrorism, as well as the Secretary of State for Culture, Olympics, Media and Sport. By having this team in place, it immediately becomes apparent that the issue of crowd management is far more than simply identifying the way in which the Crown is likely to move and providing security; indeed, it has far-reaching implications on all aspects of the event, including how the media deals with the event.

When looking at how crowd management is going to be dealt with, throughout the Games, the key objectives of the agenda were laid out. Firstly, any system that is put in place is done so with the aim of protecting the venues, events and any transport infrastructure that is fundamental to the delivery of the event. Secondly, the aim is to prepare for any event that may potentially detract from the running of the London Olympics, as well as ensuring that the capabilities are put in place to deal with events that may create disruption, such as a terrorist attack, or issues such as the breakdown of technology that could reduce transport opportunities. Thirdly, resources need to be put in place, in order to command and control the event, from a central location; here, the Olympic village is seen to be central, for dealing with event management and crowd control, as well as collecting the data that is available so that it can be reacted to in a positive way, and quickly determined as to whether or not the information could be put to good use. This is a particularly interesting point which was raised as part of the plans to improve the safety of the pilgrimage, as having the ability to react quickly to whatever happens is absolutely central to crowd safety. It has already been established that individuals and the behaviours of crowds will depend on a wide range of factors that are not necessarily within the control of those running the event, or those providing the security. Therefore, the ability to react quickly to changes, as they happen, in a positive

way, is actually arguably more important than the attempts to control the crowd, from the outset, although clearly both aspects are important (Home Office, 2009).

In order to achieve this aim, the first part of planning for the London Olympics involved identifying the key threats. By identifying these key threats, not only can they be mitigated, from the outset, but it is also possible to run various different simulations for those involved in managing the crowd, on a day-to-day basis, for particular events which may take place. However, there will always be an element of unpredictability with these types of events; but, if certain threats can be identified as being more likely than others, at the preparation stage, communications can be put in place to mitigate these issues, should they arise. The audit which was undertaken by the government identified that there were four categories of risk. Firstly, there was a risk of terrorist activity; secondly, the risk of serious crime; thirdly, the risk of public disorder; and, fourthly, the risk of natural disaster. All of these risks need to be dealt with in order to offer comprehensive crowd management, rather than simply focusing on public disorder, which is often the key focus for crowd management techniques and modelling.

By identifying terrorist activities as being a particular risk for the Games, this has a dramatic impact on the way in which crowd management will be dealt with, as there are potential risks that the crowd will be impacted upon by a terrorist threat, but will also be impacted upon by media speculation that there may be terrorist threat; this, in itself, would create public disorder, even if no threat was, in fact, imminent. Central to dealing with all of these risks will, however, be the technology of the systems that are put in place, in order to prevent these risks coming to fruition, in the first place. Having the right technology in place will also enable any information which comes to the central control to be dealt with in the most appropriate manner. Although a potential risk of terrorist activity needs to be dealt with, quickly, there is a danger that by rapidly evacuating a specific area that is thought to be in danger of imminent attack, this could, in itself, create a bigger problem, due to the crowd reaction. Therefore, the way in which the various different aspects of crowd management interact, including the modelling associated with these interactions and the cause and effect of a specific action will be of crucial importance, and the crowd management team will be central to this process (IWW, 2009).

With such a large-scale event being managed, it will be necessary for several different entities to be involved, particularly given the fact that different entities are likely to have different areas of expertise; for example, the counterterrorist unit is going to have a unique approach to how it deals with potential terrorist threats compared with that of the security teams involved. All of this input is invaluable, in terms of ensuring that the necessary processes are in place and that all potential information is made available, so that the actions can take place quickly. However, by having several different entities involved, there is a danger that no clear decisions are made and the reaction time to difficulties could become slower than it would be, if there was a core group of individuals making this decision, something which is simply impractical, given the scale of the event. It is the use of technology (Mavroidi, 2005), therefore, that will be important for ensuring that all relevant individuals have the information, at the earliest possible opportunity, and that the correct mechanisms are put in place, in order to ensure that rapid decisions can be made and mitigation processes instigated to prevent any large-scale crowd disaster. Where the actual risk comes from is, to a certain extent, irrelevant when it comes to the process of dealing with the problem should it arise, as well as identifying potential sources of risk which will offer important information to the ground management team. It is the way in which these risks are managed that will be fundamental to the prevention of any disasters relating to having such a substantial crowd, in a short space of time, in one the geographical area.

Bearing this in mind, the team in charge of ensuring crowd safety within the London Olympics 2012 has identified the relevant entities that will be involved in the process, from the point of view of protecting the various different venues and the people who will attend those venues. This includes preparing for the worst, identifying and disrupting activity that could potentially create a problem, and also identifying the key individuals who will be involved in the event that it is necessary to command, control, plans and resource a disaster, should it emerge. By having a clear framework in place, in terms of which entity will deal with which aspect of crowd management, it is anticipated that the entire process will be more effective, overall; and even if a potentially difficult situation arises, the processes will be put in place and will have been practiced to such an extent that damages can be limited. The Olympic Security Board is the central unit for managing this strategy, although clearly there are a wide range of entities that are involved in the various different aspects of managing the safety of the event, due to the

widespread nature of the risks, as well as the fact that the event itself is taking place over several different venues and there are likely to be a wide variety of different crowd behaviours.

One issue which has been identified as being troublesome within the London Olympics is the fact that the event is spread over a wide variety of venues and the question of the infrastructure that will be used to transport individuals from venue to venue. Those visiting the London Olympics are likely to find themselves in a position where they will need to utilise the transport system in order to move from venue to venue. Therefore, any difficulties which emerge within this transport system could have a dramatic impact on how the crowd moves. Simply having a technical difficulty at one of the London Underground stations could create a dramatic shift in the way in which the crowd is travelling around, as people will look to avoid a particular station. This would put pressure on different areas, which may or may not be suitably placed to deal with an increase in crowd movements, as well as potentially creating a crush, at the problem site itself (Paris, et al., 2007). Looking at the Figure 2-4 below.

Fig 2.4 Map of the London 2012 Olympic venues (Mapping London, 2012)

2.6 COMPUTERISED SIMULATION

Having looked at the underlying theories on how the various different factors associated with crowd behaviour and crowd management come together and identified the static elements that can be objectively mapped, based on external influences, the next stage is to develop this in the form of a computerised simulation, so that the authorities involved in crowd management can enter in various different permutations and identify how this will impact on how the crowd moves, eventually (Smith, 2003).

Whenever attempts are made to create a computerised simulation, a degree of flexibility will be lost and certain events cannot necessarily be taken into account, to the same extent as they would be by looking at each individual situation, without the use of computerised simulation. For example, consider a situation where a crowd is relatively dense within a specific focal area and there is a sudden influx of new individuals, thus creating a crash scenario, with many individuals attempting to travel to the nearest exit. This is something that could be simulated reasonably easily through the use of a computerised program, as this will show the way in which the individuals in the form of particles interact with each other, as they attempt to go through a relatively small exit, with those who have physical dominance being able to pass through the exit, first.

Interestingly, it was noted when attempting to establish a form of computerised simulation of crowd behaviour, that this looks at the crowd as one physical body; whereas, in reality, the crowd is made up of a multitude of individuals, all of whom cannot be individually controlled, as they have their own internal thought processes which may impact on how they behave, either as an individual or as a collective. Although it is possible to simulate the likely reactions and the overall behaviour of a crowd, there is always the chance that specific individuals will behave in an unexpected way; this will require a computer simulation to be continuously evolving to deal with new situations and new facts (Tarlow, 2000).

Simple one-dimensional characters and individuals can be somewhat easier to evaluate. However, the difficulty from a computerised simulation point of view emerges when attempts are made to identify the behaviour of the collective. It is for this reason that the model, as depicted above, has been considered to be the most efficient in the modern context, as it works on the basis of continuous external influences to the actual crowd behaviour (Helbing, et al., 2001). These external influences may, in fact, be an

internal factor that is present within one of the crowd members. For instance, consider a member of the crowd who is particularly risk averse, or has been in a crash situation, before, and is therefore likely to react in a particularly extreme manner, when faced with a crowded situation. This individual may overreact to the increasing density of the crowd as they rush to the nearest exit. This will be viewed as an external influence on the overall crowd, even though it has been generated by an internal reaction of one of the individuals (Chen & Stanney, 1999). Using this type of the computerised simulation will recognise that the behaviours of each of the individuals will in fact be deemed as yet another external factors that could impact on how the particles as a whole travel.

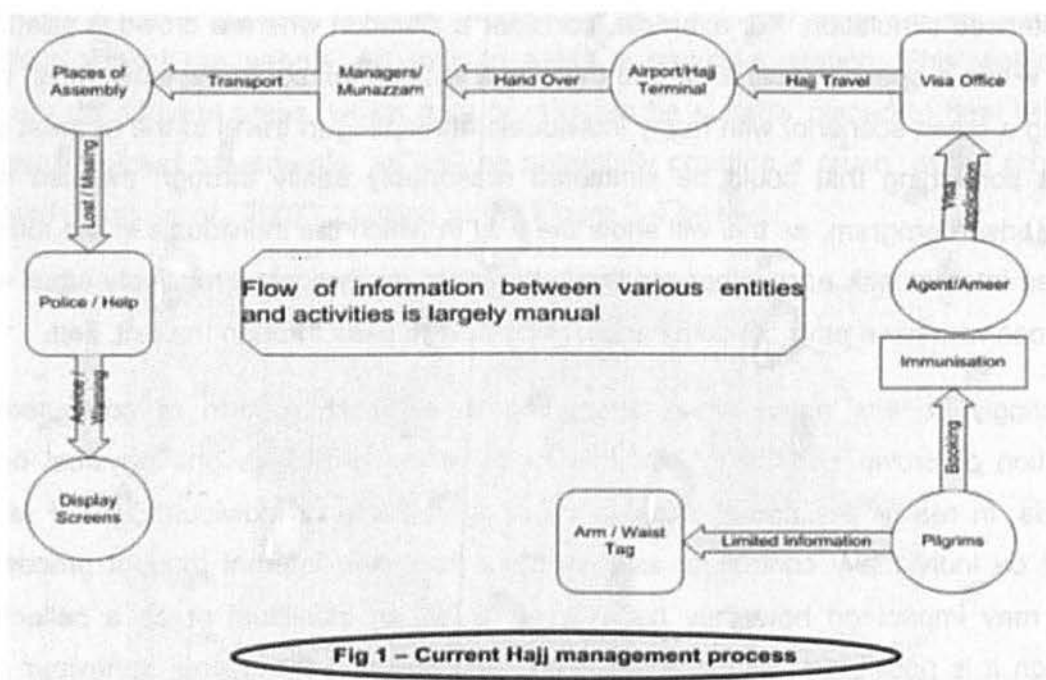


Figure 2.5 Current Hajj Management Process (Yamin, M., 2006 ,P55)

Looking at the diagram 2.5. above it can be seen that one of the difficulties that emerge when computer systems are being used to simulate all activity yet the framework has not been suitably put into place and the links understood. In the diagram above it can be seen that the flow of information is such that it will take a considerable period of time for information to travel from one point to the other. This is clearly an area of improvement that can be achieved through the use of a framework approach (Oda, 1995). By

comparing the model above with the one below which more accurately reflects the framework that is proposed during this research. By creating all of the additional links it can be seen that information flows much more easily and can therefore be much quicker at being disseminated throughout the framework and to allow the various different parties to react.

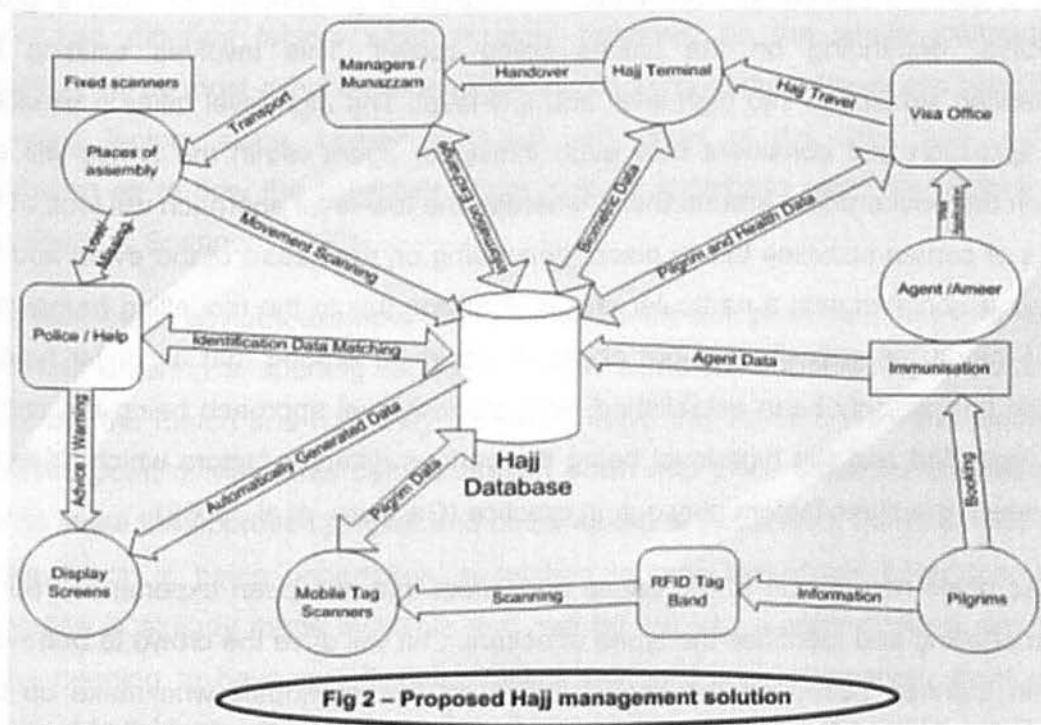


Figure 2.6 Proposed Hajj Management solution(Yamin, M., 2006,P56)

Looking at the Figure 2-6 above having a computerised simulation in place, in order to deal with crowd management on a large scale, is clearly an essential part of the overall process. This is because it is necessary for each individual involved in crowd management to be able to input a variety of different factors and identify how this is likely to impact on the crowd, as well as identify other courses of action that they could take, in order to minimise disruption. For example, by having a strong simulation in place, those involved in crowd management could identify what opening another exit would do, to ease the crowd, and whether this would potentially have the impact of changing the direction of the crowd, in its entirety, to such an extent that there would be

less danger to human life, as well as potentially influencing how the crowd move in terms of which shops they would pass, during the movement of the crowd, from one location to the next (Sime, 1995).

Having identified that there are conflicting goals associated with computerised simulation crowd movement between the actions of the individual and the actions of the collective, it becomes necessary for any computerised solution to be suitably available, so that it can be looked at from either an individual perspective or from a group perspective, depending on the issues being raised. This involves splitting the computerised simulation into high-level and low-level. The high-level takes a situation-based approach and considers how each individual agent within the crowd will act, based on the environment around them, whereas the low-level approach will look at the chances of certain activities taking place, depending on the nature of the event and the attributes associated with a particular crowd. Applying this to the modelling framework, which is being theoretically laid out above, it could be argued that a similar type of approach has already been established, with the low-level approach being the central factors identified and the high-level being the various different factors which drive the way in which the static factors play out, in practice (Garneau, et al., 2009).

This also gives recognition to the cause and effect that has been experienced during crowd modelling and identifies the types of actions that will drive the crowd to behave in a certain manner, based on the impact it has on the individuals who make up that crowd. The difficulty that emerges, when it comes to computerised simulation, is the fact that each individual could, potentially, react in a slightly different way; therefore, computer simulations are limited in their use, where the individuals within the crowd have particular attributes or where there may be a multitude of different issues coming together to create a certain overall reaction (Kenny, et al., 2001). With this in mind, it is suggested that a computer simulation associated with crowd control modelling should, in fact, limit itself to looking at one or two strands of cause and effect, without trying to draw upon a nexus of reactions from a variety of different individuals. In reality, this produces a more accurate impression of the ways in which individuals behave, in a crowded situation, as it is likely that the individuals will focus upon one aspect of their activity at a time, without necessarily drawing on a wide variety of issues, when determining their best course of action. Consider, for example, a situation where there is

a particular terrorist threat that has been raised within a crowd situation. The focus of all individuals is likely to be ensuring no injury for themselves and any family members that they have with them and to get through the nearest exit in the quickest possible time. Other secondary issues such as ensuring that they take the exit which best positions them to gain access to the public transport that they need, in order to leave the area is unlikely to rank as they have a clear priority of safety. Crowd situations will not always have such a clear priority in place and it may be the case that an individual will consider one or two different factors when moving; however, on the whole, computerised simulation will be most effective, when it takes into account the primary and possibly the secondary factors alone, something which will, most of the time, offer sufficient explanation as to how the collective group is likely to behave upon the change of an input (Poole & Springett, 2000).

A somewhat less obvious example of this would be the computerised simulation of how individuals entering a sporting facility to watch a match, and the way they behave throughout the match and how they ultimately leave the venue. From a computerised simulation point of view, this can be broken down into three separate simulations, in order to make the approach simpler and better suited to simulation. For example, where the simulation is being undertaken in relation to how individuals enter the venue, information is already made available that can be put into a computerised simulation, without needing to have any flexibility associated with the information, such as the number of individuals who have purchased tickets, how many of the crowd are likely to support a particular team and the location of their seats in reserved areas will be known, prior to running the simulation (Remagnino, et al., 1997). This will immediately give a foundational understanding of how the computer program can work, in order to simulate how this crowd is likely to move. Further information such as data in relation to how the individuals are travelling to the venue can also be presented, particularly where there is a heavy reliance on public transport. Again, this will identify the main pressure points upon entry into the venue. Once all of these have been identified and entered into the computers simulation it is much easier to identify how certain unknown issues will impact on the way in which the crowd moves. It is for this reason that, when a computerised simulation is being used, it needs to be broken down into a sufficiently small period of time that will allow for a large amount of known factors to be stated, thus leaving a relatively small number of unknown factors that can then be used to run the

various different simulations. Much of the foundational work involved in creating these computerised simulations has already been undertaken as part of the previous section of this chapter, by breaking down the various different links between all of the factors which are seen to come together, in order to establish exactly how the crowd is likely to behave. Also, by breaking down these factors, even further, a computer simulation can offer valuable information that can then feed back into the model, in more detail.

2.7. Research Gap

In this context, it has immediately been identified that using a modelling framework may be particularly appropriate, as one problem in a particular part of the event can have a knock-on effect, across all other venues, even if they themselves are experiencing no difficulties. Further difficulties from a crowd control point of view in the Olympics have emerged due to the fact that every single day is likely to be different, in terms of the crowds that are attending other venues that are most popular, due to the events taking place changing the use of those venues during that specific period of time. It has already been identified that difficulties in crowd management can arise because the crowd itself is made up of multiple individuals, all of whom have their own personalities and behavioural traits, which can completely change the way in which the crowd will behave. For example a group of individuals, who are particularly calm and can deal with stress situations well will behave differently from the threat of a terrorist attack on a crowd of individuals who are less able to deal with stressful situations. Ultimately, there is no real way for the central command to predict the type of crowd it will have to deal with on any given day. Therefore, the importance of having a solid structure in place to deal with whatever crowd reaction may arise, and to understand how the various different components of the crowd interact, will be considerably more important than attempting to force the crowd to act with a particular type of behaviour (Mounsey, et al., 2007).

Finally, the interaction between the London Olympic Committee and the emergency services, as third party providers, has also been identified as being an important aspect of crowd management, during the London Olympics. Emergency services provide vital services for the Olympics, and they will all be required to contribute as well as being part of the clear up, in the event of an emergency situation. Whilst the expertise that is

contained within the emergency services is clearly vital for this type of arrangement, there is the danger which emerges when several different third parties drawn upon to deal with an emergency situation. Therefore, modelling the way in which these third parties will interact with each other, in an emergency, is something that needs to be done, prior to drawing on this expertise, in order to ensure that it is employed to the best effect, should this become necessary (Olympic Delivery Authority, 2008).

2.8 Literature review synthesis and the development of the basis of the theoretical framework

This section discusses the synthesis of the literature review and the development of the theoretical basis from which the Crowd Control and Management Enterprise Modelling (CCMEM) framework is developed. Chapter 5 presents the final Mega Event Command and Control Architecture (MECCA) framework as seen in 5.2, figure 5.7. This framework is evaluated with two case studies. These were the Hajj in Mecca and the London Olympics 2012 utilising the Crowd Management Evaluation Components (CMEC) see 7.2, Figure 7.1. As identified in the literature, the starting point for enterprise modelling is to identify all of the various factors, which may be relevant, when modelling overall crowd behaviour. Based on the existing analysis, these factors can be split into several different categories:

- physical location in which the ground is likely to gather and issues such as the availability of exits and entrances and the likely gathering points of individuals, based on the physical layout of the region;
- the personality types of the crowd; for example, where teams are playing against each other, there is likely to be a degree of hostility between the various elements of the crowd. Furthermore, the personality types and attitudes may change, as the event progresses; again, using the example of the sports team, the behaviours of the crowd are likely to vary, depending on whether or not their team wins;
- the general aims and objectives of the crowd, which looks at whether the crowd members are attempting to view a particular event, or whether there is some other agenda, such as queuing, in order to enter a specific area, such as those seen in the Hajj; the availability of third-party support, for example the emergency services, in order to deal with emergency situations, should they arise; and

- the volume and density of the crowd itself, over the period during which the crowd is being managed. Each of these factors will be looked at, individually, for the purpose of modelling.

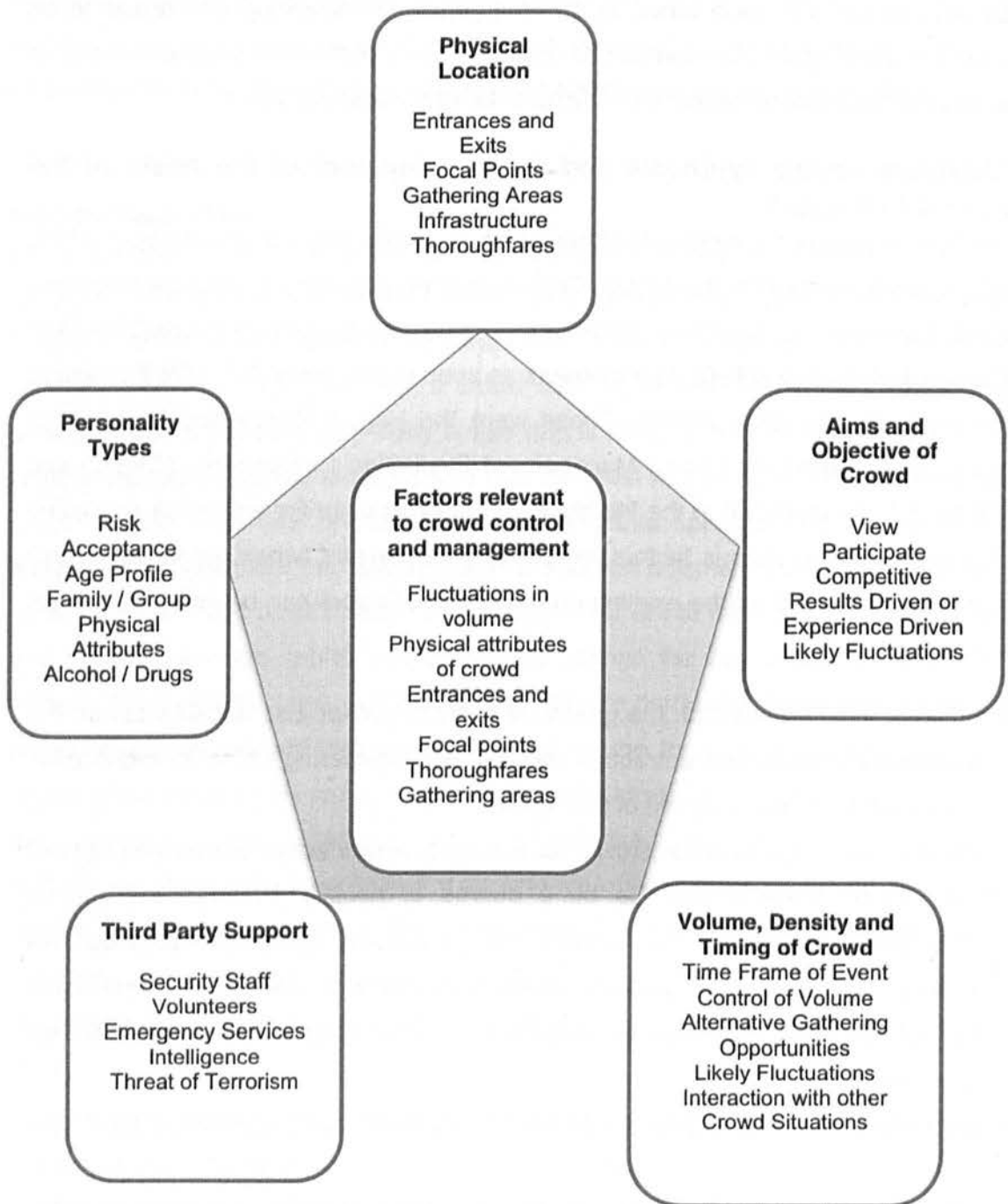


Figure 2.7 Crowd Control and Management Enterprise Modelling (CCMEM) framework

Looking at the Figure 2.7. By exploring the 25 different factors noted above, it may be the case that additional factors, which are specific to the crowd in question, will arise, such as a specific behaviour, which may be inherent in that particular actuation. For example, in the case of the Hajj to Mecca, the strong religious connotations associated with the gathering and the desperation to gain access to a specific area is likely to be considerably more relevant than it would be in another event where the level of desperation to gain access is not as great, or there is a prolonged period of time over which the crowd is likely to want to view that particular point (Smith & Lim, 1995).

The central aspect of this modelling framework will be in line with the more traditional approaches taken to crowd management, through looking at the physical movement experienced by crowd situation and how the parties (or the individuals) might behave, when put under certain physical stresses. By looking at the various different factors identified above, it can be seen that several of the different elements could have an impact on this traditional analysis. For example, the physical attributes displayed by the crowd, the make-up of the crowd, including whether or not this is a family event, or more likely to be attended by groups of adults, information relating to focal points and entries and exits, will also be objective factors that can be drawn upon, in order to undertake the traditional particle-based analysis that was looked at as part of the literature review.

Looking at the physical aspect of the way in which a crowd is likely to move is merely a small part of the proposed framework, here. It was identified that there are, in fact, a variety of different factors that may come together when modelling the behaviour of a crowd and the physical actions of the crowd, and the way in which they all interact with each other is merely a small part of this. In taking one element of the framework, for example, starting with the level of risk that individual crowd members are prepared to take, it could be identified that individuals who are more risk averse are likely to have quicker reactions to a risky situation in a crowd environment and this will encourage them to move at a greater velocity and this then can be seen to change how the physical particles move. A similar analysis can take place with the other various different aspects that have been identified above. For example, looking at the emergency services that are available to support the crowd situation will again impact on how the crowd moves, physically.

Based on this trail of thinking, the model that has been established here has a central pillar of the physical aspect of crowd management, and this will draw upon the particles' analysis that has been the backbone of crowd management analysis, for several years.

From a diagrammatic point of view, this would include the central pillar, Factors relevant to crowd control and management, which is the objective part of crowd modelling.

Surrounding this central block, which is deemed to be a view of the way in which the crowd will react once an external input has been received, are the external factors. A crowd reaction may take place, as a result of one change in one of the factors, such as a change in the objective of the crowd to get to a particular point, in order to participate, or a change in the surrounding infrastructure. By identifying these external factors and how fluctuations from these external factors might impact on the particle analysis and the way in which the crowd is likely to move, other external factors can then be drawn upon, in order either to deliberately change the crowd movement, or to ascertain how the changes are likely to impact, naturally, on the crowd.

Consider, for example, the situation in relation to a threat of terrorism. Where the crowd is behaving in a certain way, based on the particle analysis and an increased threat of terrorist behaviour is experienced, this, in combination with the general risk profile of the crowd, is likely to have an impact, but the impact will vary, depending on the six points identified, above, including the availability of entrances and exits and the types of thoroughfares that are available for the moving crowd. The aim of the particle analysis is, therefore, to shift the analysis, based on the external factors that will fluctuate over a period of time. By having an acute understanding of these external factors and, in particular, identifying the actual changes that can be implemented and how this will change the crowd behaviour, a suitable crowd modelling approach can be undertaken.

This type of modelling behaviour and taking this approach is, in fact, drawing on the existing traditional approaches to crowd management; however, it also accepts the fact that the humans involved in a crowd situation are subject to continuous changes, based either on decisions that they make, internally, or based on external stimuli, such as the availability of additional exit points, or an increased threat of terrorism, or even something such as the focal point where the crowd is trying to gather, changing. By looking at the way in which all of these factors interact with the particle-like behaviour of

the crowd, the actual physical attributes and movement of the crowd can be much more readily understood and controlled, even though this aspect of crowd management is, in itself, often objective and not directly under the control of those involved in crowd management. For example, once the rush towards a certain entrance takes place, the physical momentum of the crowd is very difficult to stop or to control; however, by opening up another entrance or by increasing the presence of the emergency services, at specific points, the external impetus on the crowd will change and the general physical movement will then also change, correspondingly.

It is this cause-and-effect style approach that makes this modelling approach suitably flexible, but also recognises the central aspects that cannot directly be changed, but can be influenced by the external factors that are within the control of the crowd management officials. The particles (or individuals) will move in a specific way, for example, looking for the fastest route or the most direct route, based on the limitations that they face, such as entrances available and the type of surrounding infrastructure and thoroughfares. Whilst all of these factors can clearly be changed, the particles themselves will move in a specific way, which can be objectively modelled, based on the available physical structures, at that point in time.

This process will then be taken forward and used in the context of computerised simulation, which will be discussed in more detail, below, in order to identify how the changing factors can be merged in with the stationary factors to create a suitable crowd management modelling framework. The next part of the report will focus on research methodology which will lead to the three main things for the next phase of the study: case study analysis, quantitative data analysis and qualitative data analysis, which will lead to the presentation of the practical framework for crowd management in events like Olympics and Hajj

2.8. Summary

The second chapter in the research report was about the literature review and this chapter looked at the underlying principles of crowd management and how those principles have evolved over the years, based on the previous academic literature and researches available. It also identified the factors relevant to crowd management, both currently and potentially, for the future, before going on to consider how this will assist in the development of a crowd control management enterprise modelling framework

(CCMEMF), drawing on modern technology, where appropriate. It is simply impossible to look towards establishing a modelling framework of crowd management without first fully understanding the very different attributes associated with how a crowd behaves in a rudimentary form. Theorists dealing with crowd management have looked at various aspects of crowd control, including the way in which individuals behave within a crowd environment. This includes the motivation and social identity that is associated with crowd behaviour and how certain entities look towards controlling crowd behaviour through the use of cliques or security individuals. The researches related to Hajj crowd management were also presented. The base for the theoretical framework has been developed in this chapter. The next chapter is about the research methodology and design.

CHAPTER 3: RESEARCH METHODOLOGY

3.1. INTRODUCTION

One of the major challenges facing this research is to achieve a modelling framework that can be applied across a wide variety of crowd based situations and the two case studies that are being used as the backbone of the research indicates just how variable the issues being faced by those involved in crowd management may be. The research methodology that will be employed is therefore critically important when it comes to identifying ways in which an appropriate model can be designed. As part of this research design and methodology section the overall methodology will be considered before going on to look in more detail at the way in which the building blocks of the modelling framework can be put together. This will involve the consideration of both quantitative and qualitative elements of the framework and breaking down the case studies in such a way that each element of the model can be designed will allow the interactive process to be achieved in a way that would not be possible without the use of real case studies (Cronin &Reicher, 2006).

The chapter prior to this looked in more detail at existing literature in this area and the issue being faced by the crowd management team in relation to their specific events as well as considering other background information which may be relevant to the way in which a model can be applied in the practical sense. The balancing part of this research will establish a model for crowd management and therefore the aim of this chapter is to bridge the gap and ascertain how precisely this model will be developed.

3.2. RESEARCH METHODOLOGY

Broadly speaking research falls into two main categories of research, either deductive or inductive with the deductive approach focusing on an existing theory and looking at practical examples to see whether or not this theory is an accurate depiction of the situation. By contrast the inductive approach uses observation to identify any key patterns, which will ultimately produce a theory that can then be used and applied going forwards. The research here therefore uses a more inductive approach as it primarily relies upon the case studies looking at examples of the crowd behaviour that is experienced in order to ascertain any theories which can be used to link a wide variety of situations. Once a model has been established there will be an element of the

deductive approach as it will be necessary to test the theory that has emerged and has seen whether it works under every circumstantial or whether it is purely a theory that can be used in most situations, but will need adaptation in particularly unusual crowd situations.

In a decision that will need to be made from a research point of view is that of primary research versus secondary research. Secondary research involves looking at existing information in the form of a literature review and analysing data that has already been presented although potentially this data can be analysed in a different way. Primary research on the other hand involves using methods such as interviews, questionnaires and other direct contact with individuals that will allow them to specifically answer questions that will be relevant to the research being undertaken. In this case it is deemed appropriate to undertake secondary research only although a wide variety of research methods are still being used, including case studies and a more traditional literature review. The reason for this decision is the fact that issues relating to crowd management can be so specific to the situation in question that primary research would not allow for any suitable variety of personalities and thought patterns to be drawn together, whereas using case studies in the form of a secondary research approach would allow for a more varied and appropriate analysis of the situation. To a certain extent it can be argued that using case studies in this way is a form of primary research, as the precise experiences and concerns of the individuals involved will be drawn on to establish a framework for the future. There will also be the need to differentiate between quantitative and qualitative analysis with the quantitative elements looking at the precise and mathematical aspects of crowd control such as considering density and the speed with which the crowd moves and these types of those lend themselves particularly well for computer-based modelling as there is a much lesser element of subjectivity to be taken into account. However, the literature review has suggested that greater emphasis needs to be placed on qualitative issues when it comes to crowd management and the personalities of the individuals involved and other more subjective issues will be a vital aspect of modelling the way in which the crowd is likely to behave. Bearing this in mind both of these elements and the way in which they will apply to the process of creating a modelling framework will be looked at in more detail under separate headings below.

3.3. CASE STUDIES

Two separate case study events were looked at as part of the modelling framework. The first event centres on a religious pilgrimage, which has been going on for several years with varying degrees of disaster happening every year and a wide variety of issues associated with crowd management being considered as well as a more recent move towards using technology as a means of controlling the ground in the type of environment that would not normally lend itself to the use of technology. The second case study is with reference to an event that has yet to take place but is likely to involve a substantial amount of crowd management over a relatively prolonged period of time. The London Olympics 2012 presents a real challenge for crowd management experts and with a wide variety of individuals coming together over several weeks and in several different locations. It is likely that a comprehensive model will be difficult to achieve and therefore by looking at the issues in this case study the theories associated with the modelling framework can be tested to the limit (Lamarche&Donikian, 2004).

Before drawing on the specific case studies here it is however useful to consider the general issues associated with using case studies as a foundation for research in the first place. Case studies are recognised as being particularly useful when it comes to undertaking a detailed contextual analysis in relation to a specific event or series of events. In particular case studies unusable when it comes to issues of social science were real-life situations need to be looked at in order to determine the way that individuals will behave in a specific situation.

With a case study it is possible to take theories and see how they apply when they interact with a real life situation as well as how the various different enemies interact with each other. This is arguably particularly important in the area of crowd management, where the behaviours of specific groups of individuals are likely to vary depending on a wide variety of external factors and by gaining an understanding of the way in which these factors will interact with each other and how this will manifest itself in a crowd situation this will be extremely useful for the purposes of establishing a crowd management model.

There are, however, criticisms for the use of the case study method. Primarily the criticism is that a case study method would only allow the researcher to look at one or two specific situations as has been the case here. In the context of this research, one of

the dangers in using just the pilgrimage and the upcoming London Olympics 2012, in order to undertake an analysis of crowd management it will simply not be possible to look at every single permutation of crowd behaviour. Therefore, by establishing a model based on these two case studies there is a danger that certain aspects of crowd behaviour that do not show themselves in these case studies will be ignored and this could create a difficulty when it comes to applying this model on a wider level.

Despite this, there are several ways in which case studies can be seen as useful provided they are used correctly and applied in a way that is in line with the ultimate aim of the research. It is suggested that in order to make the most of these case studies, both of which have an important role to play the researcher needs to ensure that they remain focused on what they are hoping to gain from the case studies and ensure that the correct data is collected from the case studies themselves. For example in the case of the Hajj to Mecca it has been established that there are several different incidents which resulted in a substantial loss of life and this is then a big part to be focussed on as part of the case study to ascertain why and how these difficulties have emerged. By focusing specifically on these individual issues lessons can be learnt which can be applied across other crowd situations.

Defining the precise issues that are likely to be taken from each case study will allow the case study to be more usable particularly when it comes to generalising and creating a model for future use. In the case of the London Olympics 2012 the key challenges being faced by the management teams have been identified through undertaking the case study and again this offers valuable understanding of how the various different issues in telling that can then be transcribed into a more general framework rather than necessarily focusing purely on the London Olympics. When using a case study the way in which the questions are formulated will be important for example by focussing on questions that begin with 'why' and 'how' information can be gained from the fact patterns that are presented in the case study. Consider for example the disasters that have taken place in the Hajj to Mecca. By asking questions such as why this has happened and how this manifested itself both before, during and after the disaster information can be obtained that allowed for generalisation of modelling of crowd management. For example it can be seen when looking at the Hajj disasters there was a period of calm and a reduction in the flow of pilgrims approximately half an

hour before the actual crush took place suggesting that those involved in crowd management could potentially use this 'calm before the storm' analysis in their own situation even if it does not involve the same specific facts.

Similarly when it comes to the London Olympics 2012, this is a one-off event, yet many of the issues being dealt with in a more generalistic way. For example, by asking the question of how those involved in crowd management can hope to identify potential bottleneck areas as part of the London Olympics and the method by which these bottlenecks are identified will be useful to other events and may even be useful when it comes to dealing with the pilgrimage in the future.

3.4 DATA COLLECTION : QUALITATIVE ELEMENTS

As noted above, the modelling framework will be made up of both qualitative and quantitative aspects in order to establish the comprehensive framework that is necessary to look at crowd management.

Traditional crowd modelling behaviour have focused on using many of the modelling analysis techniques that are used in physical movements, such as fluid dynamics and therefore centred on qualitative factors. In this section of the methodology the use of these traditional factors will be considered as they still play an important role when it comes to establishing a comprehensive modelling framework. Although the social and quantitative issues associated with crowd management play an important role in determining why certain groups of people behave in certain ways fundamentally a crowd management approach needs to consider the way in which the flows of individual will change when various different external factors are placed upon them. One of the leading models in this regard is that of Helbing, et al. (2000), which actually use the high level of mathematics and physics in order to explain the way in which a crowd would move. By focusing on the physical forces associated with crowd movement a particularly mathematical model was established as well. The aim of this research is to extend this model considerably to look at crowd behaviours from a more personal point of view rather than treating each individual as a particle to be moved about or have forces put open them. To a certain extent their reaction will of course be similar to an inanimate object but there are always likely to be variables which will automatically change the way in which the crowd reacts. Even individual factors such as physical size and strength will have an impact on the way that the crowd as a whole moves. One

particular difficulty that has emerged as a result of attempting to model this in a mathematical way criticisms have arisen due to the fact that the models simply became more complex the more they try and take into account the way in which the different entities impact on each other. For example, Helbing noted that individuals would to at least some extent actively avoid bumping into each other, although clearly some individuals would be more averse to running into each other than others. This concept of having several different independent agent is the first step towards accepting the fact that the model will be to encourage quantitative factors to be considered as well as quantitative reactions that take place when a crowd comes together.

Several different approaches taken by those academics looking to achieve a quantitative data analysis alone, for example the concept of splitting floor space available into cell grids has been used extensively. This was the foundation of the Kirchner model (Kirchner & Schadschneider, 2002) which recognised that there was a static and a dynamic grid. The static grid considers each individual as they stood still and tracking their quickest possible route to the X it whereas the dynamic model will consider the ways in which an individual will move around the graves were impacted upon by others. Under this model, it needs to be thought that the individual will attempt to default to their easiest route and the only change when required to do so by another. With this in mind a quantitative analysis becomes somewhat easier. The individuals and their movements can be modelled mathematically based on the distance they have to travel and the speed with which they travel and will be used in order to identifying the likely path which each individual will make. By looking at a group of individuals and putting their paths together the crowd starts to become easier to model and understand. Throughout this rudimentary mathematical understanding of the conversion potential problem areas can also be identified. For example, if a number of individuals are travelling at a particular speed in the direction of a particular exit the model was able to identify at what point the crowd will no longer be able to move and they crush they happen. This does not of course take into account the fact that an individual may identify the potential of the crush and may change their direction or speed to accommodate this. Despite the weaknesses associated with using mathematical modelling crowd management, it is clear that at least to a certain extent some element of the mathematical modelling needs to take place in order to identify the physical reactions that are going to take place in when individuals come together and the

difference that speed and density of groups is likely to have on the crowd as a whole. Without appreciating these physical issues the crowd cannot realistically be comprehensively modelled with any degree of certainty.

3.5 DATA COLLETION: QUANTITATIVE ELEMENTS

As eluded to in the prior section the issue of crowd management is so much more than mathematically considering how a group of individuals are likely to come together in a crowd situation and how they are likely to move when some requirement to move is placed upon them. Individuals, by their very nature have individual thoughts and specific behavioural patterns which are likely to emerge, particularly when faced with a stressful situation, such as a particularly dense crowd environment. For example, consider the position in the London Olympics there will be groups of individuals all wishing to view a wide variety of sports and events, the way in which an individual behaves will depend not only on the physical environment but also their own preferences and how keen they are to see a particular event as well as the physical issues that they personally have. An individual who has visited the Olympics to view a specific sport and views themselves as being physically robust is more likely to be more forward in their approach to enter a particular crowd situation than an individual who is indifferent about the sport and has mobility difficulties.

The actual emotional behaviours displayed by individuals is becoming increasingly recognised as important with regard to modelling crowd behaviour, particularly where emergency situations arise or where the crowd ceases to move in an obvious way or at a consistent speed. For example, when looking at modelling crowd behaviour in the London Olympics there are likely to be several different models that are taken into account. Firstly, the crowd will be modelled on the way in which it is intended to flow looking at the way in which individuals will move themselves from venue to venue, including looking at infrastructure issues as potential bottleneck points such as ticket offices, all of which can be predicted with a reasonable degree of accuracy. Secondly, however, there are likely to be models to deal with emergency situations such as how the crowd management team will deal with a situation such as a fire or terrorist attack. The way in which crowd management deals with these emergency situations will naturally be very different to the way in which it deals with day-to-day movement of crowd is an efficient way that allows the individual to be exactly what they want to see

and also to maximise their commercial benefit by directing individuals past the appropriate retail stores. The social attachment model suggests that where a stressful situation arises groups will tend to look for comfort in each other and this will directly impact on their behaviour, suggesting that the individual will send a follow others when attempting to access it is an area that is deemed to be dangerous. It is this type of social behaviour that can be seen to be at the centre of the difficulties experienced by the Hajj to Mecca, where a wide number of people attempt to leave an area because they perceive to be dangerous and they follow each other in a lemming like fashion rather than making their own independent judgement of the best way to travel. This tendency of individuals to crowd together and follow each other can be used to the advantage of those attempting to manage the crowd but does need to be taken into account, particularly when there are likely to be areas which will become bottlenecked if this type of social theory is followed. Understanding the way in which the social groups work together as a way which they interact when faced with a stressful situation will also be a fundamental part of a modelling for crowd management purposes.

3.6 Data analysis and presentation of the framework for crowd management

The methodology and research approaches being used to create a suitable model for crowd management therefore needs to draw on both the literature review and the quantitative and qualitative issues stated above and these will be drawn upon when it comes to the actual key process of establishing a model that can be applied across a wide variety of crowd situations.

The first step of establishing a model that can be used as a generic framework is to establish the various different components that will make up the overall model. It has also been identified that in order to establish a comprehensive model it will be necessary to utilise a combination of mathematical skills alongside social issues and models that will explain how a crowd reacts. By bringing these two factors together it is expected that a comprehensive model that can be established through the use of technology can be put in place that will be useful to a wide variety of crowd management activities (McKenzie, et al., 2007).

When it comes to looking at the way in which the processes have evolved in crowd management in the Hajj to Mecca it can be seen that simulation and predictive patterns are in fact very important and require to a certain extent computerised modelling to look

at what happens when a particular event takes place. The process is currently being used by those in charge of maintaining safety during the pilgrimage have already alluded to the fact that there are certain trigger points which can be identified. For example, it has been established that there is a particular calm in the amount of foot fall that goes on in a specific area approximately half an hour before a crush. This type of linked behaviour will be the second stage of the modelling process. Having identified a wide variety of factors that impact on the way in which the crowd behaves, and in particular the way in which the crowd moves, and this can then be used to identify the links between these factors and how it changes from one end of the scale can impact on the other end of the scale.

The research here, however, places a large focus on crowd behaviours and the way in which the various different behaviours can impact on crowd movement. Clearly, where there is the possibility of mathematically modelling the way in which the crowd will react will make it easier to create a model that can be used in a wide variety of circumstances although care needs to be taken to ensure that the model is not overly automated to such an extent that human emotions and reactions are not taken into account.

A secondary elements of crowd management which needs to be taken into account is that of using crowd management in a positive way and not simply using crowd management models as a way of preventing injury or death. In particular when it comes to the London Olympics, there is clearly needs to ensure that crowds are able to travel around the venues safely and this will be the first priority. Second priority will be to ensure that the crowd is satisfied in their experiences, including ensuring that visitors do not have to queue for prolonged periods of time, that all events are well attended and that infrastructure is used appropriately and comfortably by all visitors. Sadly, there will also be the requirement of ensuring that visitors to the London Olympics are able to visit the retailers that they wish to visit and that the maximum possible profit is achieved from the event. This type of agenda is often overlooked when it comes to crowd management yet in reality many events are focused on being profit-based and therefore whilst many crowd management theories focused on ensuring health and safety and this will naturally be made a priority, the other secondary agendas should not be overlooked.

As well as modelling the individual factors which feed into crowd management process is. There are also a wide variety of external factors which may directly or indirectly impact on crowd behaviour and the expectation that the members of the ground may have. For example, the level of patience and the willingness to queue may vary depending on the cost of the ticket and whether a specific individual has paid extra for faster entry. One is a specific model has been established this will then need to be tested in a wide variety of situations in order to determine whether or not it is an accurate model that can be used to deal with every type of crowd situation or whether the model is limited to a specific range of crowd management issues and the model will need to be adapted if it is to deal with other crowd issues.

Simulation is likely to be central to the development of this model and also to the testing of the model as it will be necessary, a wide variety of scenarios. In order to establish the model in the first place and also to undertake an analysis as to how the model will deal with various different crowd situations. It is only with the use of a variety of different simulations that the model can be correctly tested and adapted to ascertain the way in which mathematical modelling can be used where possible and other factors can be linked to see how the crowd changes depending on a variety of different inputs. For example a comprehensive model would be able to identify the way in which a change in mood or a change in external factor such as the breakdown of a particular piece of infrastructure would have on the crowd from a physical point of view as well as from a mental and attitude point of view.

The next step for this research is to look at creating the framework that will then be used to establish the model which can be applied across a wide variety of crowd based situations. And having discussed in the section above these will firstly be broken down into qualitative and quantitative factors in order to ascertain which of the factors could potentially be models in a mathematical way. By identifying which of the factors can be dealt with mathematically, the model can begin to take shape and the softer factors which impact on these mathematical factors can then be linked in around the core quantitative issues. For example, if it is identified that a crowd density over a specific point creates a rush that any of the social issues that will potentially increase crowd density can then be linked into this element of the model.

The next there will therefore be to identify all of the factors which will lead into the ultimate crowd management model before going on to establish a framework in which all these factors are linked together and the cause and effects of various different activities can be modelled. Once these factors have been established and the interrelationship between them have been mapped out the next step will be to run several different simulations in order to determine how effective the model is in providing valuable information to those involved in crowd management. From the simulations that are run it is expected that certain weaknesses in the model will be identified and it may even be necessary to change the model in order to deal with any weaknesses that are identified when real life simulations are run. In particular the simulations will need to be run in relation to not only achieving health and safety, but also looking at the secondary issues that may arise when it comes to crowd management. For example, the model will lead the ground based on different numbers of visitors, and ascertaining whether or not these visitors are then able to visit the appropriate retail stores, this type of information will also offer valuable data to the management team in events such as the London Olympics as this will allow them to map out which retail spots are likely to be more desirable and therefore should be charged at a higher rate than others. This information will also be useful when it comes to ensuring appropriate staff levels at the various outlets and parts of the venue. By undertaking these simulations and looking at all of the information that could potentially be provided to those involved in crowd management the model can be adapted as extended where appropriate services useful not only from the point of view of maintaining health and safety, but also from the point of view of the overall brand management regardless of the perspective being taken by the management team. It is the extension of crowd management to consider the wider issues relating to the movement of individuals within a venue that will add value to the proposed model here. This will allow an event to be commercially successful as well as not presenting a risk to health and safety.

3.7. Summary

The third chapter was about the research methodology and design that was used to conduct the present study. The research methodology that is employed is critically important when it comes to identifying ways in which an appropriate model can be designed. The detail of the research methodology involved the consideration of both

quantitative and qualitative elements of the framework and breaking down the case studies and primary research in such a way that each element of the model designed allows the interactive process to be achieved in a way that would not be possible without the use of real case studies. The chapter prior to this looked in more detail at existing literature in this area and the issue being faced by the crowd management team in relation to their specific events as well as considering other background information which was relevant to the way in which a model can be applied in the practical sense. The balancing part of this research established a model for crowd management and therefore the aim of this chapter was to bridge the gap and ascertain how precisely this model was developed.

The research methodology here is therefore being looked at from several different perspectives and it is expected that there will in fact be several different cycles that will need to be gone through in order to create a comprehensive model that will deal with the widest possible variety of simulations. In particular one of the main aims of this research methodology is to widen the net crowd management frameworks to move beyond simply ensuring health and safety, but also to offer valuable information to management teams for the management of events such as the London Olympics which is necessary to not only ensure public safety but it also needs to be a viable commercial event that gives the impression that the UK is a world leader in their ability to manage an extensive event.

The next chapters will therefore go through the modelling process from start to finish as laid out in this research methodology and would involve simulation scenarios, case study analysis and analysis of data collected through qualitative and quantitative methods, with a view to producing a comprehensive framework that will operate in the best way possible for all types of events and crowd situations.

CHAPTER 4: SCENARIO ANALYSIS- CASE STUDIES

A particular challenge faced during this research is the fact that, whilst there are multiple different theories that can be drawn upon in order to establish strong crowd management facilities, there is always likely to be an element of the unknown which presents itself, when a group of individuals come together. Furthermore, individual behaviours will vary, depending on such a wide range of issues that it can never be possible to project, with complete certainty, how a group of individuals will behave, in a particular situation (Ledesma,2002).

While still maintaining the two key case studies that have been used throughout this analysis, namely the Hajj to Mecca and the London Olympics 2012, evaluation of the modelling framework, which has been established, will also be looked at, from the point of view of determining how it is likely to work, when using other types of crowd situations. For the purposes of allowing this evaluation to take place, the primary analysis section will consider six different scenarios which have been discussed for the benefit of providing background, in the appendix. By using six specific scenarios, the modelling framework which has been established can be evaluated, with greater certainty. From this analysis, the chapter will then go on to look at how the framework operates from a generic perspective and how the evaluation that has emerged can now assist in developing the framework, in the future, by looking at the key findings of evaluation and making several suggestions for future frameworks, as well as considering how technology could be harnessed, more effectively, to achieve a stronger crowd management framework.

This evaluation phase is seen as being a particularly important stage, as management issues are, in fact, very fast moving and there is an ongoing need for those involved in crowd management to develop new skills, on an ongoing basis and to be able to adapt to changing environments. It is for this reason that computerised opportunities are so interesting in the development of these frameworks and may offer even further opportunities for crowd management, in the future.

This primary analysis involves looking at six scenarios which break down specific situations which are likely to arise, in the context of the two case studies that have been

chosen in this research paper. By looking specifically at individual scenarios that may arise and the way in which the suggested framework would affect the actions of those involved in crowd management, the weaknesses associated with the modelling framework can be more accurately ascertained, and any particular merits associated with the framework can also be readily identified. It has been suggested that the framework will be equally applicable to both types of case studies; however, by running the scenarios as laid out in the appendix, the true flexibility of the model can be more readily understood and looked at, from a practical point of view. Each of these six scenarios will now be discussed, before going on to consider the overall evaluation of the framework and identifying areas for improvement, both generally and with reference to the individual case studies and primary data collection through the questionnaires and interviews.

4.1 Scenario 1 Crowds heading towards one particular location, regardless of how large the location actually is.

The prolonged nature of the Hajj creates both a challenge and an opportunity for those involved in crowd management. Where the crowd is all heading towards one particular location, regardless of how large the location actually is, there is a potential crowd management issue. In the case of the Hajj, the actual location of the pillar will not change and the general entrances and exits are laid out to accommodate the moving crowd. These are the stationary issues that will not change. The other factors that will impact on how this crowd will behave and how this may change during the gathering will then need to be identified. The speed with which the crowd enters the area will depend on the thoroughfares that are being followed and on external issues such as weather, which may delay the start of the pilgrimage and cause more people to start the journey at a specific time, rather than spreading the crowd out, over several days. The internal decision making process for the crowd will also be a variable factor, with each of the crowd members wanting to travel, at different speeds, reflecting largely of their own physical abilities, as well as factors such as the amount of time they want to spend at the pillar. As this is a religious festival, it is accepted that the general desire to reach the pillar, within the crowd, will be great, at times, but the level of this desire will naturally vary slightly from person to person. Any part of the group which chooses to stay at the front of the pillar for a longer period than necessary will potentially slow down the movement of the crowd and is something which may impact on the build-up of the

crowd, over a prolonged period. Natural disasters or changes in the movement of the crowd that happen, along the route, will have an impact on the way in which the crowd moves around the pillar. As the actual route is set, the movement of the crowd and anything that impacts on its speed would have a bearing on how the stress points operate, as there are limited chances for diverting the route, unless there is a specific diversion put in place that requires pilgrims to follow an alternative route.

In this specific scenario, there is a slowly increasing build up taking place around the pilgrimage point of the pillar and intelligence gathered by those involved in the management has identified the density of the crowd, in this area, as increasing, with more people entering the area than leaving. As the route is already set, this information allows the crowd management team to slow down the number of people entering the area surrounding the pillar by slowing down the crowd on the pilgrimage, along the entire route, in a way that will not cause a particular crush at any given point, but will slowly, steady the speed of the crowd in its entirety.

Specific areas have already been identified as potential locations in which the crowd can be managed, including delaying the approach and using any camps which the pilgrims use, as a method of breaking down their own journeys. By creating a slight block, this will, therefore, reduce a potential problem that is emerging by the pillar out across the entire route, without any of these points then reaching a danger point.

A further area to target is to ensure that the pilgrims leave the pillar area, as quickly and efficiently as possible. This will involve opening up additional exits, so that the pilgrims can travel through a variety of different exits, depending on where they ultimately wish to travel to. The build-up of individuals by the pillar can be attributed not only to an excessive volume of people entering the area, but also to those who are already within the area slowing down or even coming to a halt, by continuing to encourage people to move around the pillar, before exiting in a controlled manner. This approach will act to improve the position around the pillar itself, as it has been noted that the majority of the pilgrims simply want to celebrate at the pillar, before moving on, rather than necessarily wanting to stay by the pillar for a prolonged period of time. Once they have achieved their aim, they wish to leave; therefore, facilitating this aim is the quickest way of ensuring that there is no excessive build-up of people, at this one location.

4.2 Scenario 2 Crowds continuously flowing past a permanent fixture.

This specific scenario considers the way in which crowd control can be used in Mina in order to deal with an emergency situation. The stationary factors that will not change have already been identified as part of the framework. These include the strong desire of the individuals to reach the pillar, even if this threatens their own personal safety; the precise location of the pillar and the route pilgrims will take will be permanent fixtures and the continuous flow of people throughout the period of the pilgrimage, which again will not stop unless specifically interfered with.

The crowd itself has been identified as being made up of a wide variety of different physical attributes and, in this scenario, the stronger physical individuals have chosen to use this advantage, in order to push others out of the way, so that they themselves can get closer to the pillar. This has created a difficulty and some of the weaker pilgrims have now fallen to the ground. Yet, they will be unwilling to leave the region, as they themselves have not yet satisfied the religious requirement.

At this point, the crowd management personnel can identify the factors that they can potentially influence, in order to deal with this emerging crisis which is fast approaching an emergency situation. Offering additional exits to those within the pillar region will not necessarily have a strong reaction, as it has already been identified that those pilgrims in the region will not leave until their aims and objectives have been met. Despite this, it is still proposed that additional exits will be opened, in order to change the general flow of the people in the pillar region, and to offer a rapid exit to those who have achieved their aims and objectives. Similarly, several different points along the pilgrimage route have been identified as being appropriate locations in which to hold members of the crowd, for a short period of time, and to alter the density of the crowd at the pillar. This will be used to reduce the number of individuals now entering the pillar area; however, the reaction to this will not be quick enough for the emergency situation to be dealt with and, therefore, more dramatic action needs to be taken in the Mina region itself. There is a relatively small number of individuals available to offer emergency services, including the need to allow access to the area for those offering medical care. Specific points have already been identified which would be appropriate for setting up a medical care facility. These points will need to be clearly identified to the public, as well as opening up the access routes to these areas, offering those individuals who do require

care an obvious route to follow. This, in itself, will reduce the pressure on the main route around the pillar. It has also been identified that, in order to divert individuals who are within the Mina region, there will need to be a concerted effort from the security services, as the crowd itself is relatively single-minded, in terms of gaining access to the religious location. With this in mind, a relatively large presence from the security forces will be necessary, at specific points around the pillar, to ensure that the thoroughfares are used appropriately and all available exits are used, in order to relieve the pressure on the key emergency points. Essentially, this will involve security services, drawing from either side of the crush point and directing the crowd out of the direction they are going and moved to another direction. The pilgrims will follow these routes when they are carefully laid out and when they are required to do so by the security services, but are unlikely to select these routes from their own personal choice.

By using the framework, therefore, when an emergency situation arises, those involved in crowd management can quickly identify ways in which their own actions can impact on how the crowd behaves. This is particularly important where there are factors that are very hard to manipulate, as they are related to religious requirements. In this case, therefore, it has been identified that an overt use of security services is necessary to divert individuals, as necessary. By locating the security services at key points and opening up new routes to assist in the exiting of the region, an emergency situation can be mitigated and medical care offered to those who require it, at the earliest possible opportunity.

4.3 Scenario 3 Weather conditions affecting crowd movement.

The final scenario to be used in the case of Mina is again quite similar to the first scenario. However, it should be noted that natural issues such as the weather cannot be controlled by the crowd management team. Instead, it is necessary for the crowd management individuals to identify any potential issues and to map them out with the use of the framework to establish the way in which these factors will ultimately impact on the crowd movement. In this case, the crowd management team followed the framework very carefully to identify how these factors which are outside of their control will interact with the way in which the crowd operates, so that they can identify how they can potentially take control back. In this particular scenario, bad weather resulted in more people staying within the camp, at the beginning of the pilgrimage. This, therefore,

resulted in some of the days being particularly low-flow, with pilgrims then choosing to use the better weather conditions to make their journey, thus having a much denser crowd on the day.

The weather conditions are beyond the control the crowd management team. However, the team is potentially able to control the speed with which individuals leave the camp area and begin their pilgrimage. Concerns, however, have arisen due to the fact that those pilgrims following the route of pursuing a religious endeavour will, therefore, be particularly keen to begin the pilgrimage. With this in mind, support is being offered to the process, to ensure that those staying at the camp at the beginning of the pilgrimage can be encouraged to follow the route, in the same order that they entered, so that the pilgrims do not feel that they are being delayed by being held at the entrance for a prolonged period of time. Consideration will also be given to the use of public transport, in order to facilitate the movement of the pilgrims, at the earlier stages of the route. By using public transport, the crowd management team will gain greater control over the flows of individuals, to ensure a consistent flow of people that, in turn, will reduce the density, at any of the potential choke points.

The ultimate aim of the crowd management team is to ensure a consistent flow of people, with no particular lull, as this would potentially result in an increasing crowd density, at some point or other point. In this context, the aim of the crowd management team will be to ensure a consistent supply of pilgrims throughout the route, even during adverse weather conditions. In order to encourage this aim, specific start times will be used to control and support offered to those who are concerned about poor weather conditions, including potentially setting up additional camps along the route, so that there is no one area of gathering which will naturally increase the density in the crowd. By using intelligence gathered, it is possible for the crowd management team to identify how many pilgrims need to be at each point along the route, in order for the movement of the crowd to be consistent. So, with this in mind, additional camps could be set up along the route, to maintain this level of movement, in a controlled fashion.

This use of the crowd management framework is a clear example of how information relating to factors which cannot be controlled by the crowd management team, can be identified, and how the factors that can be controlled can be altered to create a smoother crowd flow, while also allowing the pilgrims, ultimately, to achieve their aims

and objectives, something which necessarily must happen, if a dramatic reaction from the crowd is to be avoided. Essentially, the entire framework associated with the Hajj involves ensuring a smooth number of travellers, at any given point, and there are numerous different factors that may reduce the chance of this happening naturally, including weather conditions. By identifying these and looking at ways of influencing ground movements, such as establishing camps along the route to spread out the pilgrims so that the crowd management team can react, before an emergency situation arises.

Issues such as weather conditions or natural disasters cannot be controlled by the crowd management team; therefore, this needs to be put straight into the framework, to look at the factors that are within the control of the crowd management team to help mitigate the impact of these external issues. The pilgrims will naturally behave in a certain manner, when weather conditions worsen and this, in itself, cannot be changed without specific intervention.

4.4 Scenario 4 Breakdown of public transport Infrastructure.

The fourth scenario relates to the London Olympics which is a totally different event from the Hajj and relies on a large amount of infrastructure, due to the myriad of different venues and events that will be taking place, over the duration of the Olympic Games. This particular scenario looks at the situation where parts of the public transport infrastructure break down, either temporarily or permanently. Inevitably, the precise impact of such a breakdown will vary, dramatically, depending on the events that are going on, at that particular time, and where precisely the breakdown has taken place, as there may be alternatives available to people which are relatively easy to follow and require little direction from the crowd management team.

This immediately suggests that the crowd management team will need to have gathered substantial intelligence, prior to the Olympic Games commencing, on the infrastructure, roads that are available, and the number of people who can travel on each of the routes, at any given point in time, as well as mapping any alternatives which may be available, in the event of breakdown. This can be done through a computerised system and will allow those involved in the crowd management to run scenarios, such as what will happen, at a particular point in time, if one aspect of the infrastructure breaks. This is the first stage in using the framework to deal with a breakdown situation.

Information relating to the number of people who are likely to be within the infrastructure, at any given point in time, can be gleaned from the venue, which is being serviced by that specific route, the events that are taking place at that venue at that point in time, as well as the number of tickets that have been sold for the event, at the venue. Clearly, if the venue that is being serviced by the infrastructure is not in use, at the time of the breakdown, the impact is likely to be considerably less than if the infrastructure is serving one of the major events, such as the athletics. Therefore, the mapping, in this case, would involve drawing on the information relating to the number of people in the area, at the time, as well as the general pattern of the infrastructure and how many people can travel on any given route, at any given time.

With this in mind, the framework can then be used to identify alternative means of ensuring that the individuals reach the venue that they are trying to reach. The team will need to know the full capacity of each element of the infrastructure, in order to determine how the crowd can be dissipated and sent down alternative routes, in such a way that does not create a substantial crush, at any point. For example, there is little point in sending several underground travellers to use bus routes, as the capacity on the buses is considerably less than will be available on the underground route and this would simply result in a substantial jam, at the various different bus stops. Alternatives include walking routes which will be made available to those who could potentially travel on foot, as this is an excellent way of dissipating the crowd and ensuring that there is no excessive density, at any given point. In order to facilitate this option, the crowd management team will need to have clearly marked routes in place and use stewards and staff members who are able to offer guidance and advice to people who are now having to follow an alternative transport route. As well as identifying the alternatives that may be available, the crowd management team needs to have a support team in place to get the infrastructure working again, at the earliest possible opportunity, as well as having back-up transport available to deal with breakdowns, such as reserve buses or even underground lines that are not generally in use, but could be brought into use or diverted from other quieter lines, in the event of a substantial infrastructure emergency. It was also noted that a large number of the individuals travelling around the London Olympic events will not have intimate knowledge of the underground routes or alternative ways of travelling. Therefore, clear signage to direct the crowd will be a fundamental part of controlling the crowd, in this unexpected scenario. On the whole, it

is likely that the crowd will simply follow the instructions provided; therefore, ensuring that these instructions are clear and that they spread the crowd in an appropriate way, while also allowing people to reach their chosen venue, is something that the framework can work carefully towards achieving.

4.5 Scenario 5 Threat of criminal activity.

With reference to the London Olympics 2012, and the current climate in relation to serious organised crime and, in particular, terrorist activities, several plans need to be put in place, in order to deal with such eventualities, e.g. the threat of terrorist activity. Much of the planning in this regard will deal with identifying potential terrorist activity and preventing it from taking place, rather than necessarily managing the crowd, when terrorist activity becomes imminent or actual. Again, by using modelling framework information relating to the number of people in any given location, as well as the types of infrastructures that may be available, for transporting people from location to location and the thoroughfares that the crowd will be using when the infrastructure is not appropriate or available, would already be mapped as part of the crowd management process.

It is noted that the crowd is likely to be sensitive to potential terrorist threats and, therefore, there is no real need for there to actually be a terrorist event; the mere threat or suspicion that a terrorist event is likely will be enough to manipulate the way in which the crowd reacts and will actually create a rush for a particular exit. This, in itself, can create a danger to health and safety. Therefore, there are levels or aspects of crowd management that need to be dealt with when there is an imminent threat of terrorist activity. Firstly, the actual terrorist activity itself needs to be managed in such a way that the crowd gets moved away from the danger area, quickly and in a way that does not create additional problems, either in the area that the people are being moved to or during their transit. There is likely to be an element of crowd panic when the potential of the terrorist threat becomes even more imminent. With this in mind, there needs to be a very controlled movement of the crowd, with greater direction being given by the security staff than would necessarily be appropriate when the movement of people is due to some other reason, such as an infrastructure breakdown.

Having isolated the area that is deemed to be at risk from the terrorist activity and moved all individuals away from this immediate area, the next element of crowd control

will be to dissipate the crowd, across other areas of land, understanding the fact that moving a large number of people from a concentrated area could potentially have a ripple effect that might ultimately impact on crowd movement, across London, but will certainly have an impact within the vicinity of the threatened area.

Where terrorist activity actually takes place, additional crowd management issues will come to bear, as it is likely that there will need to be substantial security placed in the area, in order to identify the perpetrators, as well as potentially offering medical support to anyone who has become injured. Amongst the crowd are likely to be a wide variety of different personality types as well as different physical attributes; all these factors will impact upon the speed with which they leave the area and the general level of panic that is being experienced. Those who are relatively calm naturally are likely to move at a slower pace, in a more controlled manner; whereas, where there is a high level of panic, the crowd is going to be harder to control. Moreover, this will require a greater security presence, as well as strong directions being given to ensure that the crowd moves in the most appropriate manner, at the quickest possible rate, without creating a stampede. Computer simulations can be used to ascertain which exit routes will be most effective and how they will cope with the increasing density through various different potential choke points. It may also be necessary to close certain infrastructure routes, in order to prevent other individuals entering the area; this, again, will have to be dealt with in a similar way to any other infrastructure breakdown.

A final element of crowd management that needs to be dealt with as part of this scenario is the need to ensure ease of access for the emergency services to deal with the aftermath of such an event, as well as looking at the medium- to long-term impact that will allow the events to continue as quickly as possible and to deal with these events in such a way that reduces the disruption caused to the overall Olympic Games.

The real difficulty, here, in relation to crowd management and the London Olympics is the fact that terrorist activity creates a panic-based reaction which will depend on the general feelings and beliefs that the crowd has in relation to terrorist threats. Clear signage and clear control needs to be implemented by security teams, as a priority, so as to prevent panic reactions and to control the movement of the crowd trying to exit a particular location, quickly. The ripple effect of the crowd movement will also need to be considered, in more detail, with the use of computer simulation, where possible.

4.6 Scenario 6 Unknown number of tickets sold and unknown number of individuals travelling and entering various venues.

The final scenario for the purpose of this analysis actually produces quite an interesting situation. Throughout the modelling framework, it has been assumed that the number of individuals entering a particular venue will be known, due to the number of tickets that have been sold, and this is considered to be a stationary factor in the crowd management. In reality, however, this may not be the case and a scenario could emerge whereby a large number of individuals travel to a particular venue, in order to hopefully obtain tickets, or where there has been a substantial influx of fake tickets, encouraging individuals to an area that is simply not expecting them.

This creates a problem from a crowd management point of view, when using the modelling framework that has determined as one of the stationary elements which is no longer bound to be a stationary element and the framework will need to adapt to these changes, if it is to remain effective, in the current scenario.

With this particular situation, the crowd management framework also needs to take into account the large number of individuals who are now travelling to the area. The modelling process and, in particular, any computer simulations in this area could be used to determine the likely effect of an increase in the crowd, by either a certain percentage or certain figure.

By using computer simulation, in this way, it can be identified as to where the crowds are likely to gather and how crowd management techniques could be used, in order to deal with this increased crowd. For example, there may be added entrances that could be used to prevent those with tickets becoming embroiled in the crowd outside for any prolonged period of time. Secondly, additional security and new thoroughfares could be added, in order to move those who are not meant to be in the area, or do not have tickets, on to more suitable locations in an organised and controlled manner. The real danger area is likely to be the ticket booths themselves and the entrance points; therefore, this is where the focus of crowd management should be, regardless of why there has been an increase in the number of people, at a particular location. Although the scenario, here, looks at a situation where a large number of individuals attend an event for which they do not have tickets, this type of increasing crowd could take place, as a result of the crowd being moved from another area that is under a terrorist threat;

crowds moving as a result of changing infrastructure; also scheduling issues that change the general volume of people, in a particular area.

Computer simulation is, therefore, an important aspect of crowd management, as it enables the team to model what happens when there is an increase in crowd numbers and how this can be mitigated through the opening of additional entrances and exits, as well as changing the signposting to encourage the crowd to move in a different way and to take a longer route that does not involve the crowd members travelling through a particular choke point.

Fundamentally, crowd management in this type of situation, involves being able to impact on how the crowd behaves, in such a way that the overall collective crowd members do not create a danger to themselves or to others, but also allows them to meet with the overall aims and objectives. Any method that is used will need to control the flow of the crowd, when it comes to the London Olympics. This could possibly utilise alternative routes of transport and alternative infrastructure methods to impact on the behaviour and choices made by the individuals within the crowd, by accepting that crowd members are likely to be self-serving and looking to meet their own aims and objectives, without necessarily considering the impact of their behaviour might have on others in the crowd. It is up to the crowd management officials to ensure that the crowd behaves in a way that allows them to be self-serving, but also for the overall aim of maintaining crowd safety and efficiency.

4.7. Development of the theoretical framework modelling

Having established the variety of different issues that have arisen regarding crowd management and looking at the literature review in this area, it can be seen that the process of establishing a modelling framework is unlikely to be one-dimensional. Furthermore, it is accepted that there are so many different aspects of human behaviour that may impact on how a crowd behaves, that it would be unwise to attempt to model crowd behaviour, based purely on objective standards or computerised modelling, based on physical movement. With this in mind, the modelling process which has been followed in this chapter will look at various different factors which can ultimately impact on the way in which a crowd behaves; therefore, having sufficient adaptability within the model to allow for a variety of different inputs will be central to this modelling framework (Bailey, 1992).

Fundamentally, the principles of enterprise modelling will be used in the establishment of a crowd management model. This involves breaking down every element of the process into smaller elements, all of which are interdependent and will ultimately lead to the overall picture of crowd management. Crucially, it will allow the authorities associated with crowd management, in particular situations, to manipulate the crowds behaviour for the benefit of maintaining health and safety, but also in order to establish better ways of commercial exploitation for those involved in the event; something which is particularly important in the case of the London Olympics, where the issues go much deeper than simply considering the safety of the crowd (Football Stadia Development Committee, 1994).

This chapter will look at the modelling process and the various different factors that will be drawn upon, in order to create a model of how crowd behaviour is likely to take place, including drawing on factors such as the personality of the crowd involved and the general attitudes of those associated with the crowd, at a particular point in time. This framework will then be discussed in the context of establishing a computerised simulation, with recognition of the fact that it is impossible to deal with every single personality type that could be present within the crowd; but, rather, with a view to creating generalisations and norms, as far as possible.

This process will then be looked at in relation to the two case study situations that have been identified, in this research paper, namely the Hajj and the London Olympics 2012. By considering the practical application of the stated framework, any weaknesses associated with the framework can be identified, as well as looking at ways in which the framework could be adapted to deal with specific situations, as they arise. The findings will be put together in a final analysis of the issues that have arisen and conclusions drawn as to the effectiveness of the chosen model.

Components/ Issues	Security	Safety	People	Technology	Location	Management	Infrastructure	Legal
Project and Risk Management	Security/ Surveillance/	Identify Risks and Hazards / Contingency	Team Leadership	Project Management System	Main Headquarters	Time/Cost/ Monitoring Project Management	Security and Surveillance monitoring	Insurance / Licence and Permission
Event Management	Security/ Surveillance/	Structural Safety / Hazard Associated with Barriers / Providing a Safe Venue / Food Safety / Fire Safety	Event Advertising / Marketing	Event Management System	Event Control / Facilities Management	Pre-Event Planning / Preparing for Unexpected / Available Funds and Resources / Event Management Strategy	Temporary Structures	Insurance / Licence and Permission
Infrastructure and Transport	Transport and communication security	Transport safety	Communication	Communication networks: landline and wireless / Vehicles /	Venues /	Infrastructure and Transport Management	Buildings / parking / air / land / sea traffic network / Utilities / gas/electricity / water / pedestrian facilities / road networks	Transport and communication regulations
Health	Health awareness	Accidents / Trauma / Injuries / death / illness and disease	Paramedics / medical staff / Nurses / doctors / / treatment	Ambulance / Medicine / Health Management System	Facilities	National & Private health Service	Hospitals / Clinics	Medical insurance
Society and Culture	Crime Rates	Health/nutrition	Language/ Dress codes /Behaviour/ Different culture/ poverty social exclusion/	Communication	Venues/ Main Headquarters	Event Management Strategy	Support network for disabilities	Insurance / Licence and Permission
Authorities	Security/ Surveillance/	Structural Safety / Hazard Associated with Barriers / Providing a Safe Venue / Food Safety / Fire Safety	Team authorities	Contact with relevant bodies and agencies	Event	Police system	Stewards	Licences and permission
Disaster Management	Appraisal of crowd safety management / Prevent crime	Prediction/ Stampedes/fire /Building collapse and injured	Team staff disaster management	Sensor /Technology/ Communication	Venues/ Main Headquarters	Efficient crowd management	Monitored /Analysed by video cameras/Capacity of emergency doors/Create database comprehensive emergency data/Evacuation Capacity of door openings in panic situation	Licences and permission/ Insurance
Environmental Issues	Security/ Surveillance/	Pollution/Weather/Flood risk/noise	Team staff environmental	Communication	Venues/ Main Headquarters	Event Management Strategy	Food quality/transport network/water quality/air quality	Licences and permission/ Insurance
Communication and Collaboration	Security/ Surveillance/	Structural Safety / Hazard Associated with Barriers / Providing a Safe Venue / Food Safety / Fire Safety	Communication team	Satellite/fid/ wireless/ Internet /telephone/	Venues/ Main Headquarters	Event Management Strategy	Cell tower /wired communication network /wired communication network	Licences and permission/ Insurance
Crowd Control	Security/ Surveillance/	Accidents/stampedes in congested places	People density/crowd behaviour/potentially aggressive abusive	Planning /coordinating emergency /management available spaces	Event or venue density	Physically Managing	Administering coordinating/clear passage	Licences and permission/ Insurance
Legal and Regulatory Issues	Security/ Surveillance/	Monitoring	Public relation	Contact with relevant bodies and agencies	Venues leases	Compliance management	Decision management	Instruction/Local authority/Licences and permission/ Insurance
Training and Rehearsal	Deal with emergency /Security/ Surveillance/	Fire safety checklist	Team of training/advance planning	Improve skills	Deal with kinds crowd /people	Deal with large event	Deal with any threat	Deal with terrorism/Licences and permission/ Insurance
Financial and Return on Investment	Security/ Surveillance/	Accommodation occupancy rate	Public transport	Communication networks: landline and wireless /Vehicles	Main Headquarters	Team of Budget management/evaluation	Accommodation Infrastructure /Exchanging/Bank/	Licences and permission/ Insurance

Figure 4.1. MECCA Framework -Mega Event Command and Control Architecture

Previous chapters of this thesis have spent considerable time analysing the theory associated with crowd management. The purpose of this chapter is to study the framework within the context of Hajj, and how it leads to the development of a framework can be developed by giving particular reference to the various different components within the model.

As this model is broken down and looked at, in more detail, it can be seen that the existing system worked in a way that required information to be passed through the various different components, in a linear way; this means that the information which becomes known at one location will take a considerable period of time to reach the other areas of the system, potentially creating difficulties that could have been mitigated. In the example of the Hajj, the threat to public safety grows over a prolonged period of time; therefore, the ability to identify pressure points quickly and efficiently is a critical part of ensuring that all aspects of the system work together, in order to offer the most effective system for improving public safety. This interlinking of the various components will be a crucial factor of the framework and will remain central to the discussion, in this chapter.

4.7.1 DETERMINING COMPONENTS

By looking at the various different aspects of the framework as noted below, this can then be referred to throughout the analysis here and with particular reference to the components that are going to be relevant during the computerised simulation these are identified as follows:

Infrastructure and Transport

Looking at the Figure 4-2 below Infrastructure and transport across the framework looks not only at the physical infrastructure and transport which is available, but it also considers the methods whereby communications are entered into between the various different elements of the transport system. For example, in the case of the Hajj, whilst the road which the pilgrims travel along will be central to the infrastructure, the communication between the various different points along the road will be equally important. Information will need to travel from one point to another, in order to collect data in relation to the flows of people, and also to make sure that the data is presented in such a way that it is potentially useful to the other components within the framework. Whilst data are already being collected to ascertain when it is likely that a crush is going

to occur, in the next few minutes, this data has to travel through the entire infrastructure, before it can be held centrally, and before other components become aware of the difficulties emerging in one part of the infrastructure and how this is impacting on the other components.

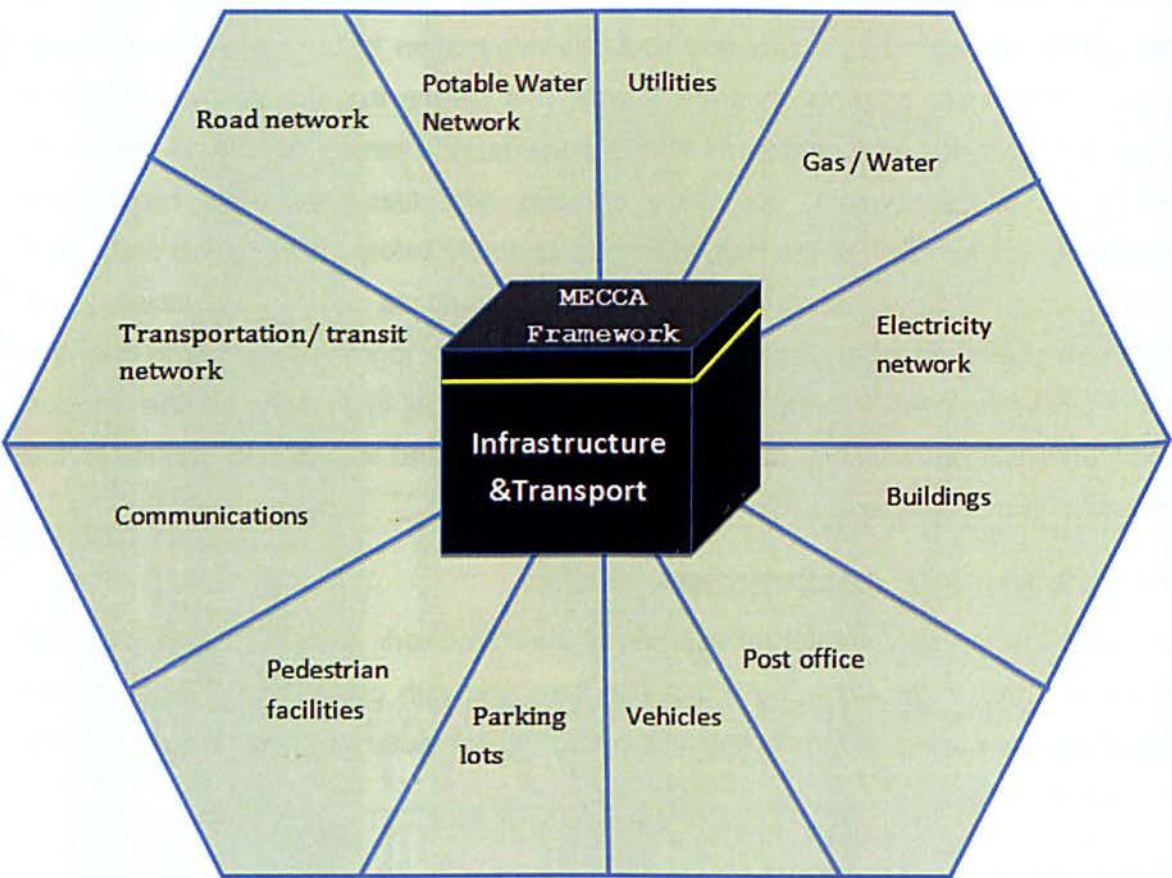


Figure 4.2 Infrastructure and transport

People Resources

People are involved in every aspect of managing the crowd and, while the focus tends to be and those involved in emergency services or those involved in managing the pilgrimage, in reality, people resources can come from a much wider range of sources, including the pilgrims themselves. The behaviour of the people involved in the pilgrimage, as well as the resources that become available based on the individual

behaviours, can transcend a wide variety of the other components. Using these people resources to transfer information and to impact on the movement of the crowds is something that can happen, along the entire pilgrimage. Moreover, whilst actions may be taken at the point where the crush appears likely, in practice, if the linkage between the people resources and the infrastructure were made clearer, it would be possible to alter the movement of people and to use people resources, at every stage of the pilgrimage, to deal with an imminent problem.

Health Factors

Looking at the Figure 4-3. below which concerns have been raised that there are potential health difficulties which may emerge during the pilgrimage, not only from the point of view of health and safety becoming compromised, but also in the event that a crush takes place. There are also health issues which may be related to the holding of a large number of individuals in temporary camps along the pilgrimage route. With this in mind, health factors need to be looked at from several different avenues; firstly, looking at the way of managing an outbreak or a massive injury and ensuring that the correct officials are able to gain access to the area and any diseases can be stopped from spreading, as well as, secondly, looking at means of preventing health concerns taking grip, in the first place. Information from the other components such as people, resources and infrastructure need to be pulled together, in order to ascertain where the majority of individuals are residing and also to map how an outbreak is likely to impact on the event, if it does, in fact, happen.

It is unlikely that the officials will, initially, be able to collect health information on all of the pilgrims, at the outset of the pilgrimage, although in time, and with the assistance of technology, this may become more feasible, in the future. Where a health threat arises, the ability of the authorities to ensure that treatment is received and that the damage is contained, as far as possible, is crucial; however, viewing this as a standalone issue is damaging to the overall success of the event.

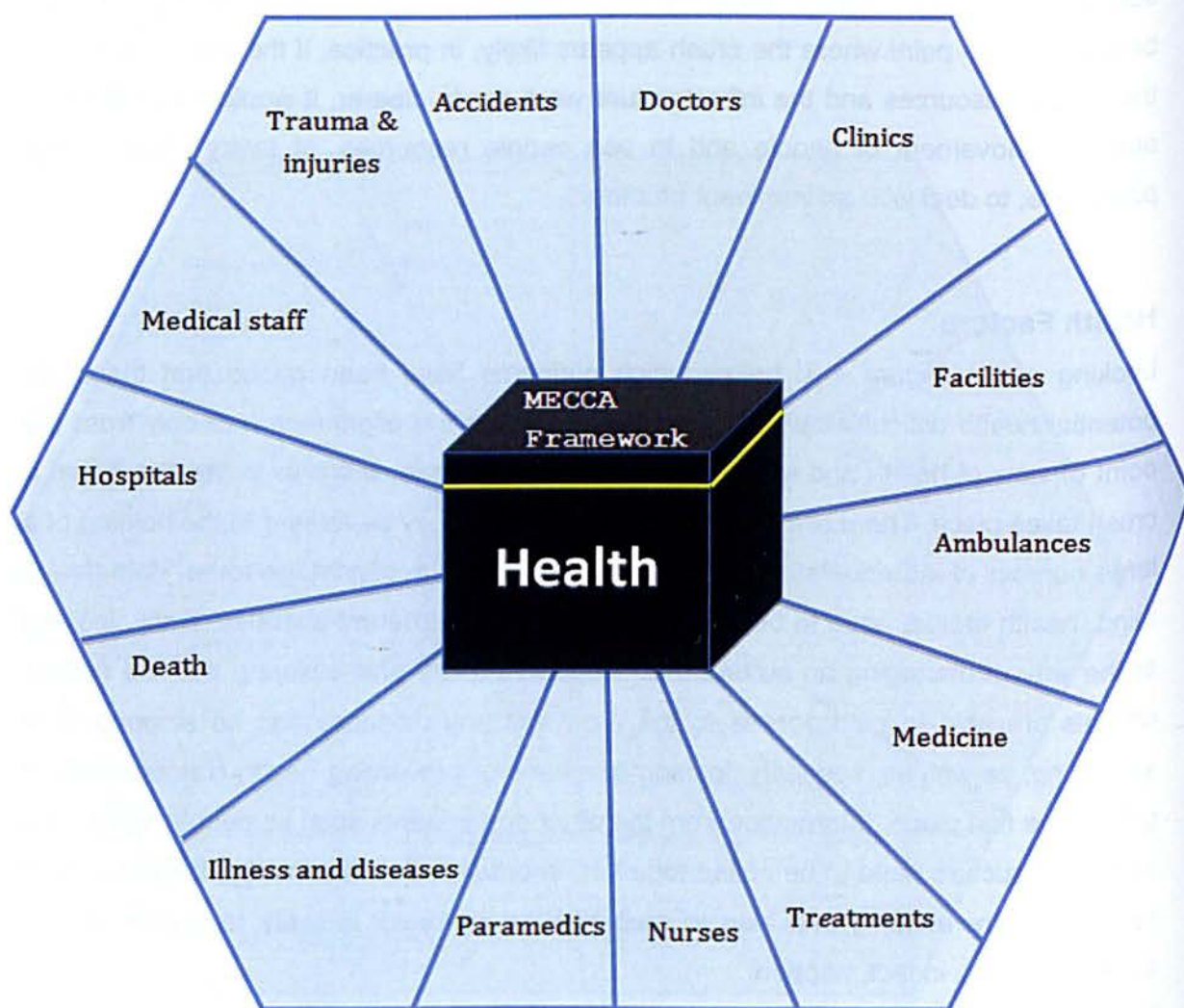


Figure 4.3 Health of the Factors

Society and Cultures

Figure 4.4. shows understanding the various different cultures which are present within the group and the types of general behaviours that are likely to emerge is something that will aid all aspects of the event management. In the case of the Hajj, it has been identified that the majority of the pilgrims will have strong religious drive and this will impact on the way in which they behave and also on how they interact with static factors such as infrastructure, health and legal resources. Again, the task of collecting data on cultures and general belief patterns could be aided by enhanced technologies and is not simply an issue that should be accepted as immovable, but rather something which may change, during the course of the event. Where other external changes take place it is necessary to ensure that the dialogue between cultural changes and the other factors is fast and direct and will be a real success factor for the event. Having a linear approach will not necessarily be helpful, as understanding the impact of the cultural factors is as important as determining the culture, in the first place.

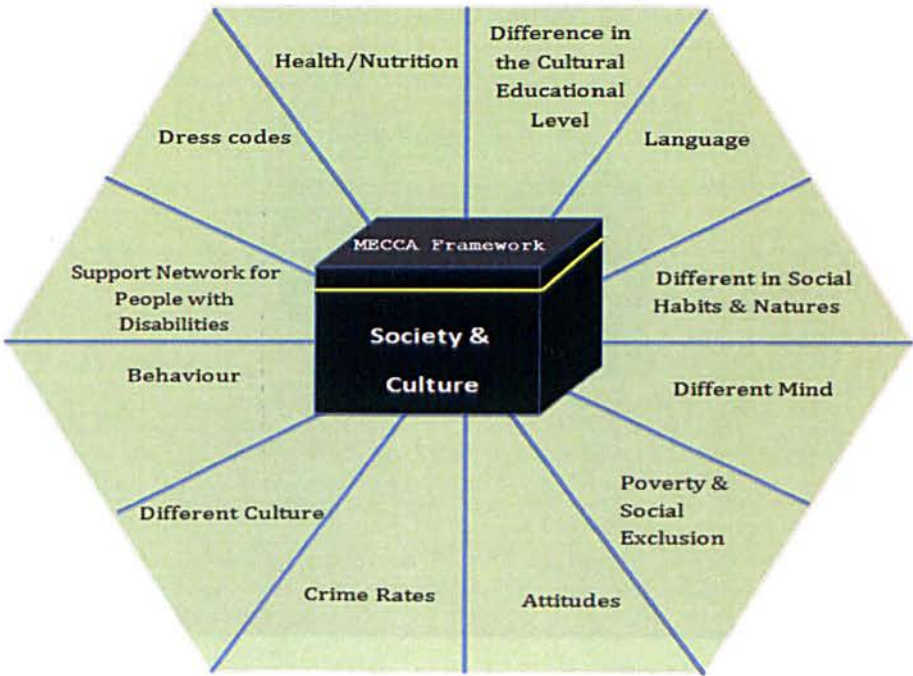


Figure 4.4 Society and Culture

Authorities

In almost all crowd management situations, there are going to be authorities and third parties that need to be drawn upon, in order to maintain order and to deal with health and safety issues, as and when they arise. Furthermore, a central hub of third parties and authorities which are involved in the management of the event is relatively commonplace; however, when it comes to establishing a framework such as the one proposed here, it becomes a fundamental task, as ensuring that these authorities are contacted with the relevant information, as quickly as possible, is crucial. In the event that they are required to take action, providing these authorities with the essential information from this source, directly, is a real potential benefit for the event. This could be achieved through the use of technology, as well as a carefully thought-out framework, to allow for the direct contact between the components, without having to travel information through the chain of command. Looking at the Figure 4-5 below.

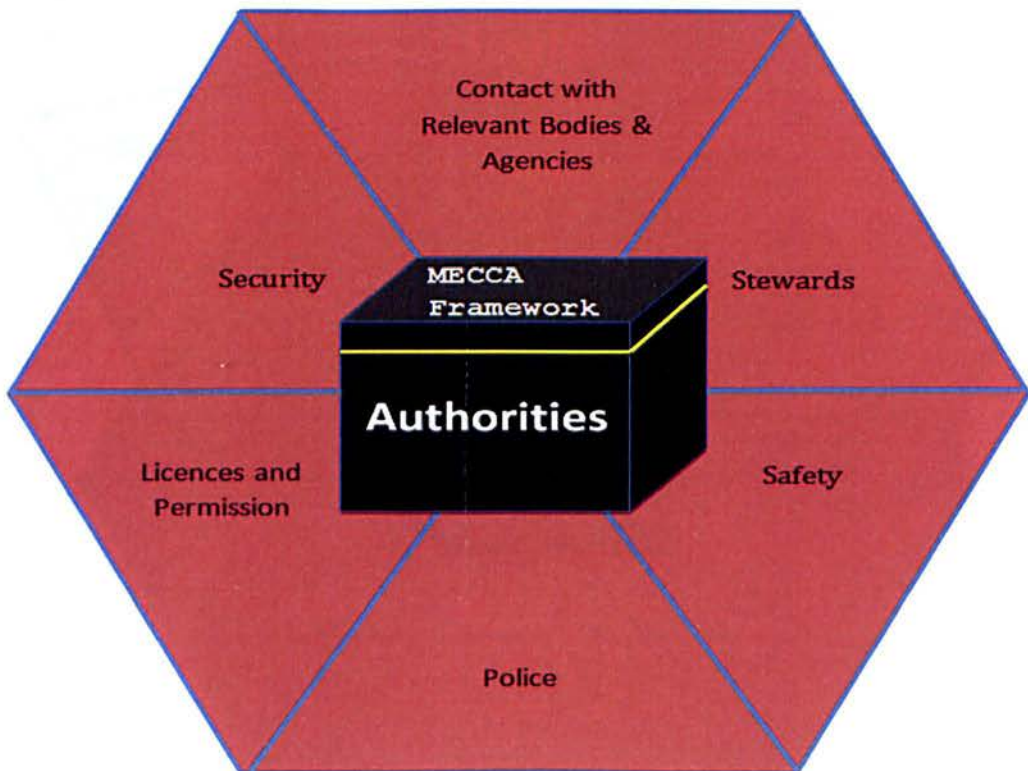


Figure 4.5 Authorities

Disaster Management

Linked to the above component is that of disaster management resources. Many of the disaster management resources will also be provided by the authorities; however, there are other factors that may be relevant to disaster management that are not provided by the authorities. Disaster management can also involve many of the issues associated with health factors and infrastructure. For example, a breakdown in the infrastructure requires management in the same way as disaster management, even though it is not yet a disaster. Provided the information is travelling through the system, effectively, these disaster management resources may be very useful and can be used to mitigate a potentially larger disaster, through ensuring that the correct resources are directed towards the correct location, as quickly as possible. Looking at the Figure 4-6 below.

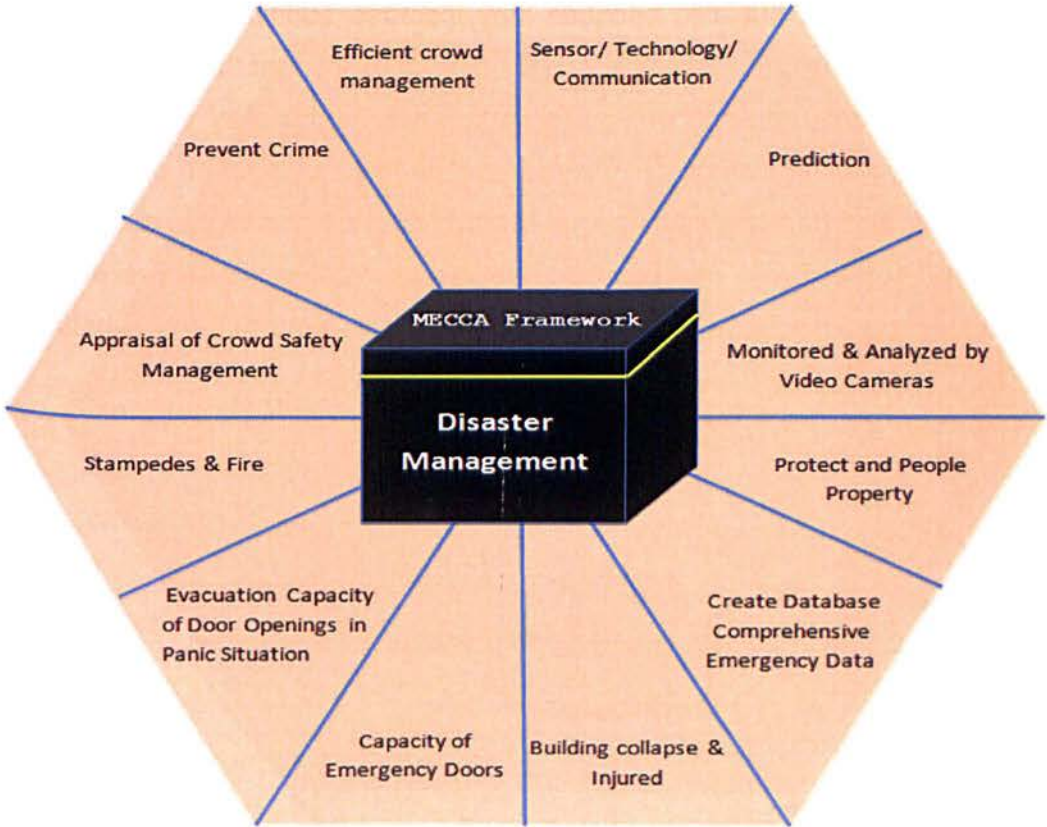


Figure 4.6 Disaster Management

Technology Resources

Finally, this component is argued by the researcher as being absolutely central. As the various different components are looked at, one of the key factors that emerge is that of the ability to collect and transfer data around the system, in a way that allows the appropriate authorities, people or resources to be mobilised. Therefore, the component which is related to the technology resources will permeate all aspects of the framework; it is also critically important for the functionality of the other components and is, therefore, going to act as the central component into which all others feed.

Environment Issues

Figure 4.7. shows environmental issues are becoming increasingly important, largely due to consumer demands, but also because they increase additional risks, such as regulations where environmental issues are not taken into account. These risks can, potentially, put the event management team in a position that they are breaching regulatory guidelines, which could have an impact on the financial position of the event. Certain aspects of the environmental issue cannot be changed, for example, the weather however, by identifying any particular issues associated with these external events, mitigation processes can be put in place to limit the impact of any substantial changes

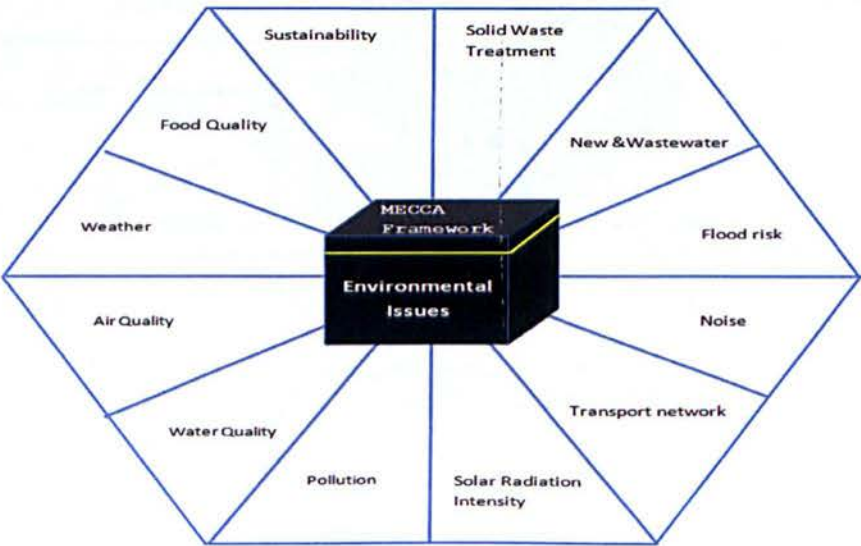


Figure 4.7 Environmental Issues

Project & Risk Management

Figure 4.8. shows a particularly important aspect of crowd management as part of a wider event is that of undertaking project and risk management, and many of the aspect of crowd management will involve identifying any particular risks which may be associated with the event and putting in place a process to manage these risks, in the most appropriate manner. Furthermore, this aspect of crowd management is likely to be ongoing throughout the process, as it will involve ongoing monitoring and adaptations to be made, in order to manage risks, as the event unfolds. Risk assessments are most likely to be undertaken as part of this framework. Looking at the Figure 4-8 below.

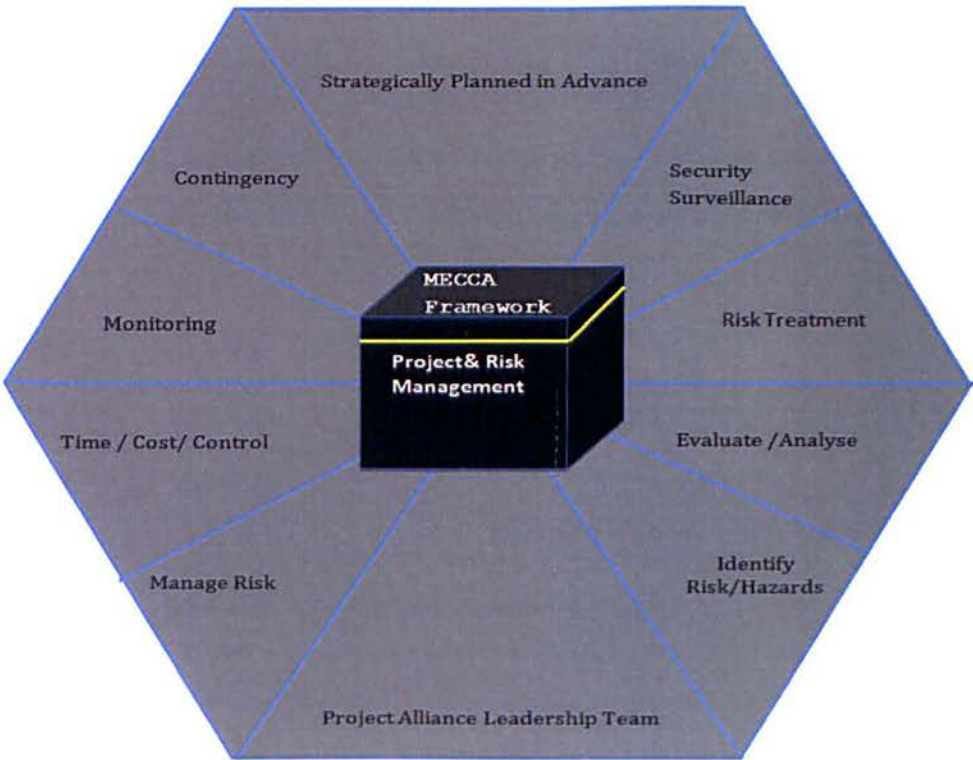


Figure 4.8 Project and Risk Management

Event Management

When it come to the management of events and crowd management, in particular, the first step of any framework is to lay down all of the factors that are potentially relevant to the to the crowd management issues. Not all events will draw on all aspects of the

framework; however, this is a good starting point to ensure that all aspects of the event are taken into account, from the outset, with the management team then being able to reduce the issues that are likely to be most relevant, in that specific event.

The management team will, initially, need to take a broader perspective of the overall event management. However, while some of the frameworks focus on specific aspects of the overall event, this particular framework encourages the management team to take a more strategic point of view; for example, to consider issues such as marketing strategies and advertising events, as well as identifying key issues such as requirements to obtain licenses, permissions etc. Arguably, this should be one of the first frameworks to be taken into account as, if these issues cannot be dealt with, the event itself may become impractical.



Figure 4.9 Event Management

Communication & Collaboration:

Looking at the Figure 4-10 below it is increasingly, communication and collaboration is going to be central to event management opportunities, due to the fact that technology is becoming much more advanced and offers facilities, not only from the perspective of achieving efficiency, but also from the point of view improving crowd safety. This is also a potentially important aspect, when it comes to the available financial resources, and it may be necessary to undertake large-scale investment, that may be required across several different events, over prolonged periods of time, if it is to become cost-effective. This aspect of crowd management may also require external expertise which would need to be obtained, at the earliest possible stage.

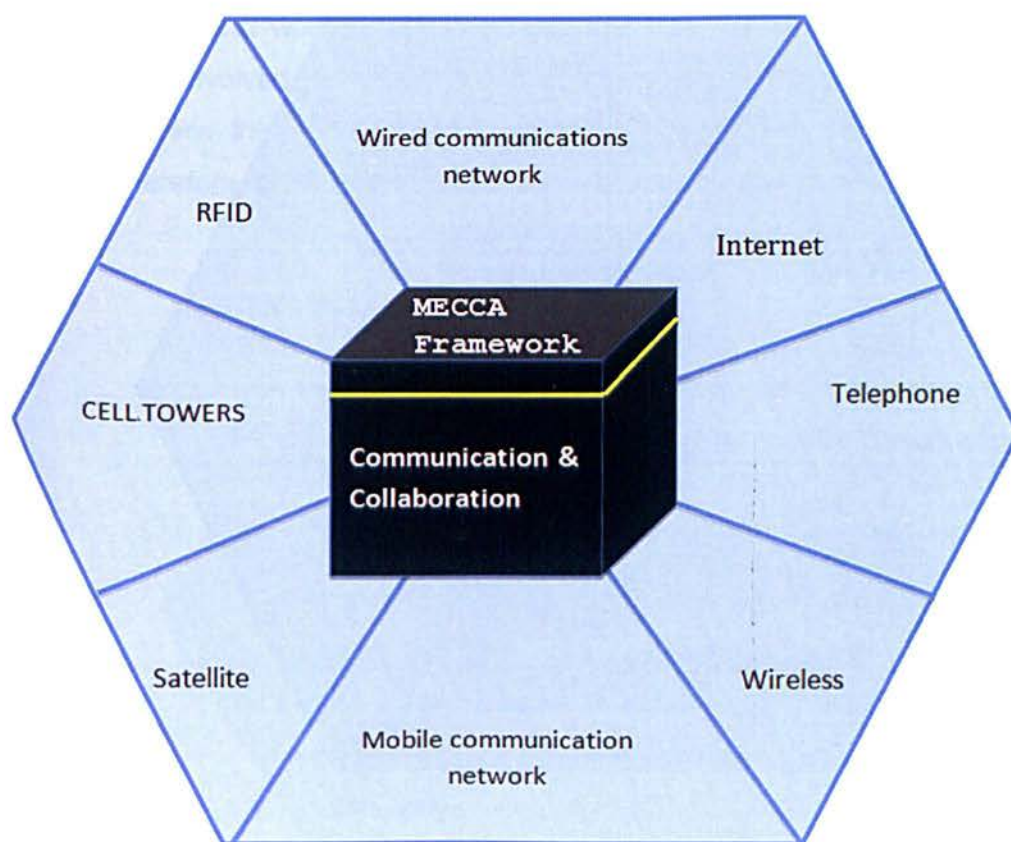


Figure 4.10 Communications and Collaboration

Crowd Control

Looking at the Figure 4-11 below it is the one of the hardest areas of crowd management is the fact that there are a wide variety of different cultures coming together however, whilst many of the aspects of society and culture can be identified, such as crime rates or poverty rates, softer issues such as attitudes and social habits can be much harder and more fluid to identify. Taking time to consider the softer issues and to identify the particularly relevant aspects of life and culture involved will allow the management team to gain an understanding, when dealing with other factors associated with crowd management, such as the willingness of the attendees to deal with the police, should this be deemed an appropriate method of obtaining security.

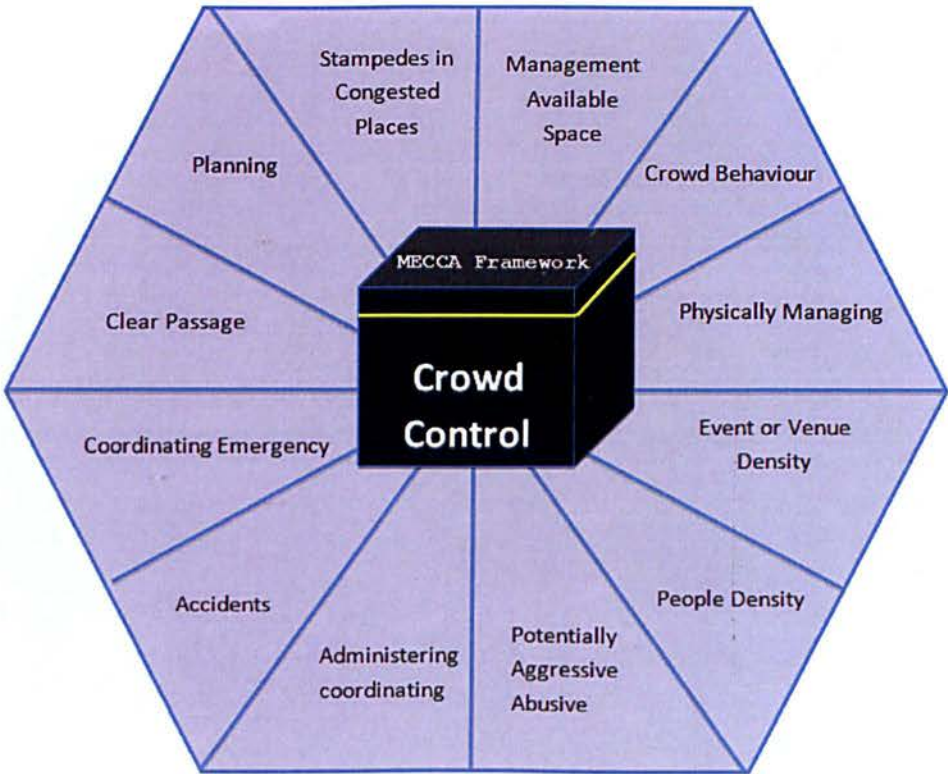


Figure 4.11 Crowd Control

Legal and Regulation Issues

Figure 4.12 shows in a similar way to the authorities and health issues, there are also requirements to consider the specific legal and regulatory issues. These, again, may be particularly important as there may be specific aspects of the regulatory issues which simply cannot be compromised and which could impact on the overall event viability. Advice needs to be obtained on what legal and regulatory issues are likely to underlie many of the other provisions, as part of event management, such as ongoing compliance management and ensuring that the activities associated with the event are continuously monitored whether they are in relation to health and safety, the environment or some other form of regulation which is deemed to be important, in this context. In the case of most large scale events, it is also important that any third parties are identified and worked with. For example, the police and government bodies will need to be involved as part of the planning stage and, again, lack of availability for many of these third parties could, potentially, jeopardise the chosen timeframe and should, therefore, be identified, at the earliest possible stage.

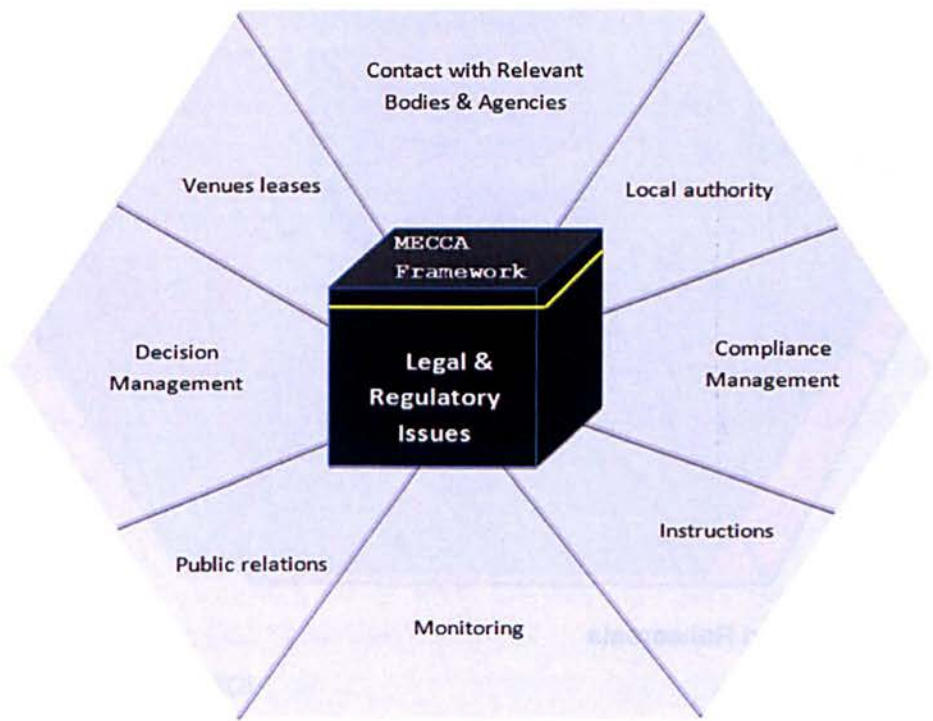


Figure 4.12 Legal and Regulatory Issues

Training and Rehearsal

Figure 4.13.shows this is an aspect of crowd management which can be dealt with in very different ways, depending on the nature of the crowd management being undertaken, and also depending on the resources that may be available. Whilst it is likely that a certain element of training and rehearsal is required for all large-scale events, the precise nature of this will naturally vary from event to event. For example, paramedics are trained to deal with a specific medical emergency, or fire safety personnel may need to deal with a particular fire threat, or there may be an entire simulation which pulls into play many of the emergency services potentially involved.



Figure 4.13 Training and Rehearsals

Financial and ROI

In many events, the ultimate aim is to produce a healthy profit. Even in those events that do not have profit as their most important aim, they will still want to ensure that there are sufficient funds available, in order to enable the necessary resources to be available to suitably manage the event and potentially to invest in future events or infrastructure for the area. By identifying the likely funding opportunity and the means whereby the financial aspect will be monitored, the budget can be managed appropriately and monitored throughout the event, regardless of the underlying aim. Looking at the Figure 4-14 below.

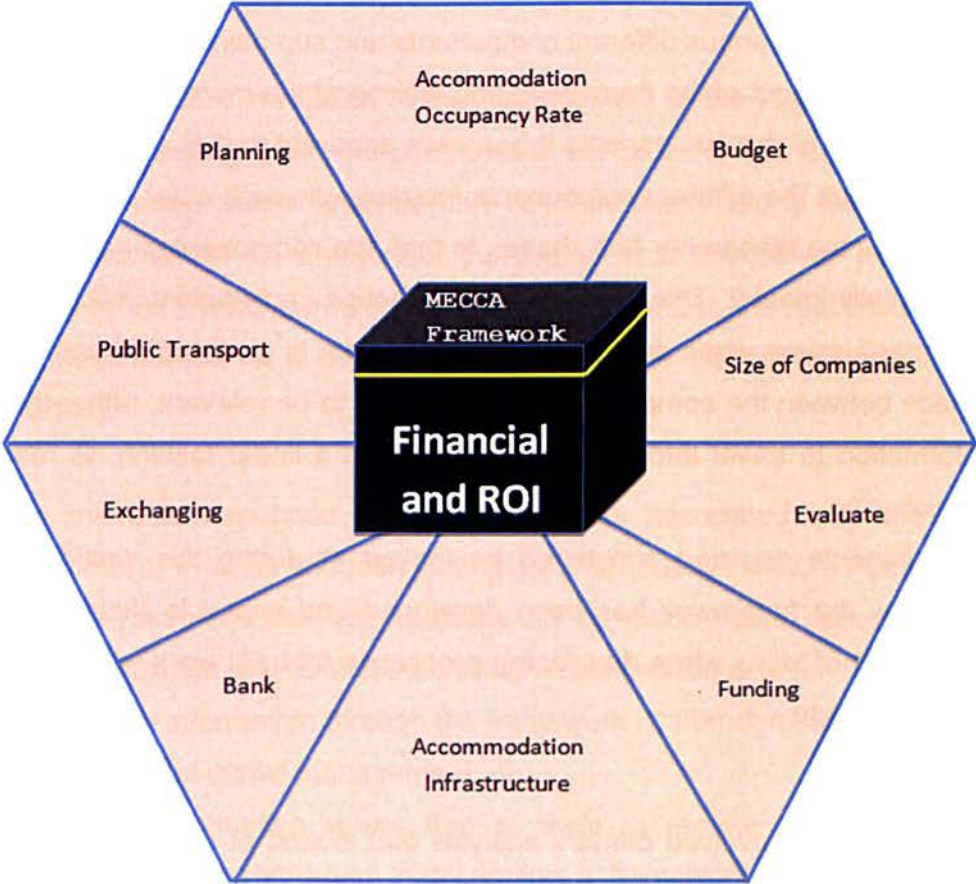


Figure 4.14 Financial and ROI

Safety and Security

Health and safety are important, in terms of crowd management, as any risks to health and safety can be very detrimental to the overall success of the event. When looking at health issues, not only is it necessary to identify the most likely risks, such as certain illnesses, but also to identify the way in which these will be dealt with, as part of the disaster management. This includes identifying the types of facilities that may be available and the level of resources that are necessary, in order to provide, adequately, for the likely health risks. By drawing on the actual risk assessment on an ongoing basis and also looking at the available resources, the way in which the different frameworks interact can be more readily seen.

Having laid out the various different components and sub points of each component that are thought to be part of the framework and looking at the more detailed definitions and aspects of each of the components it becomes apparent that one of the main issues is the way in which the different components interact with each other. The diagram above indicates how the researcher has chosen to map the components and the way in which they potentially interact. This high level of interaction immediately indicates that one of the important issues when developing the framework is to allow the communication to take place between the components as is deemed to be relevant, rather than requiring the information to travel through the component in a linear fashion, to reach the end destination.

The components depicted above will be looked at during this section, in order to analyse how the framework has been developed and how it is likely to work from a practical point of view, when developing processes that will work within the context of the Hajj pilgrimage.

4.8 Summary

The fourth chapter involved primary analysis that looked at six scenarios which break down specific situations which are likely to arise, in the context of the two case studies that have been chosen in this research paper. By looking specifically at individual scenarios that may arise and the way in which the suggested framework would affect the actions of those involved in crowd management, the weaknesses associated with the modelling framework can be more accurately ascertained, and any particular merits associated with the framework can also be readily identified. It has been suggested that

the framework will be equally applicable to both types of case studies; however, by running the scenarios as laid out in the appendix, the true flexibility of the model can be more readily understood and looked at, from a practical point of view. Each of these six scenarios were discussed, before going on to consider the overall evaluation of the framework and identifying areas for improvement, both generally and with reference to the individual case studies and primary data collection through the questionnaires and interviews. The next chapter presents the theoretical modeling framework that was made with the help of theories from the previous literature as well as the scenario analysis. The case studies have also been discussed which help in the theoretical framework modelling.

By looking at the framework in relation to the management of the Hajj, in more detail, and in particular by breaking down the components that are thought to be part of the framework, a much more useful analysis can be undertaken and a more workable framework produced. Whilst the analysis of the components themselves and the role that they will play in the overall crowd management is important, the real benefit of the crowd management framework is the ability to identify how the components actually interact (Still, 2000).

By having the interaction mapped and the processes associated with the crowd management reviewed, in a continuously changing and adaptive way, as depicted by the framework, the resources that are available will be much better utilised and any potential disasters mitigated and controlled, through quick reactions, even if they cannot be avoided. The flow of information through the framework is, therefore, identified as the crucial factor in successful crowd management.

Whenever an event or situation arises that is likely to require substantial crowd management, it has been established that creating a framework and identifying the issues that are likely to be relevant will be crucially important. With this in mind the penultimate chapter will look at the questionnaire that could be used in order to establish the basic information that will ultimately allow the crowd management team to create a framework and to gather all of the information that will be deemed to be relevant to the process of crowd management in its entirety. Although the focus of this research is to look at frameworks that work with the Hajj and the London Olympics, the

ultimate aim is to create a framework and an associated questionnaire that will be transferable into any crowd management situation.

CHAPTER 5: ANALYSIS OF QUALITATIVE DATA

5.1 INTRODUCTION

One of the two main data collection techniques is the qualitative technique which is mostly used to supplement the data collection and triangulate the study. Moreover, this technique is used to give insightful explanations of the issues that are underpinning the quantitative findings. The present research used the qualitative findings gathered from conducting the qualitative methods that is the in-depth interviews conducted with both the officials from crowd management at the annual event of Hajj and from the people responsible for the crowd management at the event of Olympics that happens once in four years. The sample size for conducting the in-depth semi-structured interviews was 20, which was small as Spector (1992) had recommended that sample size for qualitative data collection should not be very large. 10 interviews with each group were conducted. These were the key managers and workers in the organizations that worked for crowd control at the events selected for analysis that is Hajj and Olympics. The interviews were translated, transcribed into text documents and were analyzed using various qualitative charts like concept web, concept cloud and correlation web using the Leximancer software for qualitative analysis.

5.2.1. Reliability and validity of the qualitative analysis

The main aim of conducting a qualitative interview is to collect in-depth information regarding a certain issue based on the personal perceptions of individuals involved. These are subjective opinions and are accepted as a valid representation of the individuals own thoughts and perceptions regarding that certain issue (Zimund, 2003). Very like the reliability and validity in the data collected through quantitative data collection methods, the issue of reliability and validity exists for qualitative data collection too. The reliability of the information can be assessed by asking the same question again to the interviewee for the repeat of information. Re-interviewing the same interviewee for the key points will also assess the reliability of information. On the other hand, another way to assess the reliability of the information is to interview several interviewees regarding the same issue. The valuable information attained from one interview can be tested for reliability by taking subsequent interviews on the same topic

by asking about similar experiences in a different manner (Sekaran, 2003; Bryman and Bell, 2007). The other important issue is about the validity of information collected through the qualitative interviews conducted. The validity of the information can be evaluated by making comparisons or cross checking the same information collected through other methods (Sekaran, 2000; Collis and Hussey, 2003). In this case, the present study was triangulated using both types of data collection methods. The quantitative method was the close ended survey method whereas the qualitative method was the in-depth interviews.

5.2.2. The in-depth interview data analysis approach

The qualitative analysis in the present study used in-depth detailed explanation to identify the themes and understand the crowd management for Olympics and Hajj which was guided by the iterative data analysis model presented by Miles and Huberman (1994). According to this model, there are four main phases or steps when analyzing the qualitative data. These four steps are data collection, data reduction, data display and drawing or verifying the conclusion for the research. These four steps have been shown in following figure.

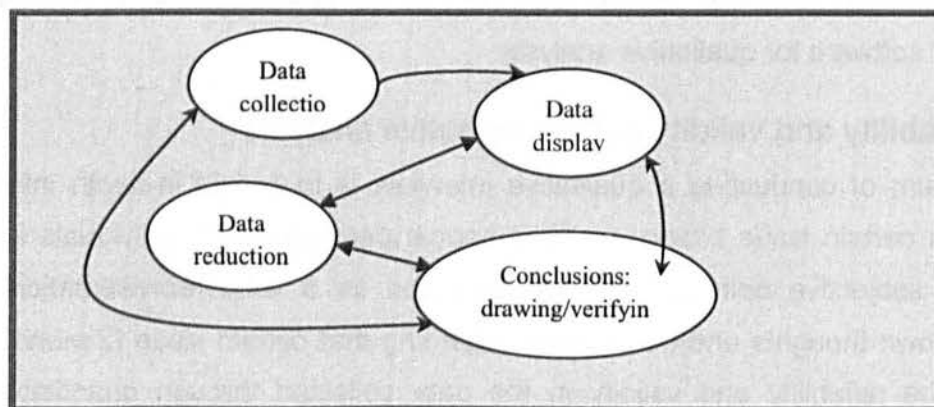


Figure 5.1. Iterative data analysis Model (Miles and Huberman, 1994, p. 12)
Components of Qualitative Data Analysis

According to detailed explanation of the model, Miles and Huberman (1994) define data analysis *"as consisting of three concurrent flows of activity: (1) Data reduction, (2) Data display, and (3) Conclusion drawing/verification"* (p.10).

These three data phases are the main and most important parts in analysing the data and are explained in detail as follows:

1. **Data Reduction:** The first step in analysing the qualitative data is the data reduction which is not something separate but done as part of the analysis. The data reduction is basically done to assist in sharpening, sorting, focusing, discarding and organizing the data in a way that the final conclusions are drawn and verified. The data can be reduced and transformed through ways like the selection, summarizing, paraphrasing and through in depth searching for themes and looking for similar patterns. This helps to bring together similar themes and identify themes that are different.
2. The data display is the second major phase of iterative data analysis model, which includes taking the reduced data and displaying that data in a particular, organized manner, which presents themes in a compressed way so that conclusions can be drawn out.
3. The conclusions and verification of the reduced data is done in the final step where all the analytical activity is carried out for qualitative research. The noted themes are brought together and checked for further regularities, and patterns of similarities and differences which are explained in possible configurations, any correlations, causal patterns and flows and causal flows and similar propositions.

5.2.3 Data Reduction and Display-Leximancer

The present study used the Leximancer qualitative analysis tool for the analysis of the qualitative data collected. The Leximancer tools are used as text mining softwares that are used to analyse the contents of the data collected. The information is displayed in the form of concept cloud, concept web and the correlation wheel. The concept web for instance displays the main themes in the data collected in the form a concept map. The brighter the concept is, the more it appears in the conceptual map which would provide the overview within the text and how it is related to other concepts. The correlation wheel on the other hand illustrates the concepts in a way which shows the correlations between the concepts and how much they are related. The following part of the chapter

explains the main themes in the in the qualitative data collected along with their analysis and followed by the diagrammatical illustrations.

5.2.4. Thematic Analysis of Interviews

The main aim of the interviews was to understand the crowd management done for the events of hajj and Olympics and how the crowd management at both places was similar or different. The analysis of the interviews conducted is done through identifying various themes in the interviews transcriptions. The interviews mainly started with questions relating to introducing the interviews and what type of organizations they belonged from. In addition to this, they were also asked what role their organizations had in the crowd management at the events of Hajj and Olympics. Following were the themes that were identified from the interviews. For graphical representations, the discussion is followed by the concept cloud, the concept web and the correlation wheel, which illustrate the main and important themes in the interviews.

5.2.4.1.Safety and Security

In a question related to the safety and security of the people coming to attend the events. All the respondents agreed that in the present timings of terrorism around the world, the safety and security of the people attending the event was a top priority and there was no compromise in keeping the safety and security to extreme high levels at the events. As one of the respondents answered in a response to a question related to the security and safety of people that *'.....there can never be a compromise on the safety and security of the people who attend the Olympics.....'*. The risk areas are highlighted and special attention is given to such areas which as one respondent named as *'...high prioritized.....'*. In another question regarding how the security strategy is determined, one of the respondents replied that this depends on the size and demographics of the crowd. However, the respondents of the Olympics respondents were more concerned with the number of security personnel than the Hajj respondents, as one of the respondent explaining the security and safety at the Olympics said that *'.....The number of security personnel depends on the size of the crowd, along with the demographics of the group.....'*. In addition to this, the geographical nature of the event was also important in determining the security and safety strategy as well as the number of the security professionals to be put up for crowd management. Another thing that was pointed out by a respondent explaining the security and safety at the annual

event of Hajj was that the culture and type of gathering also determines the security strategy as well as the *'.....type of gathering also determines the reactions of people towards various crowd situation and the place of the crowd.....'*. Both the Olympics officials and Hajj officials interviewed explained that they used state of the art techniques and facilities to maintain the security. *'.....crowd management mainly including work barriers, surveillance cameras, where there are thousands of cameras and to monitor the crowd accurately, as well as the element of security men and who is one of the important elements and helping to manage the crowd and control and final element is traffic calming, which helps a lot in crowd control management and is one of the most efficient techniques.....'* On the whole, the security and the safety strategy was important for any event, be it an international event that happens once every four years that is Olympics or be it the annual religious pilgrimage of Muslims that the event of Hajj. Hence, it could be said that the safety and security is a very important part of the process of crowd management and also event management.

5.2.4.2.Crowd control and Event Management

Another important area identified in the interviews identified was the crowd control and event management. Respondents agreed to the fact that maintaining control in large events is a very important and major responsibility as according to one respondents *'.....There can be many number of reasons due to which there can be a disaster in a crowd based situation. Any small abnormal situation can lead to a general panic in the crowd, which itself could be a cause of a large disaster. This is why the crowd based situations are very difficult to handle.....'* all these things are preplanned and pre – thought, even the contingency situations are thought beforehand so that these situations can be handled before as well. As put by one of the respondents that the crowd control plans are made in detail and completely so that at the time of need all plans can be implemented properly and completely and in a reply to one of the questions the respondent said that *'.....It is important that there is an appropriate to the size of the crowd and of security men that is responsible for the crowd.....'*. some things happen unplanned and the officials responsible for the crowd management and event management have to take care of such situations so all the respondents agreed that all plans are made before the actual event starts. Sometimes disruption is caused when there is a non-cooperation of the public with security men to follow the instructions and as one respondent said that *'..... failure to listen to the directives of sound*

provided of regulators to manage the crowd can also be one of the reasons of the disaster in a crowd.....' The main aim of the event management is to manage the large crowd in a way that the event happens peacefully and in a secure manner. Hence the main aim can also be said in a one liner that achieving a large crowd and maintaining its integrity and ensure the overall efficiency of the crowd and get the expected profits from the crowd. The important thing to note here is that the managing a large event with a large crowd needs is a huge responsibility and needs a lot of planning and proper employment of available resources so that all goes well, especially if it is an international event like OLYMPICS being witnessed may thousands of people live and millions around the world. It takes months and months of planning to make security plans and other crowd management issues which need to be overlooked in every detail possible. In case of Hajj, which happens every year, the security officials are much more experienced and because of the nature of the event, the probability of security breaches is less.

5.2.4.3.Environmental Issues

Another very important issue as part of the crowd management identified was the issue related to the environment in which the event takes place. According to one of the respondents, it is very important to specially focus on the environmental issues because sometimes the main cause of any disaster can be an error in overlooking the environmental issues. In the words of another respondent who was focusing on the importance of the environmental cleanliness and other issues said that *'.....the environmental issues for the planning and management of the crowds of vital importance, because sometimes the environmental issues also give rise to the crowd disasters and sometimes the planning also becomes difficult due to the problems arising in crowd management.....'* Most respondents agreed to the fact that the environmental issues are very important in the planning of events or being able to manage a large crowd. Especially in events like Hajj and Olympics where people from all over the world come to participate and witness the event. One of the respondents highlighted the importance of environmental issues said in a reply to a question that *'.....the environmental issues for the planning and management of the crowds of vital importance.....'* When it comes to the people attending the event from different geographical areas around the world, they would expect to see the environment clean as this would also add to the reputation of the host country. *'.....especially at an event*

like Hajj, where people from all over the world are coming belonging from all kinds of cultures, there are environmental issues that need to be tackled and kept the environment clean so that no problems arise.....'. Therefore, the importance of environmental issues cannot be overstated as all the respondents quite agreed to the importance of environmental issues in crowd and event management.

5.2.4.4. Communication and Collaboration

For any plan to be successful, effective communication is the key. This was another theme identified in the interviews conducted with the respondents of both the crowd management of Hajj and Olympics. One of the respondents said in an answer to a question about communication and collaboration that '*...the plans for security and the overall event management work when there is excellent communication and understanding level between the people involved in planning the event.....*'. The people responsible for communication and collaboration have to check all the facilities as well as the there is training given to all individuals responsible for crowd management at any level, as it has been established that effective communication is a key component for an event to be successful. The overall management team especially the officials that are responsible for communication are supposes to maintain the quorum for the level of communication. It is important that there is a right amount of communication at the right level. One of the respondents explained that '*.....without proper understanding because the lack of communication or even a small communication gap could lead to missing some instructions which could ultimately cause an accident or even a major disaster.....*'. Hence, not only the individuals responsible for communication, but also any technology being used is double checked that is properly working and all instructions have been delivered well. Talking about the communication and collaboration between the officials handling crowd management, a question was posed to the respondents regarding the main threats that could have a negative effect on the communication and collaboration of employees. The respondents identified that there could be a number of reasons why communication and collaboration could possibly fail. One of the respondents pointed out that '*.....when it comes to the fail of communication and collaboration on the scene, one reason could be the failure of technology or the equipment being used.....*'. Another respondent said that one of the possible threats could be on another level which is bureaucracy and conflict between work teams, or the disruption of the IT department during the event. Hence, for an event to be successful it

is of prudent significance that the event is managed through effective communication and collaboration between the members of the crowd management team.

5.2.4.5.Society and Culture

The society and culture is also a very important aspect of crowd and event management. Several respondents highlighted the significance of the societal and the cultural factors in the managing and planning of the crowd. One of the respondents from the Hajj group focused that *'.....the pilgrimage of Hajj brings together millions of Muslims from all over the world. The event that this being carried out is for the people whose presence would make the event possible. And every culture and society have norms that might be different from other cultures and societies.....'* It is of prudent importance that the officers working on crowd management are aware of the norms and cultures from which the people belong. So that the crowd gathered and crystallized consists of similar communities so that they can be handled accordingly. Hence, while undertaking the crowd planning it is very important to understand the society and culture in which the event is to be arranged and managed. All respondents agreed that the norms of society and the culture of the place where the event is hosted as well as of the guests should be known so that the event happens in a proper and successful manner.

5.2.4.6.Health and Safety

The next theme identified was related to the health and safety of the people attending the event. According to all respondents the issue of health and safety is one of the most important issues in the event and crowd management. As one respondent's explained that *'.....one of the most important areas in the arrangement of an event and the*

important aspect of crowd management alongside security is the health of the crowd.....' While considering the issues that could arise relating to the health of the crowd, the major setback could be unhealthy conditions and the unclean environment during the event in the area where the event is being conducted. According to one respondent, *'.....unhealthy conditions and unclean environment can give rise to epidemics and that could be a major setback to the event.....'* While several respondents focused on keeping the environment clean so that there could be safe and healthy conditions for the people attending the event, one of the respondents pointed out the importance safe and healthy conditions as *'.....also in emergency disaster situations the importance of health and management cannot be denied as if any*

emergency disaster happens, so that everything can be controlled, first aid can be given on time and people can be saved from major problems, so therefore, the preparation of the event should include the tentative organization and set up in hospitals.....' Some other issues pointed out by other respondents in the interviews were the external threats such as terrorism and natural threats such as floods and fires as well as disease and injuries resulting from collisions during the attendance of events. All these things have to be thought of before and there should be an arrangement such that if any ill happenings occur at the event, they can be taken care of accordingly without any delay. It is the responsibility of the crowd and event management teams to take care of the health of the people attending the event and taking care of whatever happens in the event.

5.2.4.7. Infrastructure and Transport facilities

The next identified theme or the factor that was important for crowd management was the infrastructure and transport facilities. All the respondents agreed to the fact that in order to carry out a large event, the infrastructure and transport facilities have a significant importance. The roads, infrastructure and transport facilities do not only give a way to travel and visit the event but also, as one respondent said that *'.....provides ways out during disasters.....'*. Roads and other developed infrastructure along with proper transportation facilities makes it easier for the people visiting the event to travel from one place to another. According to the respondents, the presence of proper infrastructure with proper road signs and roads, and other facilities ensures that *'.....the congestion in the pressure points is decreased.....'* which makes travelling easier, less tiring and more enjoyable and because of all the excellent arrangements and proper facilities, there is an opportunity to increase the revenue collected from the event. But this depends on the type of event being carried out. In a large event like Olympics, the infrastructure for roads, travelling through public transport like buses, trains, taxis, metros and other transport mode should be managed so people don't have any problem when they need to travel from one place to another. One of the respondents focused on the importance of roads and developed infrastructure in words that *'.....there should be roads connected to the event as well, and there should be ample parking space outside the arena where the event is being held.....'*. The infrastructure also includes the pedestrian areas and the sidewalks and the respondents also focused on the importance of making such pedestrian areas and sidewalks so that

people find it easier to travel. When the respondents of Hajj crowd management interviews were asked about the similar questions regarding the infrastructure and transport, they also focused on the importance of good infrastructure and transport for the facilitation of the pilgrims. One of the respondents explained that *'....to complete various steps of Hajj, Muslims have to travel from one place to another in the city of Mecca over a distance of 25 kms, which is why the travelling is a main part of the pilgrimage.....'*. The respondent further explained that *'..... As our organization is given the responsibility of the mobilization of people, so the travelling through public transport like buses, trains, taxis, metros and other transport mode is managed by us so people don't have any problem when they need to travel from one place to another.....'*. The Saudi government has already developed the infrastructure, roads, bridges and other transport facilities which help and facilitate the pilgrims to complete their Hajj steps in time. Hence, it could be said that be it any type of event, the properly developed infrastructure is very important for events to reach a success level.

5.2.4.8. Legal and Regulatory Issues

The next theme identified in the interviews was the legal and regulatory issues that appear in crowd management. The legal regulation regarding event and crowd management is in coordination with the event being planned. It has always been said that there is a reason of making rules and laws, and the reason is that it is for the benefit and good for the people. If people don't abide by the rules and laws, there can be problems, which can obviously lead to restlessness, lawlessness, crimes and other problems leading to major disasters in the event being held. All the activities and the planning of those activities is carried out based on the law of that country. One of the respondents explained an example for this that *'.....all the international travelers coming to witness the event must carry their passports at all times. This is in coordination with the law of any country where the event is being held.....'*. Doing this is important for many reasons like this will not only cover the law part, but will also help to keep security checks, therefore, it could be said that the legal regulation when planning for the event is of great importance too. Hence it could be said that the regulatory requirements are very beneficial to the safety of the crowd. One of the respondents who was explaining about the regulatory requirements for Olympics explained that *'.....in case of OLYMPICS, there is a rule, that if the game starts at 10 am, people need to come to the arena certain hours before so that security can be*

checked, there is no hassle and people can be settled before the game event starts.....'. This will help with all kinds of security checks and proper planning and implementation of rules and regulations will help to avoid any kind of disaster situation during the event.

5.2.4.9. Training and Rehearsals

Training and rehearsals are seen very important for the event and crowd management as well. The organizations that are responsible of planning the event and also take part in crowd management giving training to their employees beforehand so that when the actual event takes place, the employees are well aware of how to handle such situations when they occur at the event. One of the respondents explained the importance of training and rehearsals in such a way that *'....the rehearsal on the entire event is considered important but certain things like security and other similar plans become extremely important.....'*. The main reason of training the employees beforehand is that when they come across such situations in real time, they can manage it well. For example, when one respondent was asked why the training and rehearsal was important, he replied as *'.....one of the reasons of rehearsals and exercises being important in any process to manage the crowds as well as the work of testing of the plans that have been working to make sure that they are ready to handle readiness in case of an emergency or any disaster situation.....'*. In a further question relating to the kinds of training and rehearsals one of the respondents explained that there are different kinds of training given to the employees so they are trained to organize and manage the actual event and crowd situation. *'.....These exercises are very intense and cover emergency situations to make sure that all departments are ready to manage the crowd in time. These simulation exercises help to visualize and have an understanding of what the employees might actually face in the real time situations. These exercises make them expert to handle any kind of situations that might occur during the main event. In addition to this for contingency situations, our employees have basic understanding and training to take hold of such situations where they don't have any record of previous handlings in such situations.....'*. Hence all the respondents agreed to the importance of the training and rehearsals for event and crowd management.

5.2.4.10. Disaster Management

The last, but not the least important theme identified in the interviews was the disaster management. The main aim of crowd management is to avoid any disaster situation and if for example any such situation arises, the disaster management is done to minimize the damage as much as possible. When there is a large crowd, any number of things can happen. Even something causing panic can itself lead to a large disaster. In an interview with an official responsible for Hajj crowd management explained that *'.....in many previous Hajj events almost about before ten years, things like fire in the camps because of the stoves, or trampling of people due to excess number of people in one area caused disasters which cost lives of people. But after these incidents, especially precautions were taken in the years to come stoves are not allowed inside the camps now*'. this was the best example of disaster management in situations where there is a likelihood of managing the disaster and also taking lessons to avoid such situations in future. Another respondent gave an example that *'.....the mobilization of people is controlled, groups of people are made so that more than required people do not go at one place in a specific time, and this would avoid the incidents of trampling. These incidents could be avoided with a proper planning of the entire event so that all these precautions are pre-thought about.....'*. Disaster Management for the crowd management process is very important too as it takes into account all the steps with extra precaution to be held in the main event. Disaster management is very important because it takes into account how the responsible people will take action if any disaster situation arises. The most important aspect of disaster management that is dealt as a part of the overall crowd management is managing the potential threats like the security problems. In addition to this other things like the infrastructure changes as well as the health and medical planning is also an important part of the process of managing the crowd. Hence when it comes to planning the event on the whole, disaster management becomes a very important part of crowd management.

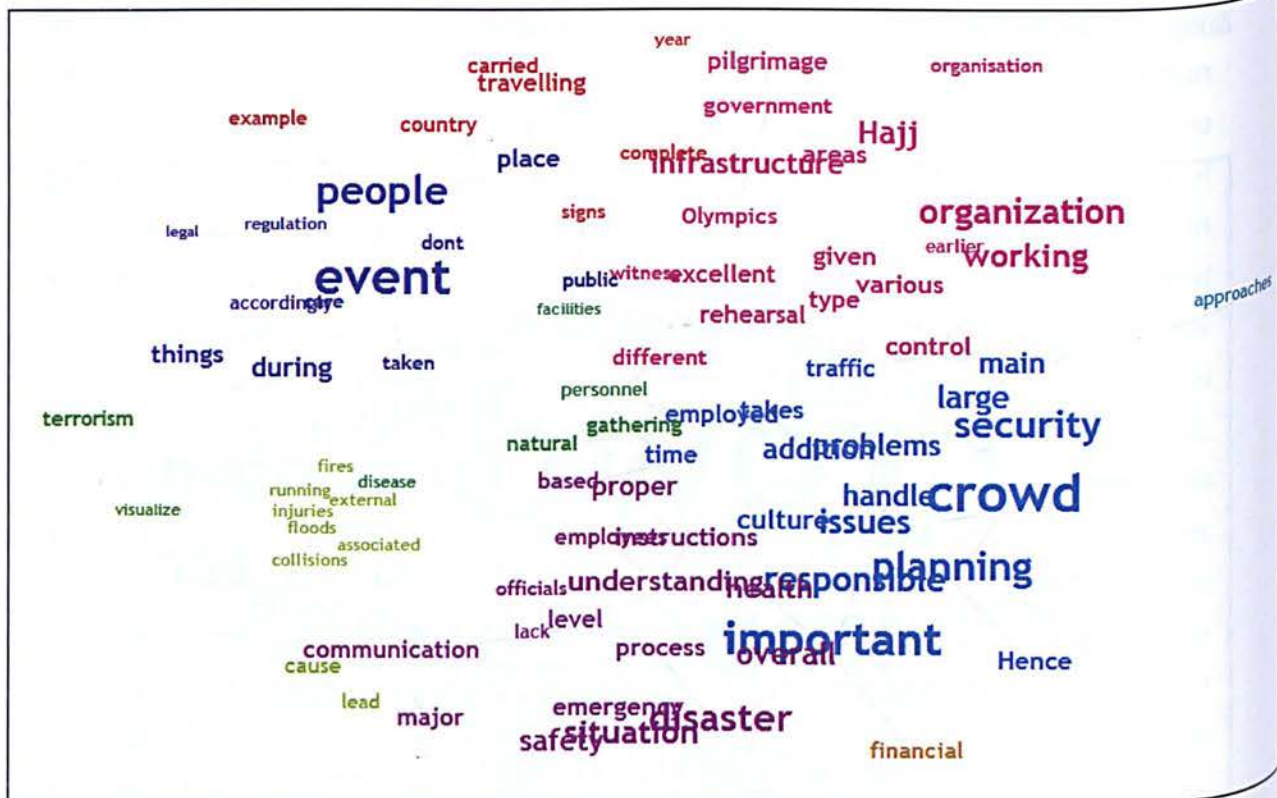


Figure 5.2. - Concept web

The above figure 5.2. highlights main concepts and their connections with each other that came out during the analysis of the interviews. These are the concepts that the interviewees had discussed the most in their responses. The figure gives the main idea of what the overall analysis of the interviews was about. The main concept centers the cloud which is 'crowd' and the planning, management, people, disaster, organization, health, security and other similar terms were the highlights of the interviews and the connections that were placed between them by the interviewees. It can be seen that most of these have been identified and described in the CCMEM framework and discussed in the various interviews.

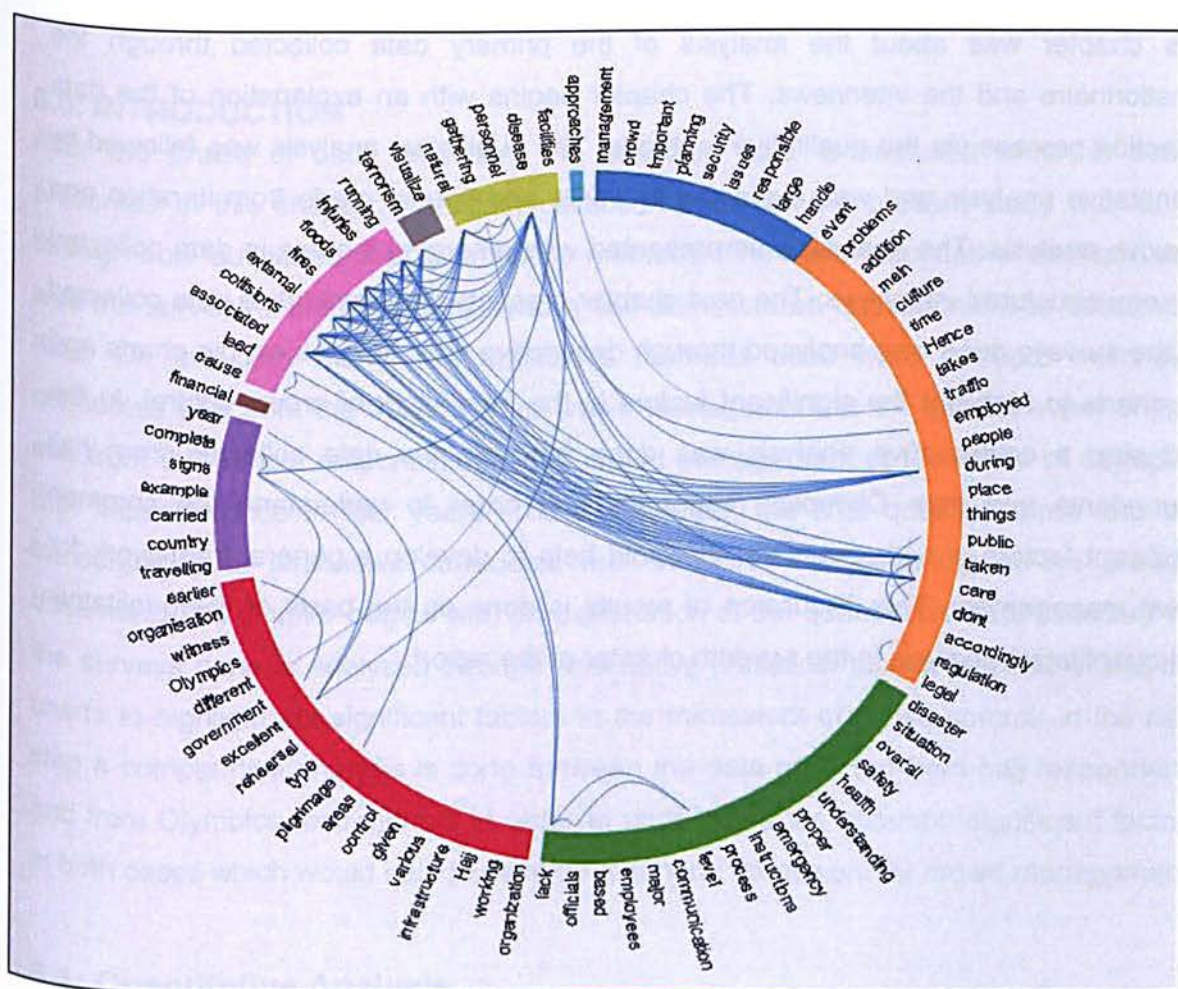


Figure 5.3. Correlation wheel

The above figure 5.3. shows the correlation wheel, which shows the main terms, concepts of the interviews analysis and the correlations between them. Some concepts that are not connected by the lines do not have any correlation between them while, the other concepts with connected lines between them are correlated.

5.3: Summary

This chapter was about the analysis of the primary data collected through the questionnaire and the interviews. The chapter begins with an explanation of the data collection process via the qualitative methods. The qualitative analysis was followed by quantitative analysis and was explained in words and figures made from iteration and reflexive analysis. The analysis was presented with emerging themes in data collected via semi structured interviews. The next chapter presents the quantitative data collected via the surveys done was analysed through descriptive statistical tables, pie charts and bar charts to highlight the significant factors in the framework of crowd control. In the next step a comparative analysis was done between the data collected from hajj respondents and from Olympics respondents in order to understand the common significant factors in both cases which would help to develop a general framework for crowd management. The discussion of results is done on the basis of the qualitative and quantitative analysis in the seventh chapter of the report.

CHAPTER 6: ANALYSIS OF QUANTITATIVE DATA

6.0: INTRODUCTION

After the phase of data collection, the collected data is analysed which is being presented in this chapter. The data collection done for the present study was done through both qualitative and quantitative methods. The main quantitative method used was the survey method that employed a self-administered questionnaire to collect the data. On the other hand, the qualitative methods used were in-depth interviews conducted with both the officials from crowd management at the annual event of Hajj and from the people responsible for the crowd management at the event of Olympics that happens once in four years. The cover letter, the final questionnaires and the transcriptions of interviews conducted are shown in the appendix of the present document. The chapter begins with an explanation of the quantitative data collected via the surveys done is analysed through descriptive statistical tables, pie charts and bar charts to highlight the significant factors in the framework of crowd control. In the next step a comparative analysis is done between the data collected from hajj respondents and from Olympics respondents in order to understand the common significant factors in both cases which would help to develop a general framework for crowd management.

6.1: Quantitative Analysis

6.1.1: Data collection and Response rate

For the ongoing research an online survey was conducted with two different groups of respondents. The online survey was made on survey monkey and the link was floated on a famous social website where 462 people responded to the survey from the 1000 people considered, making the response rate to be 46.2%. This was a very good response rate. Out of these 462 respondents, 225 were the respondents of Hajj survey, whereas, the other 237 respondents filled the survey as Olympics respondents. This survey monkey link was floated on the social website in the beginning of February 2013, for almost a month and the results were collected on 15th of March, 2013. The data was collected as per the devised methodology through a self-administered online questionnaire which was easy to understand. The following part of the chapter analysis the data collected through quantitative survey and qualitative interviews.

6.1.2. Data collected from respondents of Hajj survey

Question 1:

What is your role within your organization?		
Answer Options	Response Percent	Response Count
Director	17.8%	40
Higher Management	19.6%	44
Team Leader	18.2%	41
Security	21.3%	48
Crowd control	23.1%	52
answered question		225
skipped question		0

Table 6.1- role within your organization (Hajj respondents)

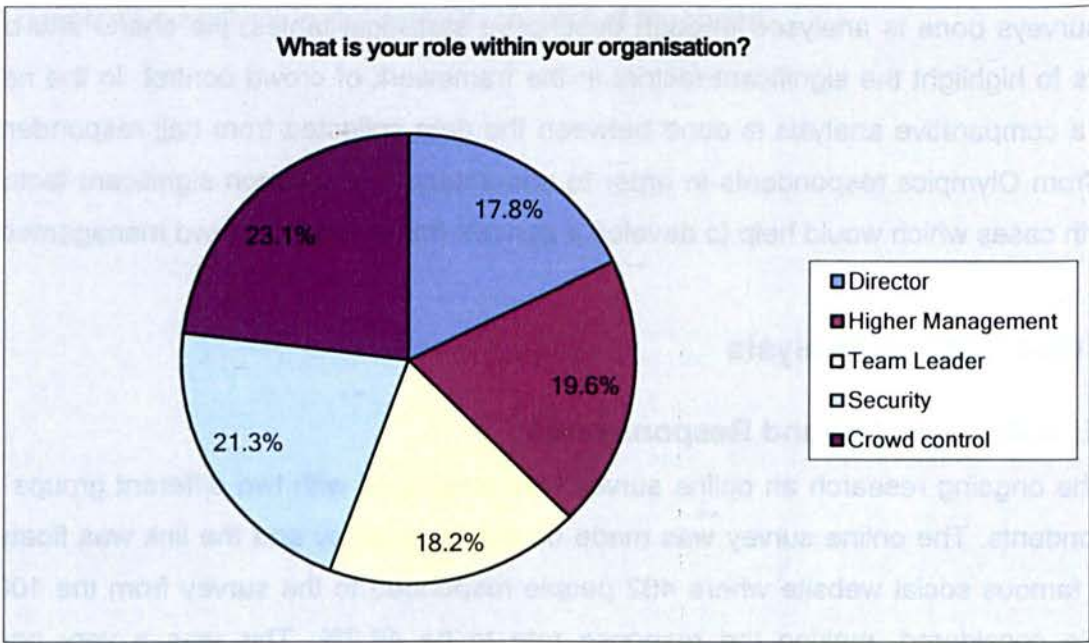


Figure 6.1- role within your organization (Hajj respondents)

Interpretation:

The first question collected demographic information regarding the role of the respondent in the organization they worked for. 17.8% respondents were Directors, 19.6% belonged to Higher management, 18.2 % were Team Leaders, 21.3% were from Security and 23.1% were from crowd control. Looking at the Table and Figure 6-1 above .

Question 2:

What type of organisation do you work for?		
Answer Options	Response Percent	Response Count
Event management	5.8%	13
Security management	16.4%	37
Sporting events	0.9%	2
Health and safety	10.2%	23
Fire-fighters	5.8%	13
Traffic	6.2%	14
The Ministry of Health	9.3%	21
Ministry of Hajj	16.9%	38
Ministry of the Interior	11.1%	25
Immigration	5.8%	13
Affairs of the Two Holy Mosques	11.6%	26
answered question		225
skipped question		0

Table 6.2- type of organisation you work for (Hajj respondents)

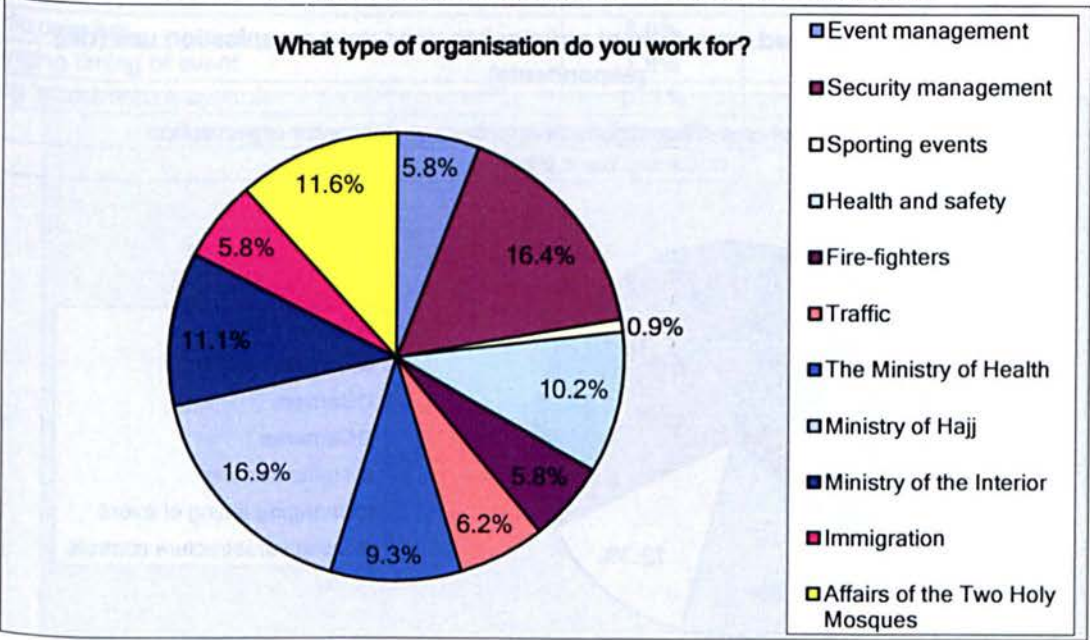


Figure 6.2- Type of organisation you work for (Hajj respondents)

Interpretation:

The second question was about the type of organization the respondents worked for. Highest percentage of respondents (16.4%) was from security management, while the lowest among Hajj respondents were from the sporting events organization, which was almost 0.9%. Looking at the Table and Figure 6-2 above .

Part 1: SAFETY

Question 3:

What sort of crowd management approaches does your organisation use?		
Answer Options	Response Percent	Response Count
Ticket control	9.3%	21
Security staff	23.1%	52
Barriers	13.3%	30
Cameras	17.8%	40
Traffic calming	16.4%	37
Changing timing of event	1.3%	3
Using infrastructure controls	18.7%	42
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.3- Sort of crowd management approaches does your organisation use (Hajj respondents)

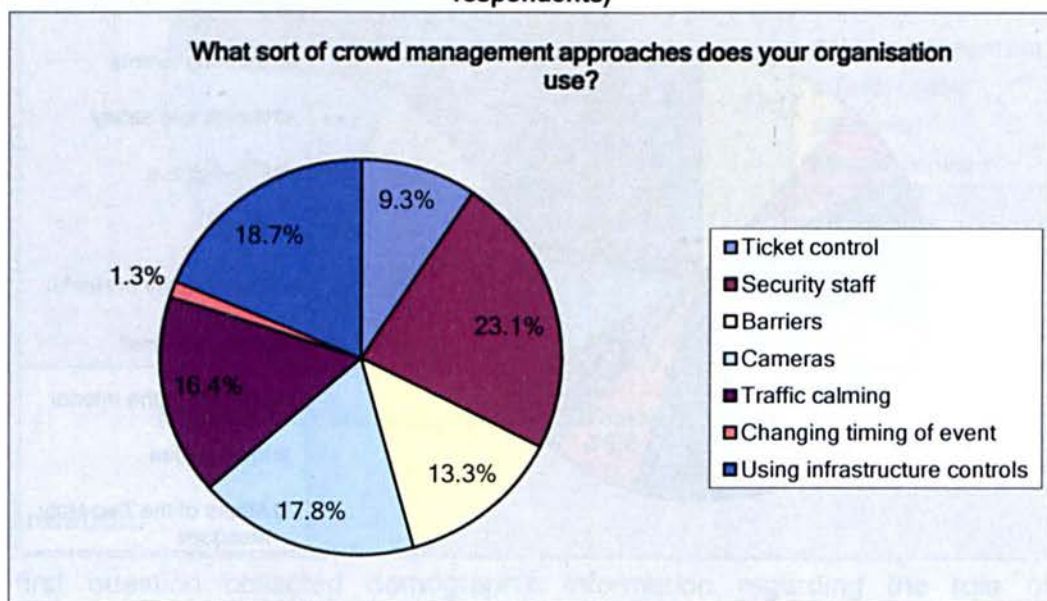


Figure 6.3- Sort of crowd management approaches does your organisation use (Hajj respondents)

Interpretation:

The third question was about safety measures or approaches of crowd management used by the organization the respondents worked for. The most approach used was security staff (23.1%) and the least used was the 'changing time of event' which was 1.3% percent. Other techniques like Ticket control (9.3%), Barriers (13.3%), Cameras (17.8%), Traffic calming (16.4%) and using infrastructure controls (18.7%). %. Looking at the Table and Figure 6-3 above .

Question 4:

What is the main crowd management approach used?		
Answer Options	Response Percent	Response Count
Ticket control	10.7%	24
Security staff	29.8%	67
Barriers	13.8%	31
Cameras	16.0%	36
Traffic calming	8.9%	20
Changing timing of event	1.8%	4
Using infrastructure controls	19.1%	43
answered question		225
skipped question		0

Table 6.4- main crowd management approach used (Hajj respondents)

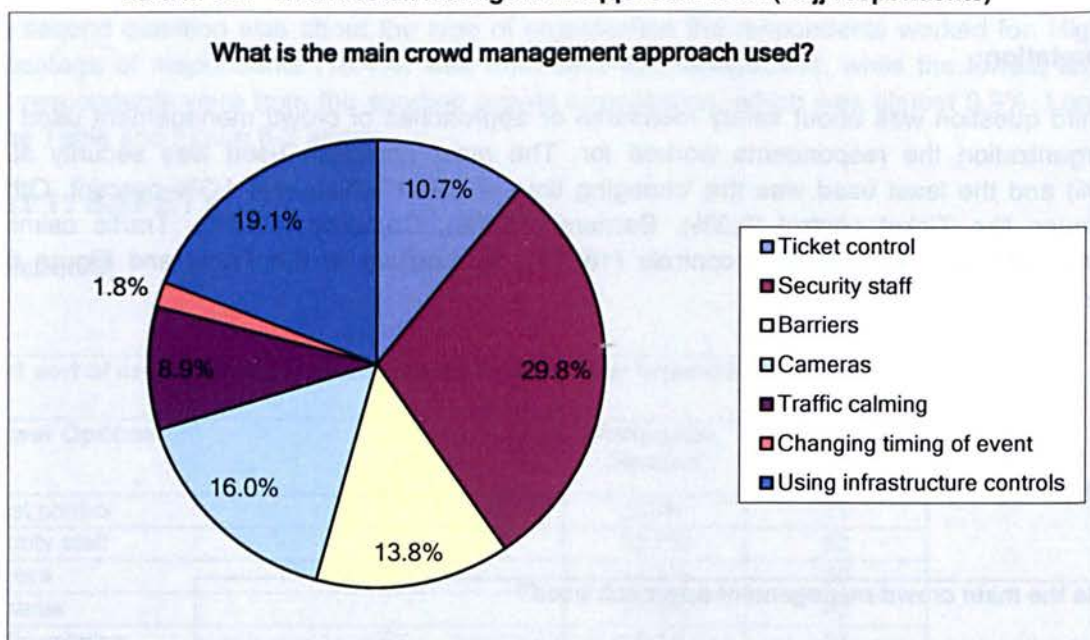


Figure 6.4- main crowd management approach used (Hajj respondents)

Interpretation:

The fourth question was about safety measures or approaches of crowd management used by the organization in the particular event of Hajj. The most approach used was security staff (29.8%) and the least used was the 'changing time of event' which was 1.8% percent. The least used technique was 'changing time off event' because the time of Hajj cannot be changed, as it is a religious pilgrimage which happens on the same Islamic dates each year. Other techniques like Ticket control (10.7%), Barriers (13.8%), Cameras (16.0%), Traffic calming (16.0%) and using infrastructure controls (8.9%). Looking at the Table and Figure 6-4 above .

Part 2: CROWD CONTROL

Question 5:

On a scale of 1 - 10 (1 being none and 10 being total), how much control Do you have over the following issues with the crowd you manage?												
Answer Options	1	2	3	4	5	6	7	8	9	10	Rating Average	Response Count
Size of the crowd	25	31	18	16	13	16	14	23	28	41	5.82	225
Demographic of the crowd	22	28	21	19	14	20	17	18	39	27	5.74	225
Movement of the crowd	15	27	27	16	18	15	23	27	32	25	5.82	225
Use of infrastructure to move crowd	19	15	27	25	20	16	18	30	27	28	5.84	225
Timing of the crowd at key focal points	16	21	26	17	21	24	17	25	30	28	5.88	225
Thoroughfares	18	28	16	18	19	23	21	26	26	30	5.85	225
Amount of staff present	16	28	24	13	14	29	19	24	23	35	5.88	225
Terrorist threats	23	23	21	21	14	19	19	20	25	40	5.86	225
answered question												225
skipped question												0

Table 6.5- control over the following issues with the crowd you management (Hajj respondents)

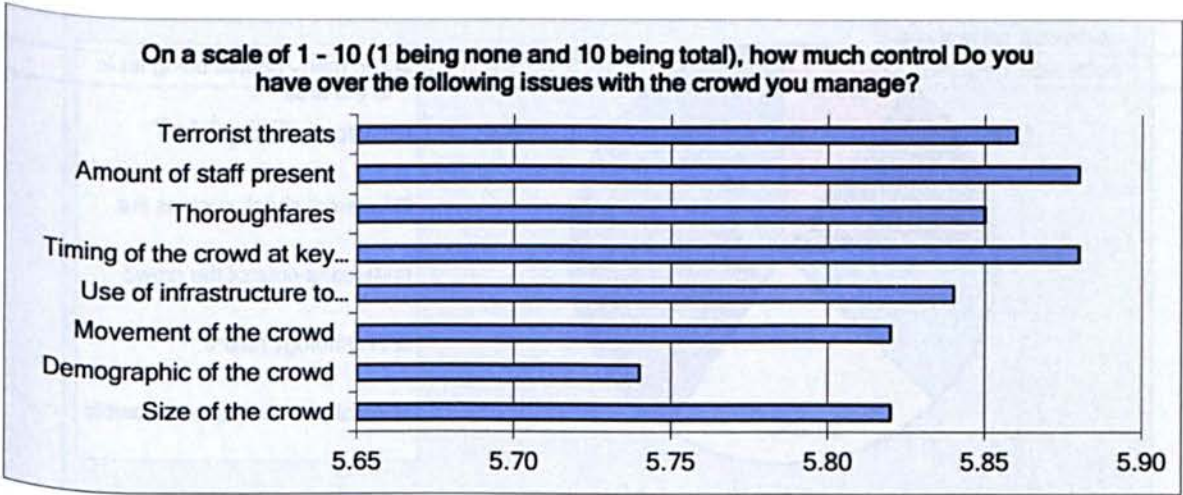


Figure 6.5- control over the following issues with the crowd you management (Hajj respondents)

Interpretation:

The next question was a rating question, which enquired about the control that the respondents had over the crowd at the event. Among many factors like terrorist threats, amount of staff present, thorough fares, timing of the crowd at key focal points, use of infrastructure to move crowd, movement of the crowd, demographic of the crowd and size of the crowd, the factor over which they had the most control was the timing of the crowd, amount of staff present, and the factor over which was least control was the demographic of crowd, as it has been clearly shown in the bar chart above. Looking at the Table and Figure 6-5 above .

Question 6:

What is the most likely cause of a disaster in a crowd based situation?		
Answer Options	Response Percent	Response Count
Too many people being let in to the area	20.0%	45
Too few security staff	20.9%	47
External shock such as fire	21.8%	49
Misbehaviour of the crowd	13.3%	30
Technology failure	13.8%	31
Focal point being inaccessible	10.2%	23
answered question		225
skipped question		0

Table 6.6- likely cause of a disaster in a crowd based situation (Hajj respondents)

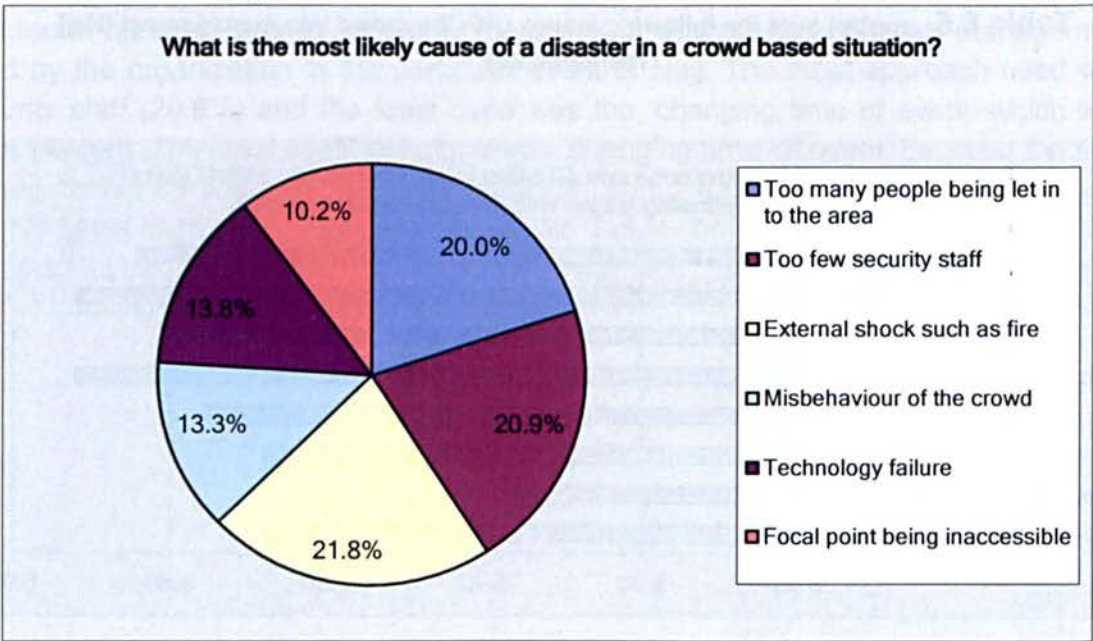


Figure 6.6- likely cause of a disaster in a crowd based situation (Hajj respondents)

Interpretation:

The next question enquired about the likely cause of a disaster in a crowd based situation. According to responses of the survey the most likely cause of a disaster in a crowd based situation was when there was external shock such as fire (21.8%), too few security staff on the event (20.9%) and there were too many people were being let in to the area (20.0%). The rest of likely reasons of a disaster in a crowd based situation include like misbehavior of the crowd (13.3%), technology failure (13.8%) and focal point being inaccessible (10.2%). Looking at the Table and Figure 6-6 above .

Part 3: TECHNOLOGY

Question 7:

On a scale of 1 to 10 (1 being least and 10 being most) Which of the following technologies would be beneficial for crowd control												
Answer Options	1	2	3	4	5	6	7	8	9	10	Rating Average	Response Count
Ticket control	5	5	7	18	21	26	38	46	37	22	6.92	225
Automatic holding barriers	2	5	4	12	26	18	30	63	35	26	7.24	221
CCTV	2	4	1	8	21	23	26	21	32	87	7.98	225
Crowd density analysis	1	4	2	9	21	27	36	51	48	26	7.42	225
Automatic infrastructure changes	1	4	2	6	22	27	42	43	44	34	7.49	225
Alarms when density increases	1	4	2	6	17	30	44	39	42	40	7.56	225
<i>answered question</i>												225
<i>skipped question</i>												0

Table 6.7- technologies beneficial for crowd control (Hajj respondents)

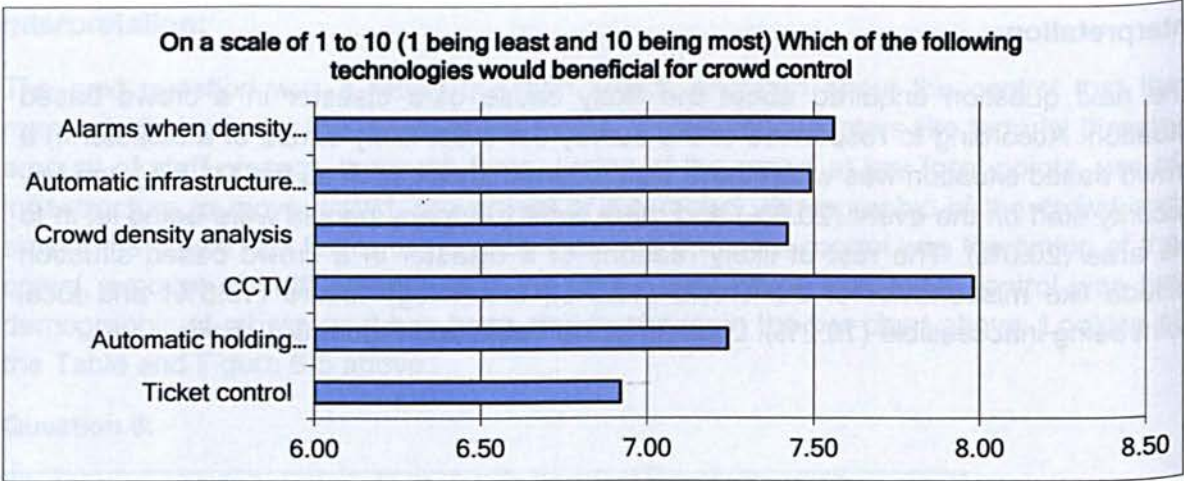


Figure 6.7- technologies beneficial for crowd control (Hajj respondents)

Interpretation:

The next question was a rating question, which enquired about which technologies would be beneficial for crowd control when it comes to a general crowd control. The most rating was achieved by the option of CCTV cameras. Alarms when density increases was the second most thought to be beneficial technology for crowd control. Among other technologies, there was an automatic infrastructure change, crowd density analysis, automatic holding barriers and ticket control. The technology of ticket control received the least rating as shown in the chart above. Looking at the Table and Figure 6-7 above .

Question 8:

On a scale of 1 to 10 (1 being least and 10 being most) which of these do you see as within your role?												
Answer Options	1	2	3	4	5	6	7	8	9	10	Rating Average	Response Count
Planning the event	4	8	7	16	40	46	30	36	11	26	6.42	224
Determining crowd movement	1	8	18	23	35	49	28	24	21	18	6.17	225
Disaster management	1	3	26	25	30	47	41	22	18	11	6.04	224
Customer services	1	7	20	20	43	43	45	22	14	10	5.98	225
First aid	4	6	19	37	40	38	30	23	16	10	5.77	223
Security	1	10	20	37	42	32	33	18	15	16	5.81	224
Maximising profits	8	13	24	36	44	38	22	23	9	2	5.19	219
Advertising	25	28	33	35	24	29	22	14	11	3	4.50	224
Sales	49	29	20	26	33	29	20	8	8	3	4.07	225
answered question												225
skipped question												0

Table 6.8- Your role (Hajj respondents)

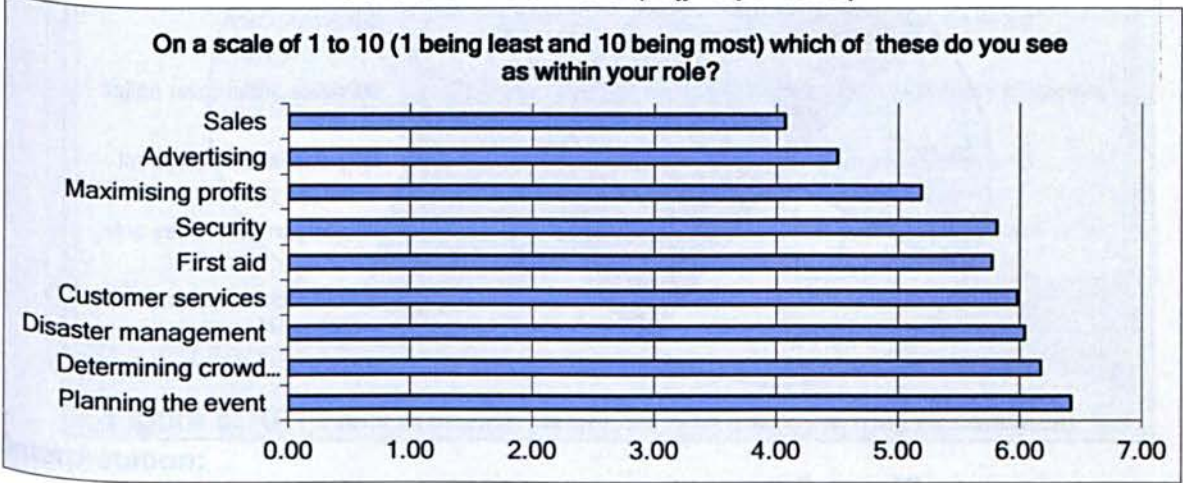


Figure 6.8- Your role (Hajj respondents)

Interpretation:

The next question was a rating question, which enquired about which important things these respondents use the most as within their role. The first one is the planning of the event which received the most rating. It was closely followed by determining crowd movement, disaster management, customer services, security, first aid, maximizing profits and advertising. The least important factor was found to be sales as shown in the chart above. Looking at the Table and Figure 6-8 above .

Part 4: SECURITY

Question 9:

Which of the following security personnel do you use during crowd management?		
Answer Options	Response Percent	Response Count
Private police	21.8%	49
Private undercover police	18.2%	41
Specialist crowd control teams	27.1%	61
Emergency services only	20.4%	46
No specialist security personnel	12.4%	28
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.9- security personnel (Hajj respondents)

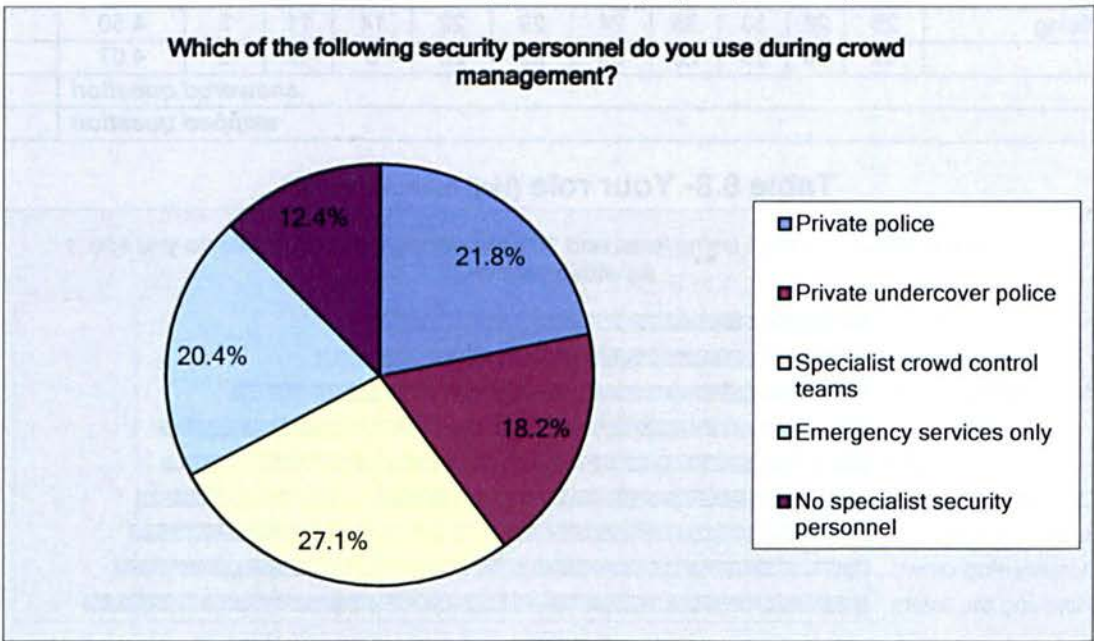


Figure 6.9- security personnel (Hajj respondents)

Interpretation:

The question was about type of security personnel do the respondents use for crowd management. The most was used by specialist crowd control teams (27.1%), the second was private police (21.8%), followed by the emergency services only (20.4%), private undercover police (18.2%) and no specialist security personnel (12.4%).

Question 10:

How do you decide on the number of security personnel to be employed?		
Answer Options	Response Percent	Response Count
Size of the crowd	29.3%	66
Nature of the event	25.3%	57
Cost of security personnel	19.1%	43
Legal requirements	14.2%	32
Spread of the crowd (geographic)	12.0%	27
answered question		225
skipped question		0

Table 6.10- number of security personnel to be employed (Hajj respondents)

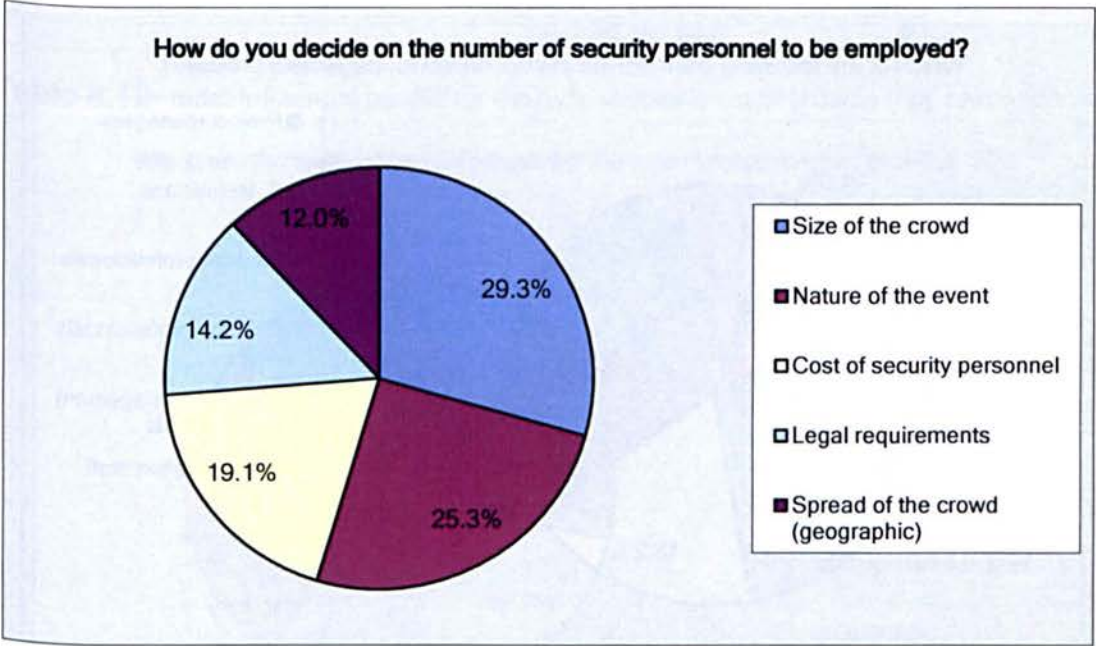


Figure 6.10- number of security personnel to be employed (Hajj respondents)

Interpretation:

The question was about how the number of security personnel to be employed was decided. The most method used was size of crowd (29.3%), followed by the nature of

the event (25.3%), cost of the security personnel (19.1%), legal requirements (14.2%) and spread of the crowd (12.0%). Looking at the Table and Figure 6-10 above .

Part 5: PEOPLE

Question 11:

Which of the following are involved in your crowd management process?		
Answer Options	Response Percent	Response Count
Project managers	18.7%	42
IT technicians	16.0%	36
Medical professionals	18.2%	41
Security professionals	14.2%	32
Disaster management professionals	16.4%	37
Administration staff	7.6%	17
Politicians	4.0%	9
Military	4.9%	11
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.11- crowd management process (Hajj respondents)

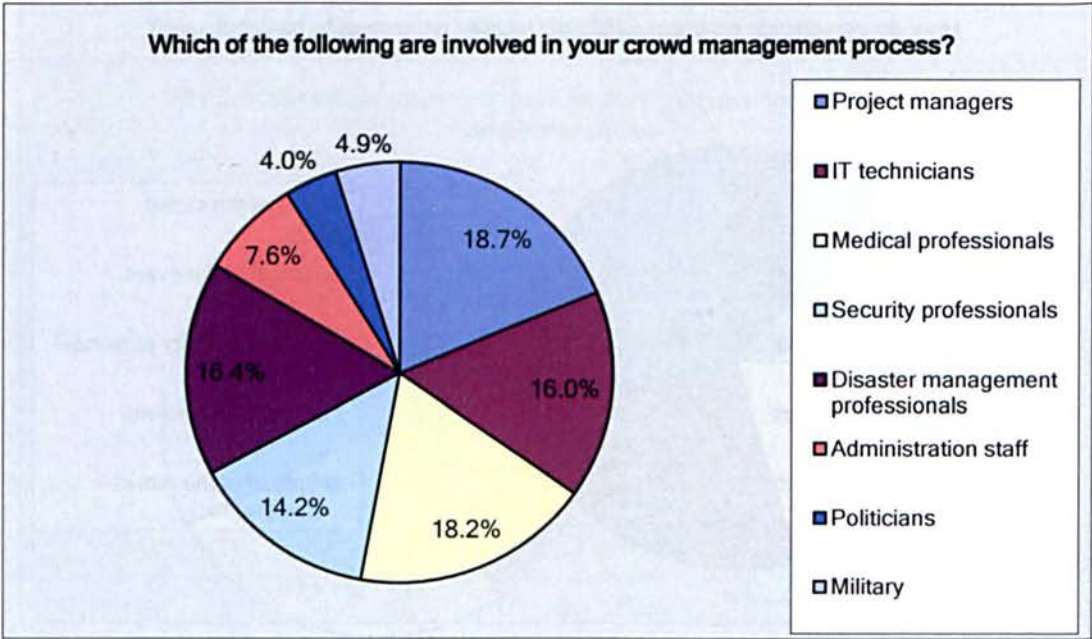


Figure 6.11- crowd management process (Hajj respondents)

Interpretation:

The next question was asked that who are the important officials involved in the crowd management process. According to the survey result, the most used were project managers with (18.7%) and medical professionals (18.2%), closely followed by Disaster management professionals (16.4%), IT technicians (16.0%). Small percentage of respondents opted for administration staff (7.6%), Military (4.9%) and Politicians (4.0%). Looking at the Table and Figure 6-11 above .

Question 12:

Which are the most influential people for the safe management of crowds?		
Answer Options	Response Percent	Response Count
Project managers	13.8%	31
IT technicians	15.1%	34
Medical professionals	18.2%	41
Security professionals	13.8%	31
Disaster management professionals	12.4%	28
Administration staff	12.9%	29
Politicians	5.8%	13
Military	8.0%	18
answered question		225
skipped question		0

Table 6.12- most influential people for the safe management of crowds (Hajj respondents)

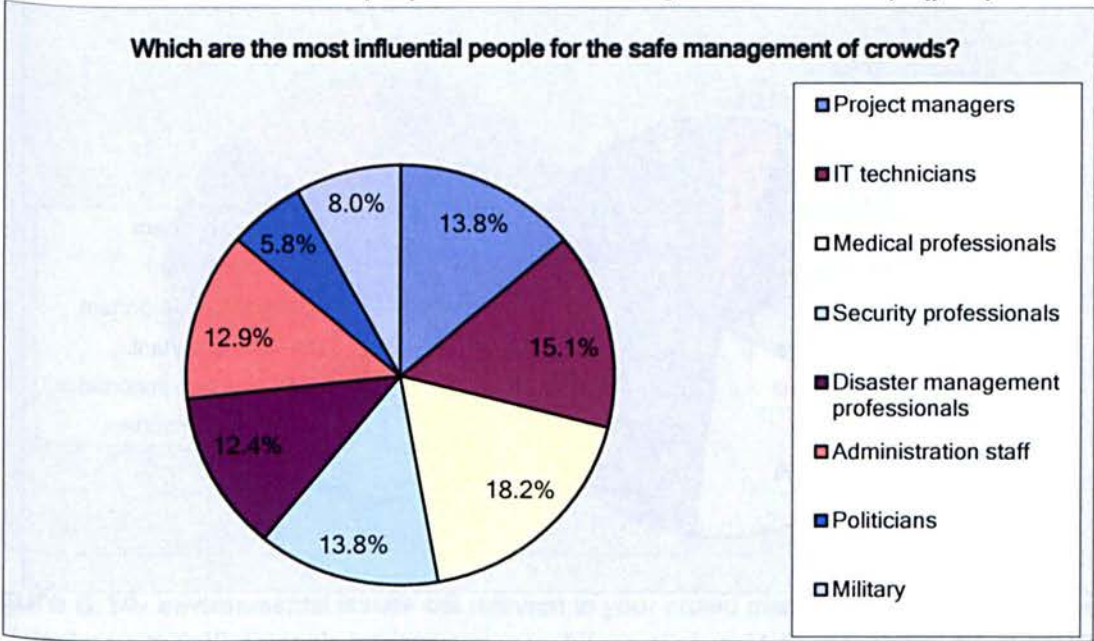


Figure 6.12- most influential people for the safe management of crowds (Hajj respondents)

Interpretation:

The next question was asked that which are the most influential people for the safe management of crowds. According to the survey result, the most used were project managers with (13.8%) and medical professionals (13.8%), closely followed by Disaster management professionals (13.8%), IT technicians (15.1%). Small percentage of respondents opted for administration staff (12.9%), Military (8.0%) and Politicians (5.8%). Looking at the Table and Figure 6-12 above .

Part 6: ENVIRONMENTAL ISSUES

Question 13:

How relevant are environmental issues to crowd management and planning?		
Answer Options	Response Percent	Response Count
Vitally important	29.8%	67
Very important	18.2%	41
Moderately important	20.0%	45
A little important	13.8%	31
Of very little importance	13.3%	30
Not at all important	4.9%	11
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.13- environmental issues to crowd management and planning (Hajj respondents)

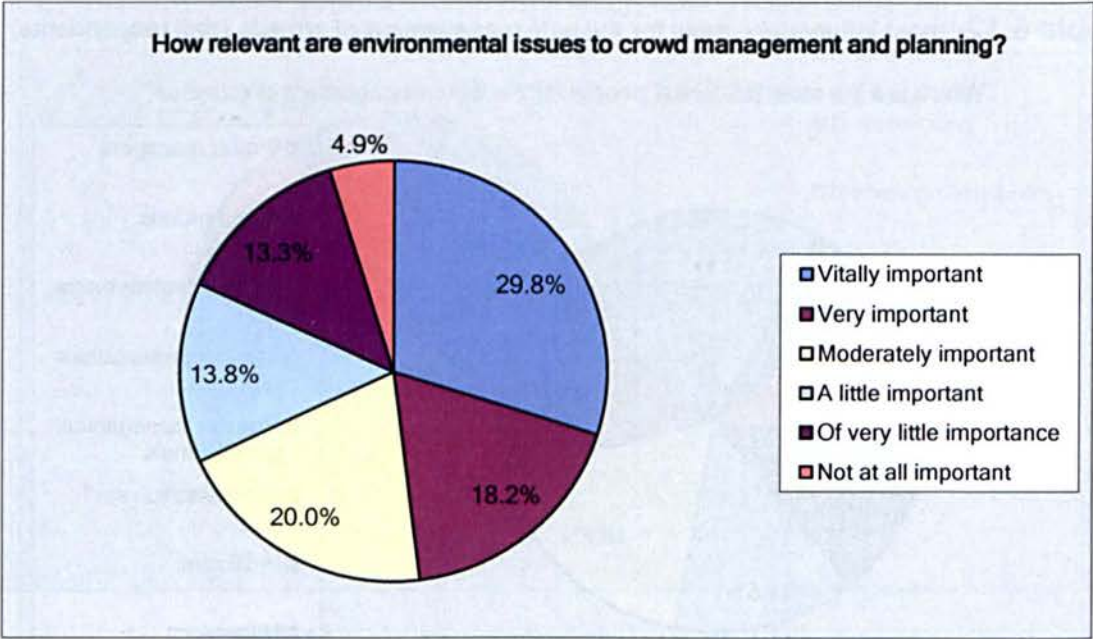


Figure 6.13- environmental issues to crowd management and planning (Hajj respondents)

Interpretation:

The next question was about the relevance of environmental issues to crowd management and planning. Almost 29.8% of the people though that the environmental issues were vitally important. Most of the responses were positive and only 4.9% thought that it were not at all important. Looking at the Table and Figure 6-13 above .

Question 14:

Which of the following environmental issues are relevant to your crowd management?		
Answer Options	Response Percent	Response Count
Human waste	20.9%	47
Noise pollution	16.9%	38
Water pollution	14.7%	33
Air pollution	16.0%	36
Whatever the law requires	20.0%	45
Refuse generated	11.6%	26
answered question		225
skipped question		0

Table 6.14- environmental issues are relevant to your crowd management (Hajj respondents)

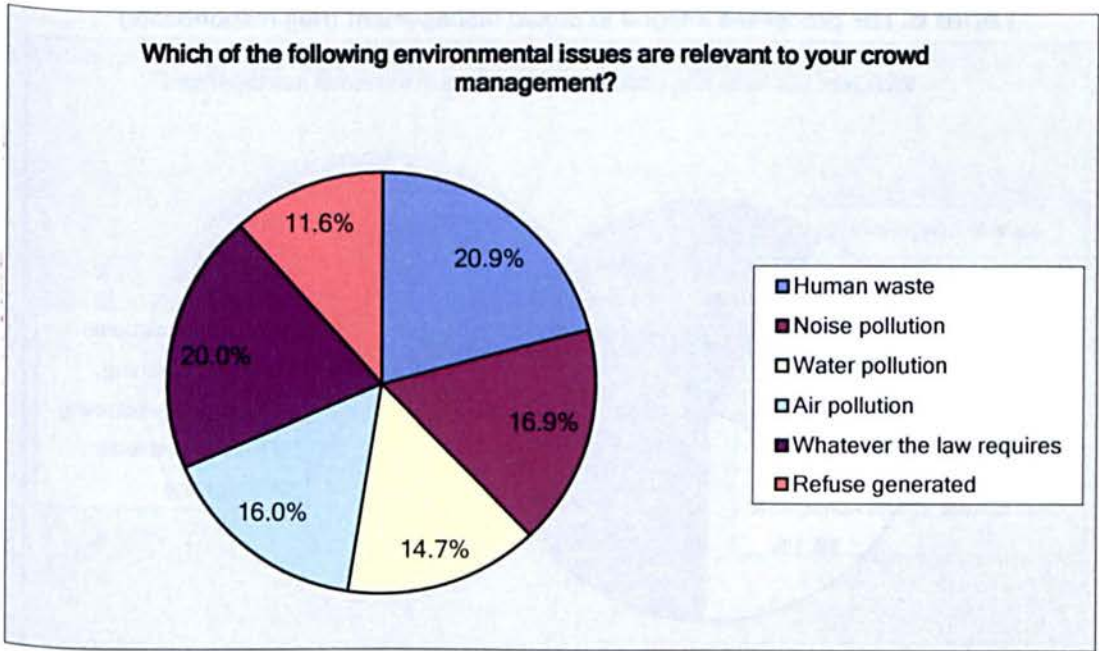


Figure 6.14- environmental issues are relevant to your crowd management (Hajj respondents)

Interpretation:

The next question was about the important environmental issues that are relevant to crowd management. The most important issue was human waste (20.9%), and other issues whatever the law requires (20.0%), noise pollution (16.9%) and air pollution (16.0%). The least was refuse generated (11.6%) and the least percentage was attained by water pollution (14.7%). Looking at the Table and Figure 6-14 above .

Part 7: PROJECT AND RISK MANAGEMENT

Question 15:

Which of the following processes are integral to crowd management?		
Answer Options	Response Percent	Response Count
Risk assessments	23.1%	52
Project planning	26.7%	60
Emergency planning	19.1%	43
Risk simulations	22.2%	50
Budgeting	8.9%	20
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.15- processes integral to crowd management (Hajj respondents)

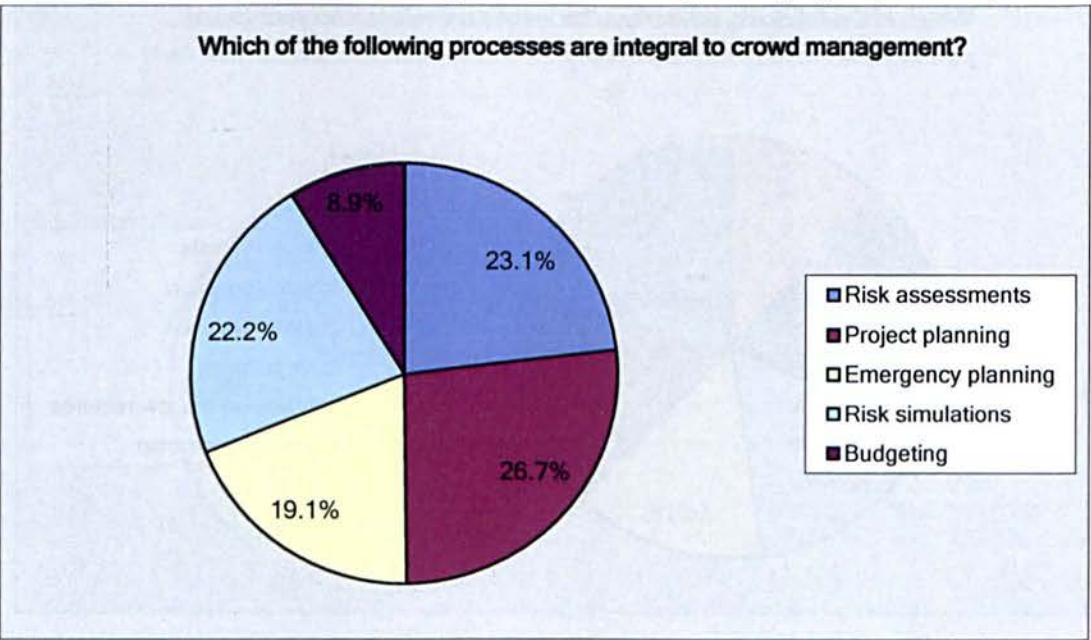


Figure 6.15- processes integral to crowd management (Hajj respondents)

Interpretation:

The next question was about the following processes that are integral to crowd management. According to the results of the survey, the project planning achieved 26.7%, which was followed by risk assessments to be 23.1%, risk simulations to be 22.2%, emergency planning to be 19.1% and budgeting to be 8.9%. Looking at the Table and Figure 6-15 above

Question 16:

Whose responsibility is project and risk management?		
Answer Options	Response Percent	Response Count
Overall management team	16.0%	36
Specific project management professionals	21.8%	49
Private police	20.9%	47
Security professionals	23.6%	53
Depends on the area of risk	17.8%	40
answered question		225
skipped question		0

Table 6.16- responsibility of project and risk management (Hajj respondents)

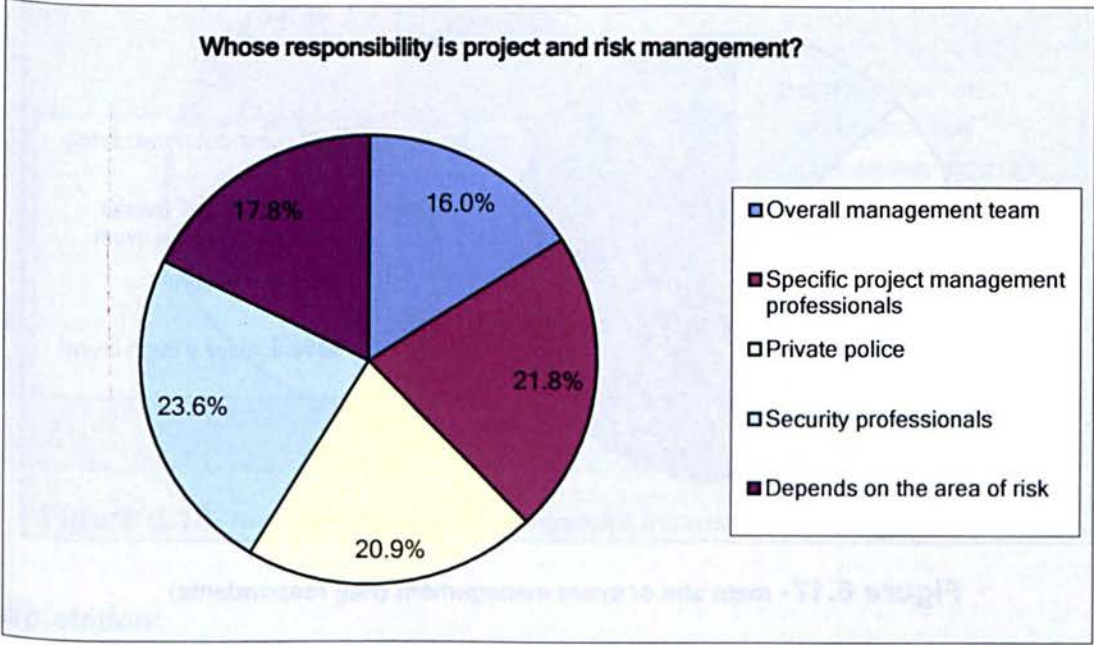


Figure 6.16- responsibility of project and risk management (Hajj respondents)

Interpretation:

The next question enquired about the responsibility of the project and risk management. Specific project management professionals were found to be 21.8%, followed by security professionals (23.6%), private police (20.9%), the next selected option was 'depends on the area of risk, (17.8%) and overall management team was found to be the least responsible was (16.0%). Looking at the Table and Figure 6-16 above.

Part 8: EVENT MANAGEMENT

Question 17:

What is the main aim of event management?		
Answer Options	Response Percent	Response Count
To maintain crowd safety	35.1%	79
To make sure overall efficiency of the event	26.7%	60
To make a profit	25.3%	57
To achieve a large crowd	12.9%	29
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.17- main aim of event management (Hajj respondents)

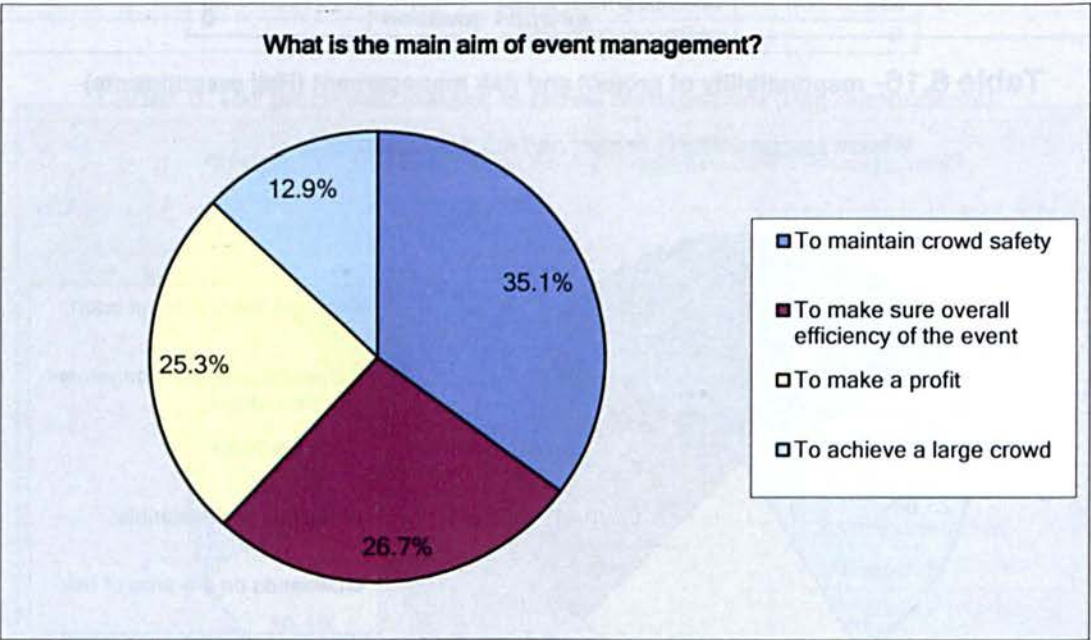


Figure 6.17- main aim of event management (Hajj respondents)

Interpretation:

The next question was about the main aim of event management. According to the responses of survey, the most selected option was to maintain crowd safety (35.1%),

the second selected option was to make sure of the overall efficiency of the event (26.7%), to make a profit (25.3%) and the least selected option was to achieve a large crowd (12.9%). Looking at the Table and Figure 6-17 above .

Question 18:

How important is event management to crowd safety?		
Answer Options	Response Percent	Response Count
Vitally important	28.9%	65
Very important	20.0%	45
Moderately important	17.8%	40
A little important	12.9%	29
Of very little importance	14.2%	32
Not at all important	6.2%	14
answered question		225
skipped question		0

Table 6.18- importance of event management to crowd safety (Hajj respondents)

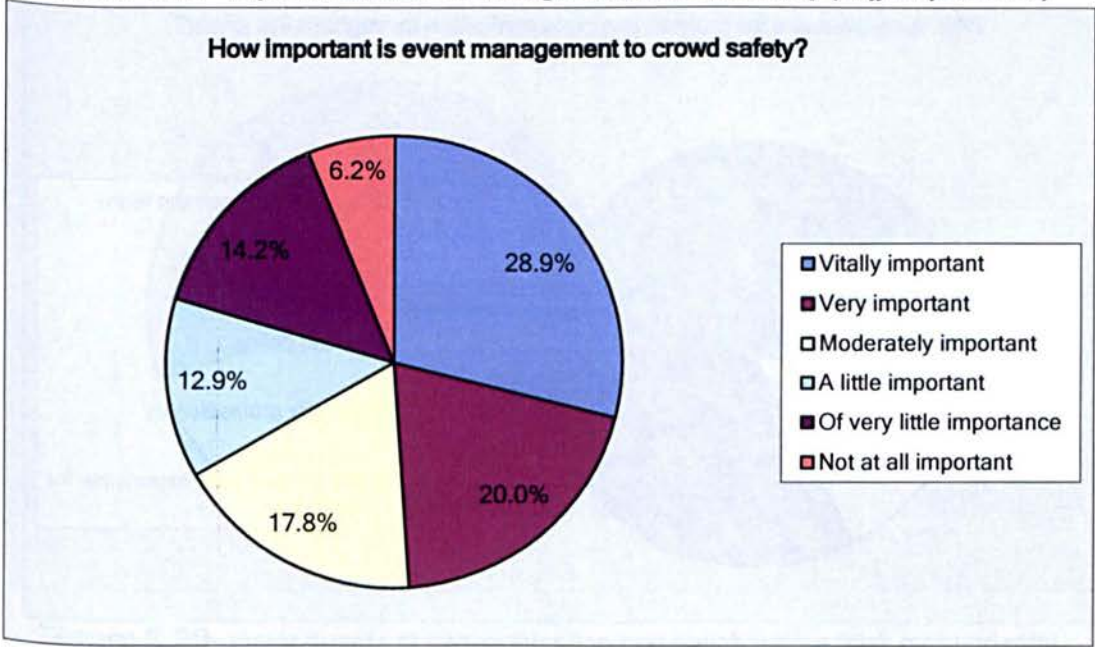


Figure 6.18- importance of event management to crowd safety (Hajj respondents)

Interpretation:

The next question was about what respondents thought how important event management to crowd safety was. Most of the respondents gave a positive response, almost 28.9% said that they thought it was vitally important, 20.0% was very important, 17.8% said that it was moderately important, whereas only 12.9% thought it was of a

little importance, 14.2% thought that it was of very little importance and 6.2% said that it was not at all important. Looking at the Table and Figure 6-18 above .

Part 9 : COMMUNICATION AND COLLABORATION

Question 19

Who is responsible for maintaining communication throughout the event?		
Answer Options	Response Percent	Response Count
Overall management team	24.4%	55
Project management professionals	33.3%	75
Private police	15.1%	34
Security professionals	13.8%	31
All professionals responsible for own area	13.3%	30
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.19- responsible for maintaining communication throughout the event (Hajj respondents)

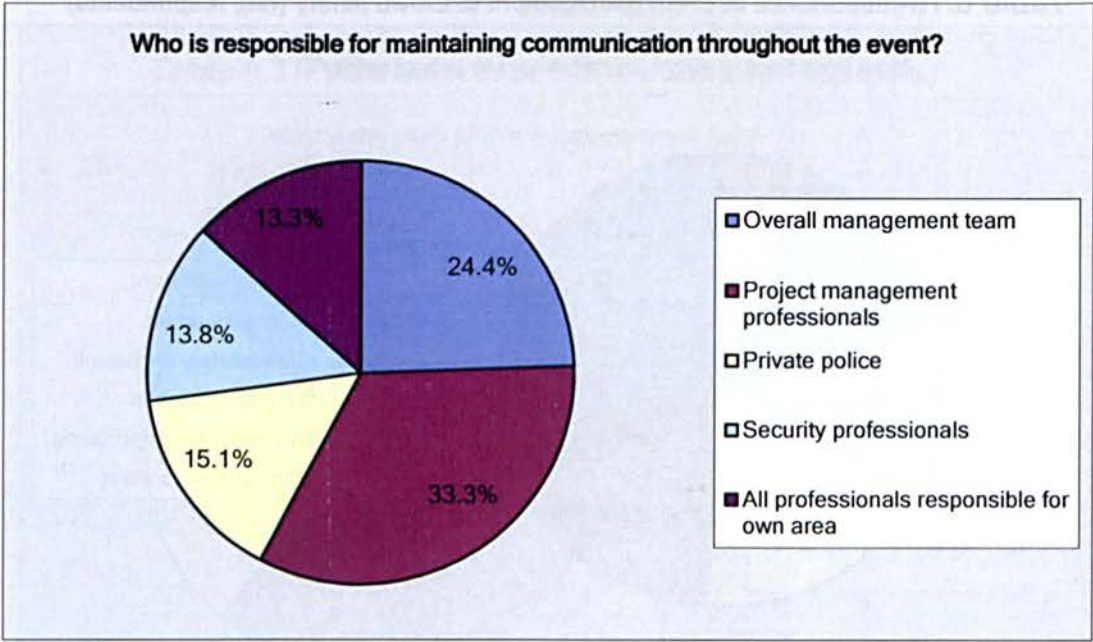


Figure 6.19- responsible for maintaining communication throughout the event (Hajj respondents)

Interpretation:

The next question was about what respondents thought that who is responsible for maintaining communication throughout the event. According to the results of the survey, the most important was the project management professionals which was 33.3%, overall management team was (24.4%), private police (15.1%), security

professionals (13.8%) and the least percentage was achieved by all professionals responsible for own area (13.3%). Looking at the Table and Figure 6-19 above .

Question 20

What are the major threats to communication and collaboration?		
Answer Options	Response Percent	Response Count
Breakdown of IT	20.0%	45
Too many managers	27.6%	62
Conflict between the teams	22.2%	50
Lack of systems	19.6%	44
Too much bureaucracy	10.7%	24
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.20- major threats to communication and collaboration (Hajj respondents)

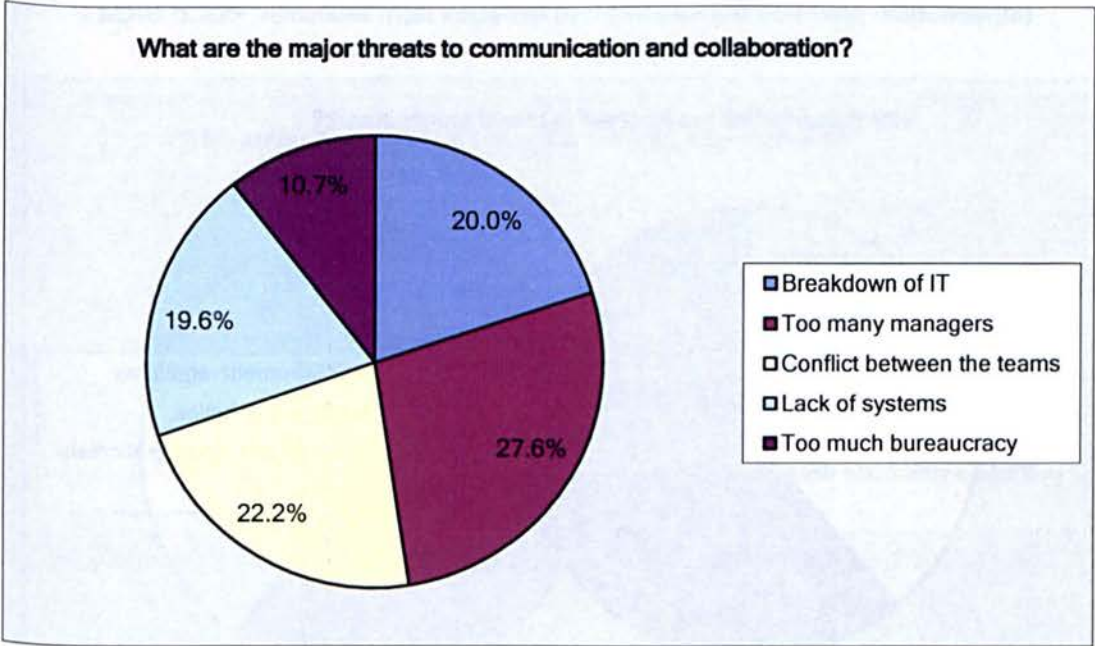


Figure 6.20- major threats to communication and collaboration (Hajj respondents)

Interpretation:

The next question in the communication and collaboration was about the major threats to communication and collaboration. The most identified threat by the respondents was that if there are too many managers (27.6%) and conflict between the teams (22.2%). 20.0% of the respondents thought that break down of IT could be a major threat to communication and collaboration. 19.6% thought that lack of systems altogether could be a reason or threat to communication and collaboration. And 10.7% thought that too

much bureaucracy was a reason or threat to communication and collaboration at the event. Looking at the Table and Figure 6-20 above .

Part 10: AUTHORITIES

Question 21- authorities involved in crowd management

Which authorities are involved in crowd management?		
Answer Options	Response Percent	Response Count
Government regulators	31.6%	71
Police authorities	29.8%	67
Health and safety authorities	27.1%	61
None	11.6%	26
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.21- authorities involved in crowd management (Hajj respondents)

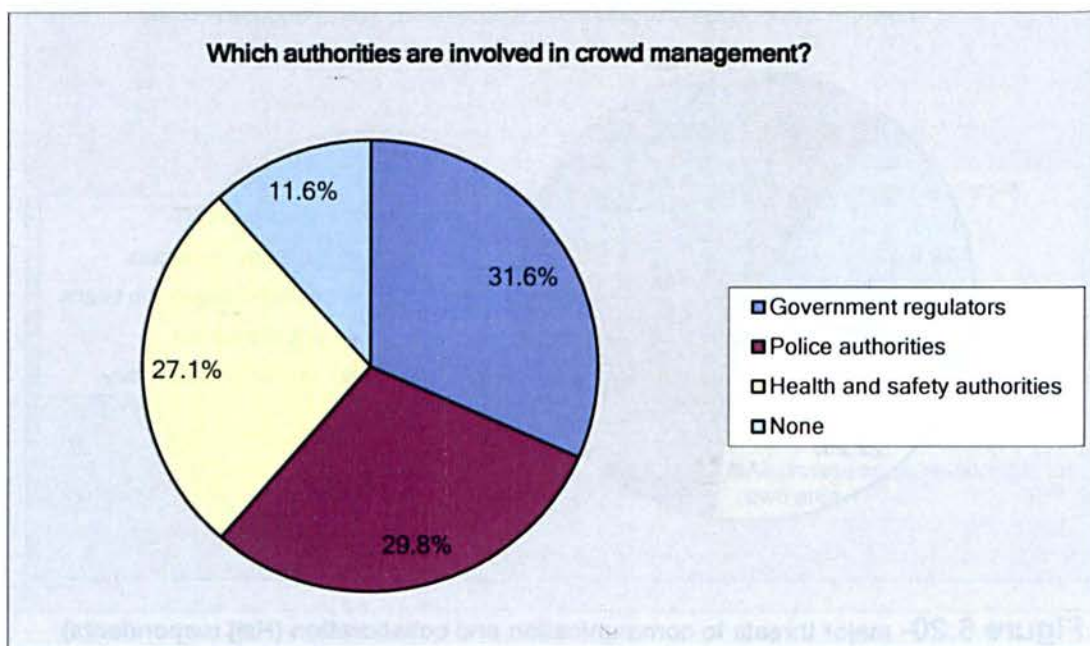


Figure 6.21- authorities involved in crowd management (Hajj respondents)

Interpretation:

The next section of the questionnaire enquired about the authority. According to the responses of the survey, the most involved authorities were government regulators as voted by 31.6% of the people. 29.8% of the people thought that the police authorities were also involved in crowd management. 27.1% of the respondents thought that the

health and safety authorities while 11.6% of the respondents thought that none of these were important. Looking at the Table and Figure 6-21 above .

Question 22

Which authorities are most influential to crowd management?		
Answer Options	Response Percent	Response Count
Government regulators	30.7%	69
Police authorities	29.3%	66
Health and safety authorities	29.3%	66
None	10.7%	24
answered question		225
skipped question		0

Table 6.22- authorities most influential to crowd management (Hajj respondents)

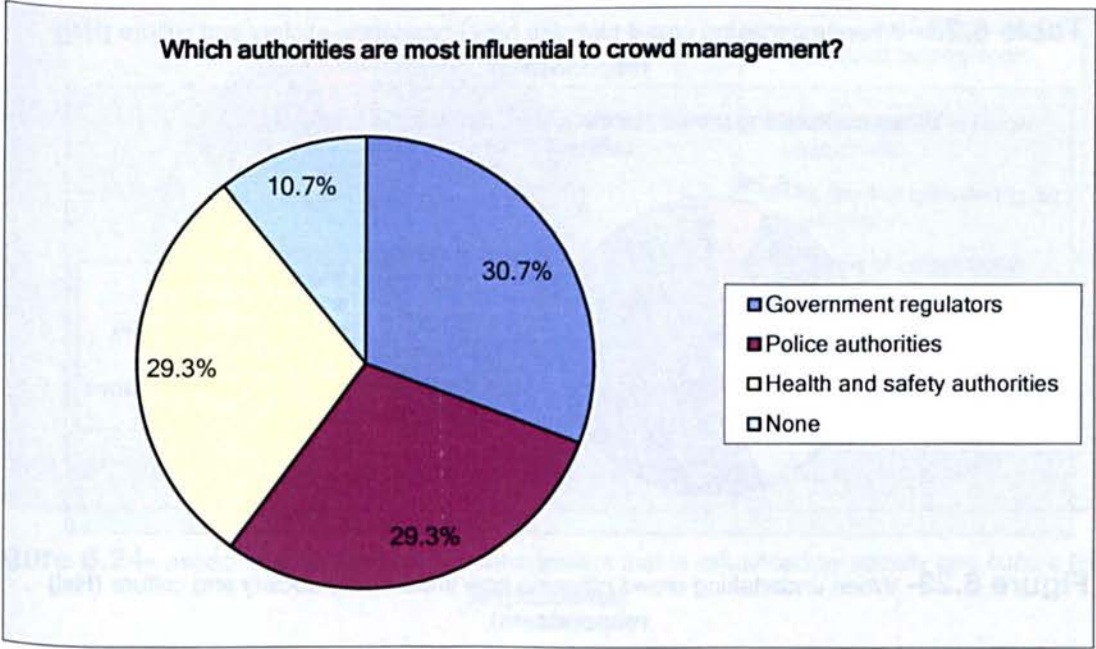


Figure 6.22- authorities most influential to crowd management (Hajj respondents)

Interpretation:

The next section of the questionnaire enquired about the authority that is most influential to crowd management. According to the responses of the survey, the government regulators were thought to be the most influential as voted by 30.7% of the

people. 29.3% of the people thought that health and safety and police authorities each were most influential to crowd management. Looking at the Table and Figure 6-22 above .

Part 11: SOCIETY AND CULTURE

Question 23

When undertaking crowd planning how important is society and culture?		
Answer Options	Response Percent	Response Count
Vitally important	29.8%	67
Very important	25.8%	58
Moderately important	19.1%	43
A little important	9.3%	21
Of very little importance	9.8%	22
Not at all important	6.2%	14
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.23- When undertaking crowd planning how important is society and culture (Hajj respondents)

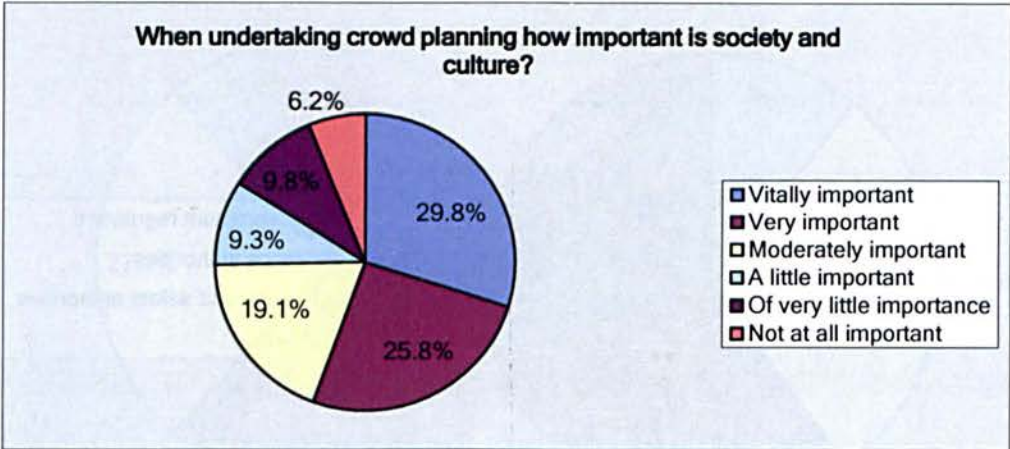


Figure 6.23- When undertaking crowd planning how important is society and culture (Hajj respondents)

Interpretation:

The next section of the questionnaire enquired society and culture. The first question was when undertaking crowd planning how important was society and culture. Almost 50% thought that it was vitally or very important. 19.1% said it was moderately important, whereas almost 27% thought it was less important, which was very less in comparison to the positive response of the people. Looking at the Table and Figure 6-23 above .

Question 24

Which aspect of event and crowd management is influenced by society and culture?		
Answer Options	Response Percent	Response Count
The crowd demographic	24.0%	54
The willingness to follow instructions	24.0%	54
The level of calm during an emergency	16.9%	38
The use of infrastructure	17.3%	39
Medical requirements	12.0%	27
None	5.8%	13
answered question		225
skipped question		0

Table 6.24- aspect of event and crowd management that is influenced by society and culture (Hajj respondents)

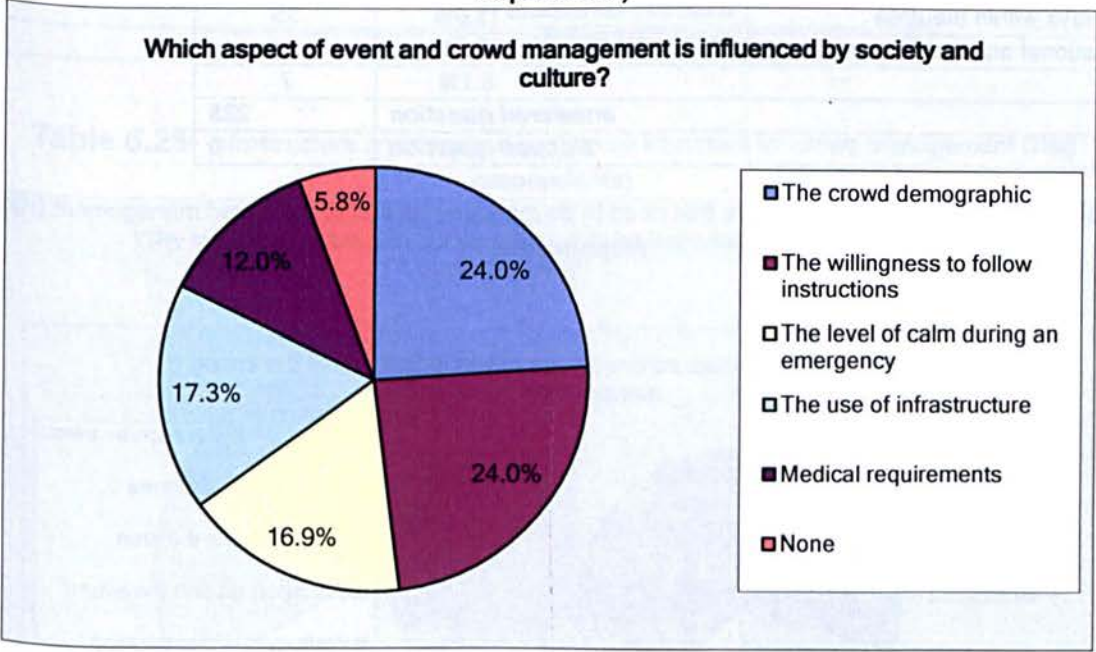


Figure 6.24- aspect of event and crowd management that is influenced by society and culture (Hajj respondents)

Interpretation:

The next section of the questionnaire enquired about what aspects of the event and crowd management was influenced by society and culture. The crowd demographics (24%) and the willingness to follow instructions (24%) was found to be the most influential factors. The use of infrastructure (17.3%) was next, 16.9% thought that the level of calm during an emergency was the most influential, 12% thought that medical

requirements was the most influential and 5.8% thought that none of these factors were influential. Looking at the Table and Figure 6-24 above .

Part 12: INFRASTRUCTURE AND TRANSPORT

Question 25

Which forms of infrastructure need to be managed as part of the crowd management?		
Answer Options	Response Percent	Response Count
Public transport such as trains and buses	18.2%	41
Car routes to the area	19.6%	44
Car parking in the area	13.3%	30
Transport around the event	19.6%	44
Walkways within the area	15.6%	35
International and long distance travel	10.7%	24
None	3.1%	7
answered question		225
skipped question		0

Table 6.25- forms of infrastructure that need to be managed as part of the crowd management (Hajj respondents)

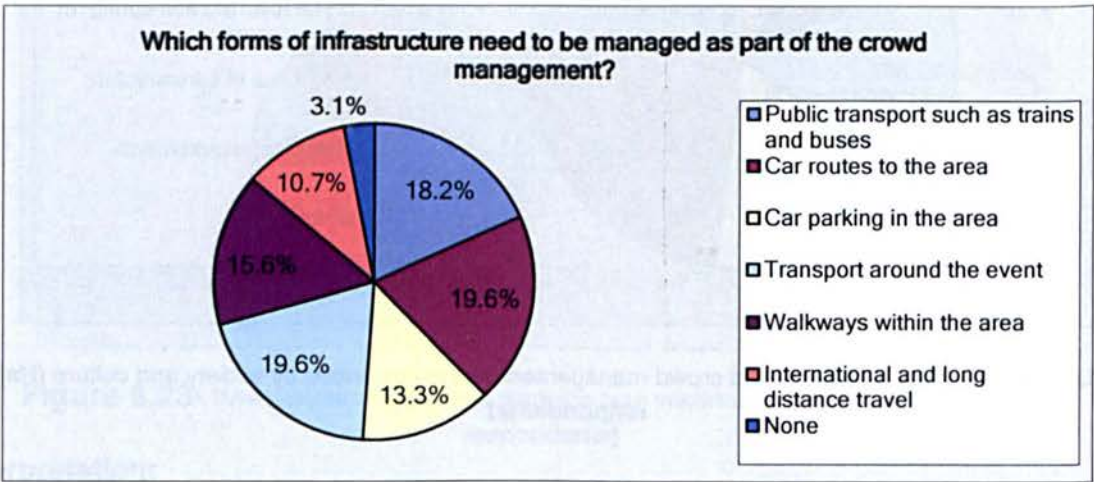


Figure 6.25- forms of infrastructure that need to be managed as part of the crowd management (Hajj respondents)

Interpretation:

The next section of the questionnaire enquired about the forms of infrastructure need to be managed as part of the crowd management. 18.2% thought that it was public transport such as trains and buses. 19.6% thought that it was car routes to the area.

18.2% thought that it was car parking in the area. 19.6% voted for transport around the event, 15.6% thought that it was the walkways within the area and 10.7% thought that it was international and long distance travel. Looking at the Table and Figure 6-25 above .

Question 26

Why is infrastructure and transport seen to be important for crowd management?		
Answer Options	Response Percent	Response Count
It provides exit routes in a disaster	15.1%	34
Ensures lack of crowding at pressure points	27.1%	61
Encourages people to visit the event	23.6%	53
Allows people to be tracked and followed	16.0%	36
Opportunity for greater revenue	14.2%	32
None	4.0%	9
answered question		225
skipped question		0

Table 6.26- infrastructure and transport seen to be important for crowd management (Hajj respondents)

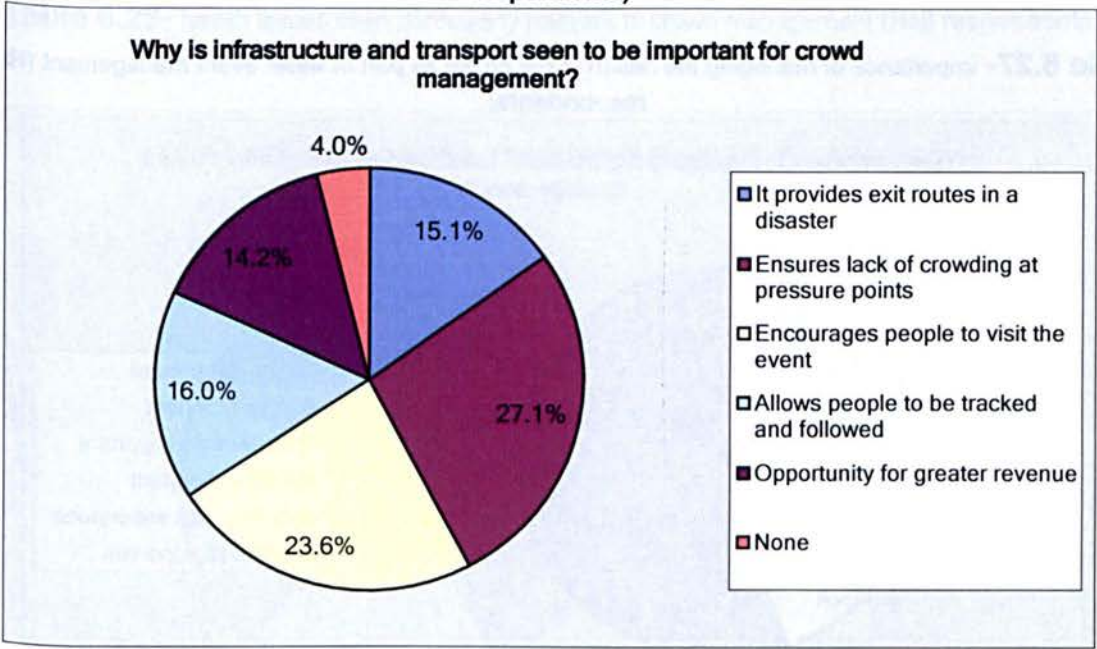


Figure 6.26- infrastructure and transport seen to be important for crowd management (Hajj respondents)

Interpretation:

The next section of the questionnaire enquired about the importance of infrastructure and transport to be important for crowd management. About 27.1% said that it was because it ensures lack of crowding at pressure points, 23.6% said that it was because

it encourages people to visit the event, 16.0% said that it was because it allows people to be tracked and followed, 14.2% thought that it was because it was an opportunity for greater revenue, whereas only 4.0% said that none of these factors were important. Looking at the Table and Figure 6-26 above .

Part 13: HEALTH

Question 27

How important is managing the health of the crowd as part of wider event management?		
Answer Options	Response Percent	Response Count
Vitally important	32.9%	74
Very important	22.7%	51
Moderately important	15.1%	34
A little important	13.8%	31
Of very little importance	10.2%	23
Not at all important	5.3%	12
answered question		225
skipped question		0

Table 6.27- importance of managing the health of the crowd as part of wider event management (Hajj respondents)

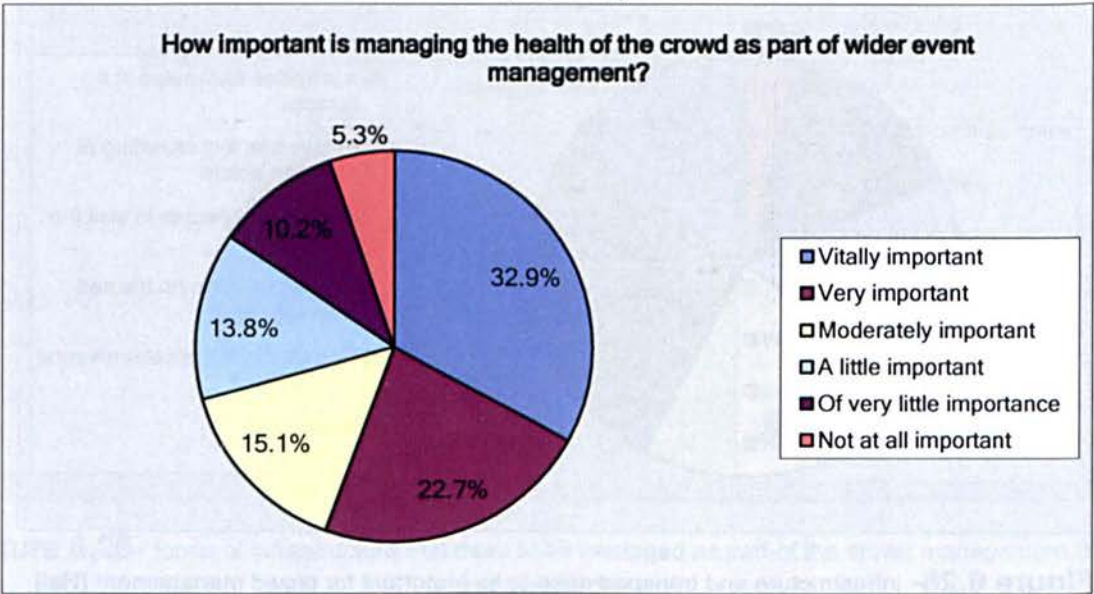


Figure 6.27- importance of managing the health of the crowd as part of wider event management (Hajj respondents)

Interpretation:

The next section of the questionnaire enquired about the importance of managing health of the crowd as part of wider event management. More than 50% of the respondents gave a positive response and thought that it was very important. 15.1% of the respondents thought that it was moderately important. 28% of the respondents thought that it was either very little or not important at all. Looking at the Table and Figure 6-27 above .

Question 28

What health issues are seen as particularly relevant to crowd management?		
Answer Options	Response Percent	Response Count
Injuries through crushes	24.0%	54
Illness and injury whilst attending event	17.8%	40
Contamination across attendees	20.0%	45
External threats such as terrorism	20.4%	46
Natural threats such as flooding	13.8%	31
None	4.0%	9
answered question		225
skipped question		0

Table 6.28- health issues seen particularly relevant to crowd management (Hajj respondents)

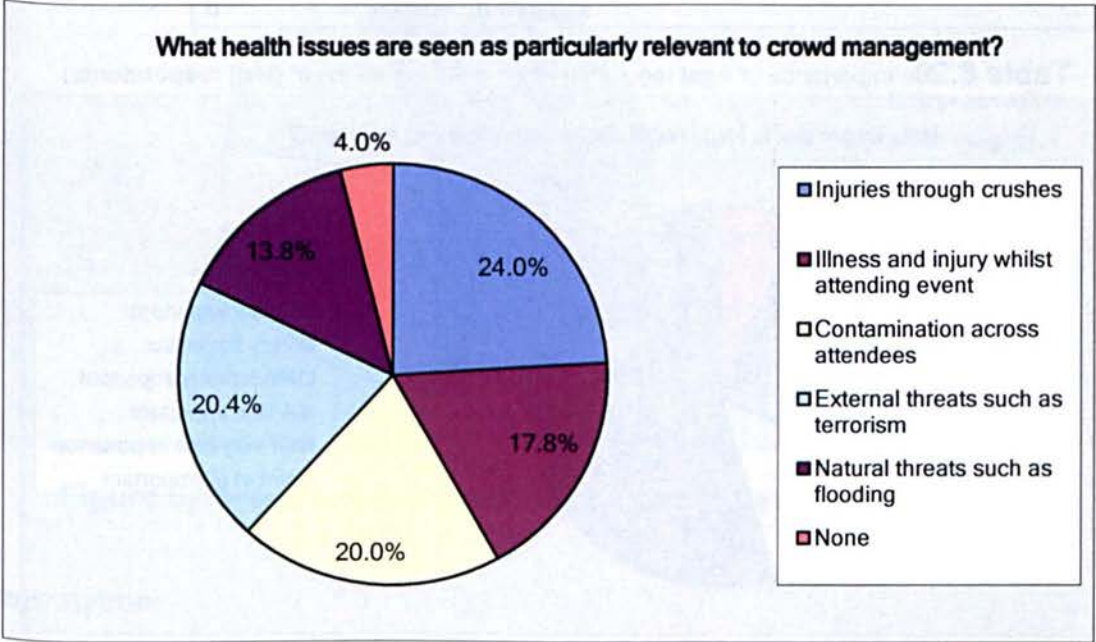


Figure 6.28- health issues seen particularly relevant to crowd management (Hajj respondents)

Interpretation:

The next section of the questionnaire enquired about the health issues that are particularly relevant to crowd management. Almost 24% of the respondents thought that injuries through crushes were particularly relevant to crowd management. 17.8% of the respondents thought that illness and injury while attending the event was relevant. 20.0% thought that contamination across attendees was important, whereas external threats such as terrorism was thought by 20.4%, 13.8% thought that natural threats such as flooding was thought important whereas only 4% thought that none of this was important. Looking at the Table and Figure 6-28 above .

Part 14: LEGAL AND REGULATORY

Question 29

How important is legal regulation when planning an event?		
Answer Options	Response Percent	Response Count
Vitally important	33.3%	75
Very important	21.3%	48
Moderately important	13.3%	30
A little important	15.6%	35
Of very little importance	9.8%	22
Not at all important	6.7%	15
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.29- importance of legal regulation when planning an event (Hajj respondents)

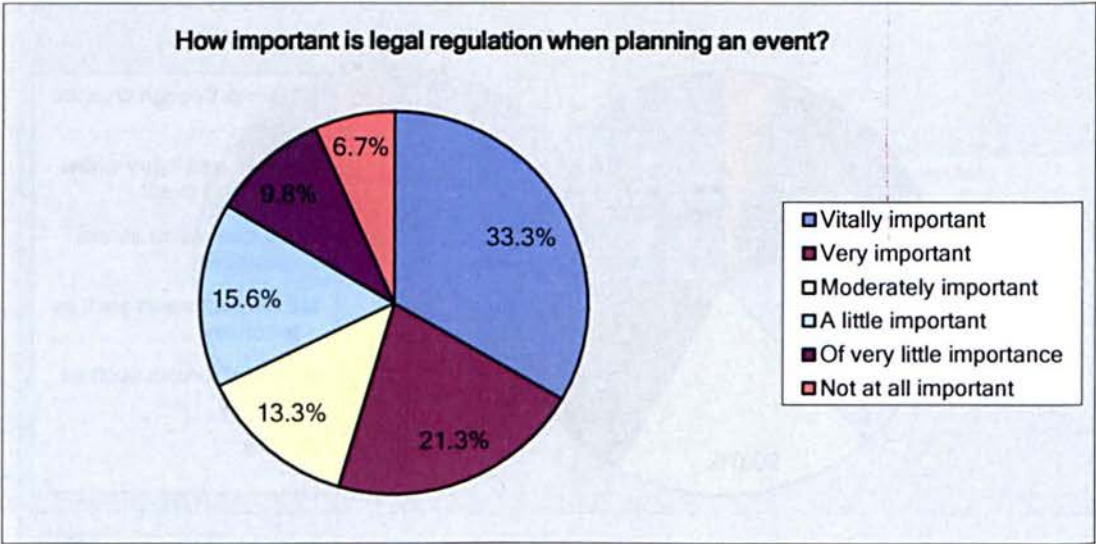


Figure 6.29- importance of legal regulation when planning an event (Hajj respondents)

Interpretation: The next section of the questionnaire enquired about how important is the legal regulations when there is a planning of an event. 33.3% opted for vitally

important and 21.3% opted for very important, 13.3% opted for vitally important, 15.6% opted for a little important, 9.8% opted for of very little importance, and 6.7% thought that it was not important at all. Looking at the Table and Figure 6-29 above .

Question 30

Do you feel that regulatory requirements are beneficial to crowd safety?		
Answer Options	Response Percent	Response Count
Yes – incredibly	30.7%	69
Yes – slightly	19.6%	44
Moderately	27.1%	61
Rarely	16.4%	37
Never	6.2%	14
<i>answered question</i>		225
<i>skipped question</i>		0

Table 6.30- regulatory requirements beneficial to crowd safety (Hajj respondents)

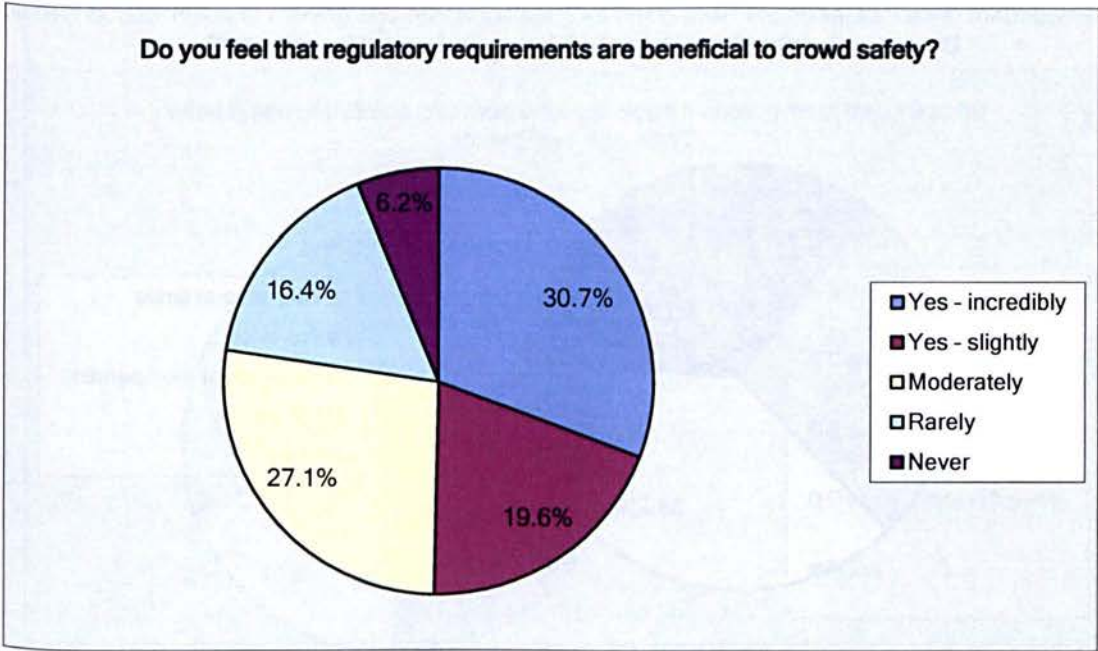


Figure 6.30- regulatory requirements beneficial to crowd safety (Hajj respondents)

Interpretation:

The next section of the questionnaire enquired about how beneficial was the regulatory requirements to crowd safety. Most of the respondents thought that incredibly yes it was incredibly, 19.6% chose the option 'yes slightly', 27.1% thought that it was 'moderately'.

'16.4% thought that it was rarely beneficial, and 6.2% said never. Looking at the Table and Figure 6-30 above .

Part 15: TRAINING AND REHERSAL

Question 31

Do you undertake any advance training and rehearsal for an event?		
Answer Options	Response Percent	Response Count
Yes, several times	9.3%	21
Yes once	14.7%	33
Yes parts of the operation	38.2%	86
Not usually	27.1%	61
Never	10.7%	24
answered question		225
skipped question		0

Table 6.31- advance training and rehearsal for an event (Hajj respondents)

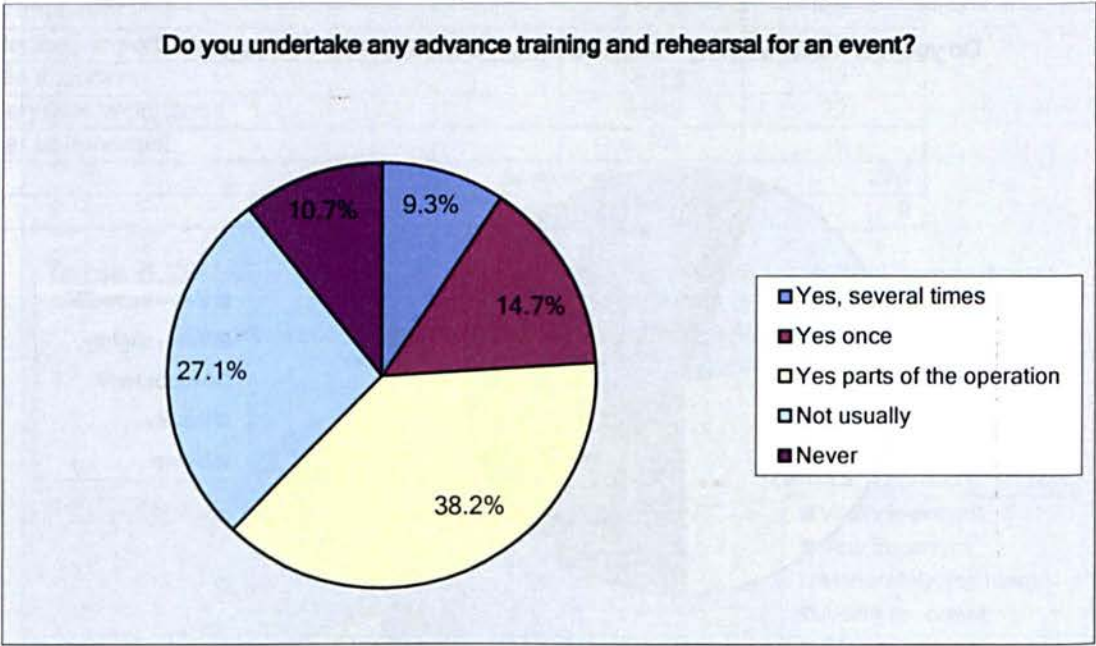


Figure 6.31- advance training and rehearsal for an event (Hajj respondents)

Interpretation:

The next section of the questionnaire was about training and rehearsal for the event. 38.2% respondents answered as 'yes parts of the operation' are about training and rehearsal for the event. 27.1% of the respondents answered 'not usually', 14.7% of the

respondents were 'yes once', 10.7% of the respondents said 'never' and 9.3% of the respondents were 'yes, several times'. Looking at the Table and Figure 6-31 above .

Question 32

What types of training and rehearsal are seen as being most important for crowd management?		
Answer Options	Response Percent	Response Count
Simulation	19.1%	43
Disaster management practices	31.1%	70
Training to use specific technology	19.6%	44
Overall event rehearsal	23.1%	52
None	7.1%	16
answered question		225
skipped question		0

Table 6.32- types of training and rehearsal seen as being most important for crowd management (Hajj respondents)

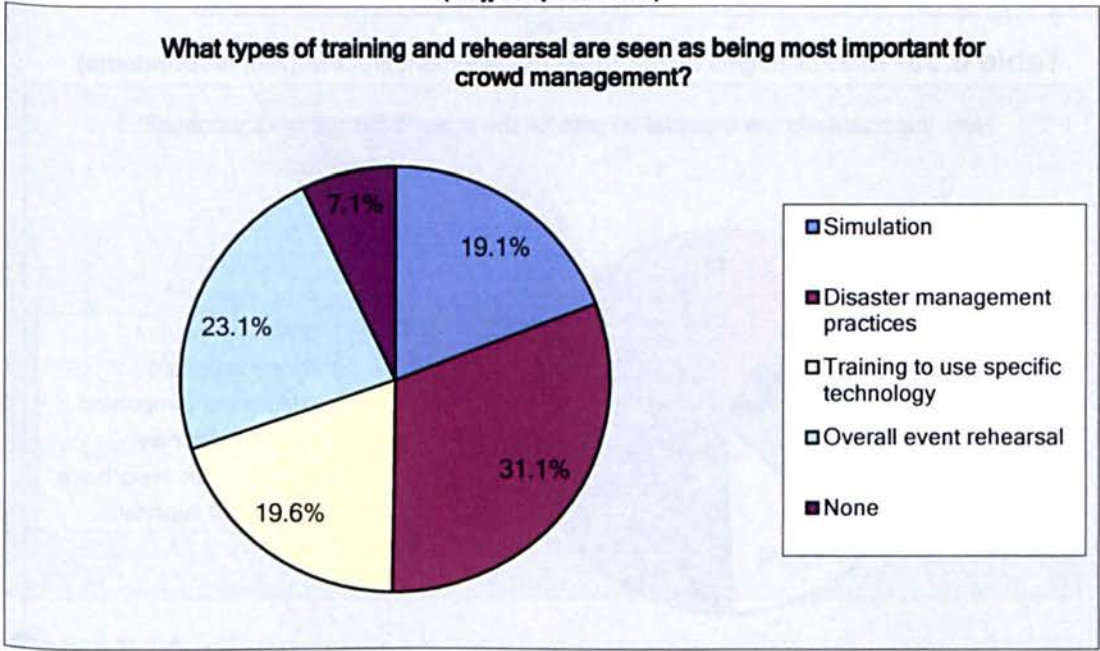


Figure 6.32- types of training and rehearsal seen as being most important for crowd management (Hajj respondents)

Interpretation

The next section of the questionnaire was about the types training and rehearsal as being most important for crowd management. 31.1% of the respondents said that disaster management practices were a type of training and rehearsal are seen as being

most important for crowd management. The second selected option was 'overall event rehearsal' which was 23.1%. Training to use specific technology was opted by '19.6%' and simulation was opted by '19.1%'. Looking at the Table and Figure 6-32 above .

Part 16: FINANCIAL

Question 33

How important are the financial targets for the crowd management process?		
Answer Options	Response Percent	Response Count
Vitally important	28.9%	65
Very important	21.8%	49
Moderately important	12.4%	28
A little important	16.4%	37
Of very little importance	12.0%	27
Not at all important	8.4%	19
answered question		225
skipped question		0

Table 6.33- financial targets for the crowd management process (Hajj respondents)

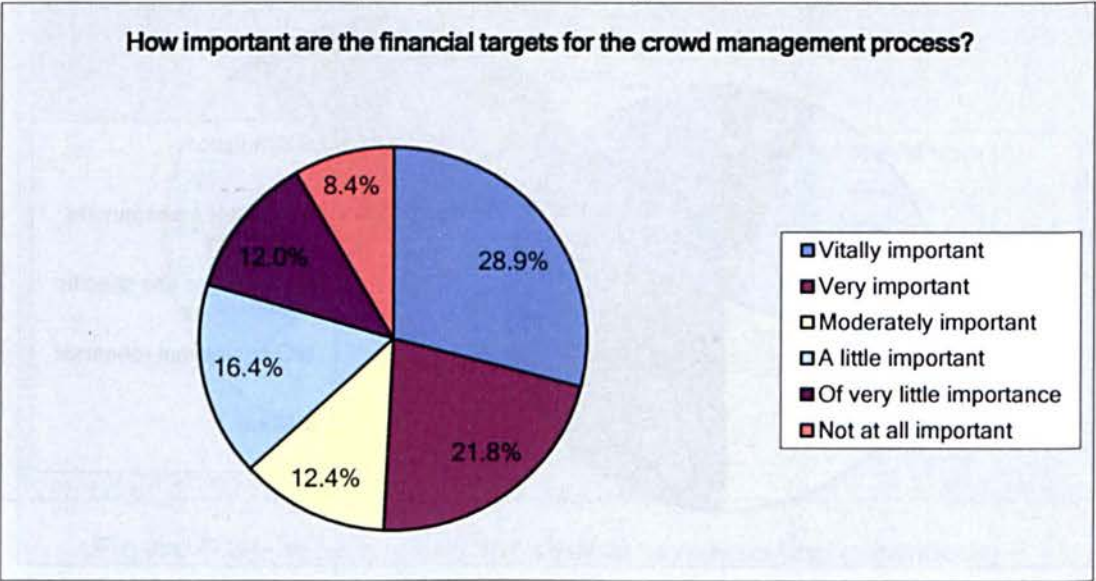


Figure 6.33- financial targets for the crowd management process (Hajj respondents)

Interpretation:

The next section of the questionnaire covered the financial aspects. The question asked about the importance of the financial targets for the crowd management process. almost more than 50% thought that was vitally important or very important or moderately

important which is a large percentage. In comparison to this only 8.4% of the respondents thought that it was not important at all. Looking at the Table and Figure 6-33 above .

Question 34

Which financial measures are deemed important for the crowd management process?		
Answer Options	Response Percent	Response Count
Return on investment	20.4%	46
Income for every attendee	23.6%	53
Overall income	21.3%	48
Overall expenses	26.2%	59
None	8.4%	19
answered question		225
skipped question		0

Table 6.34- financial measures deemed important for the crowd management process (Hajj respondents)

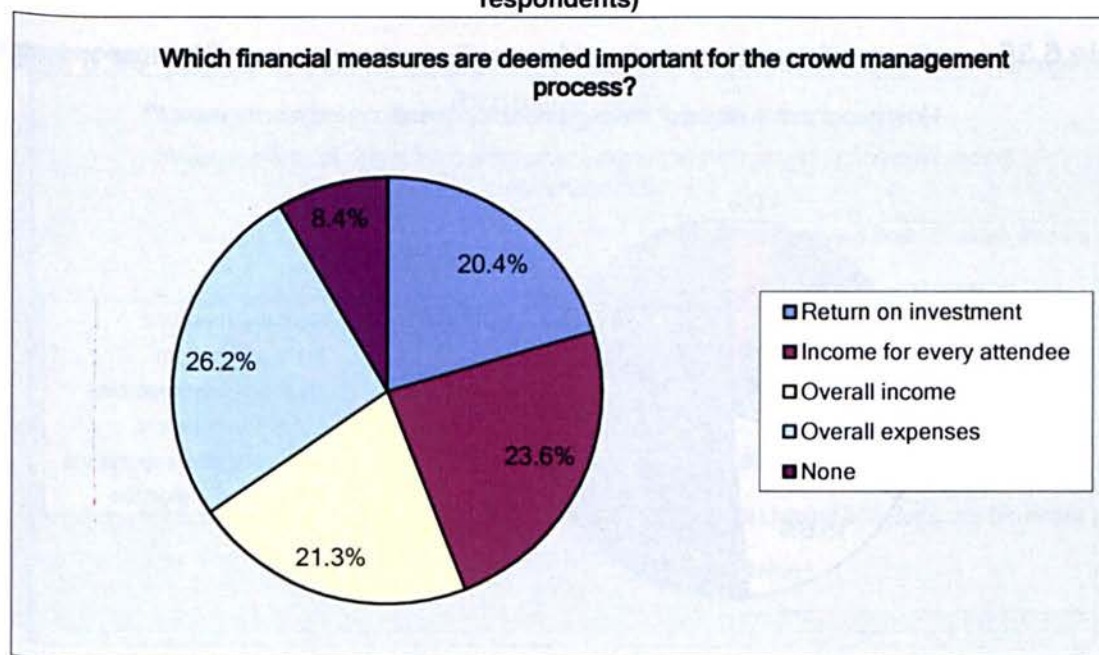


Figure 6.34- financial measures deemed important for the crowd management process (Hajj respondents)

Interpretation:

The next question was about the financial measures that are deemed important for the crowd management process. Almost 23.6% of the respondents said that the income for every attendee was very important, 21.3% said that the overall income was important,

26.2% said about the overall expenses, 20.4% said that the return on investment, where as 8.4% said that none of that was important. Looking at the Table and Figure 6-34 above .

Part 17: DISASTER MANAGEMENT

Question 35

How important is disaster management for overall crowd management?		
Answer Options	Response Percent	Response Count
Vitally important	32.4%	73
Very important	19.1%	43
Moderately important	15.6%	35
A little important	18.2%	41
Of very little importance	10.7%	24
Not at all important	4.0%	9
answered question		225
skipped question		0

Table 6.35- importance of disaster management for overall crowd management (Hajj respondents)

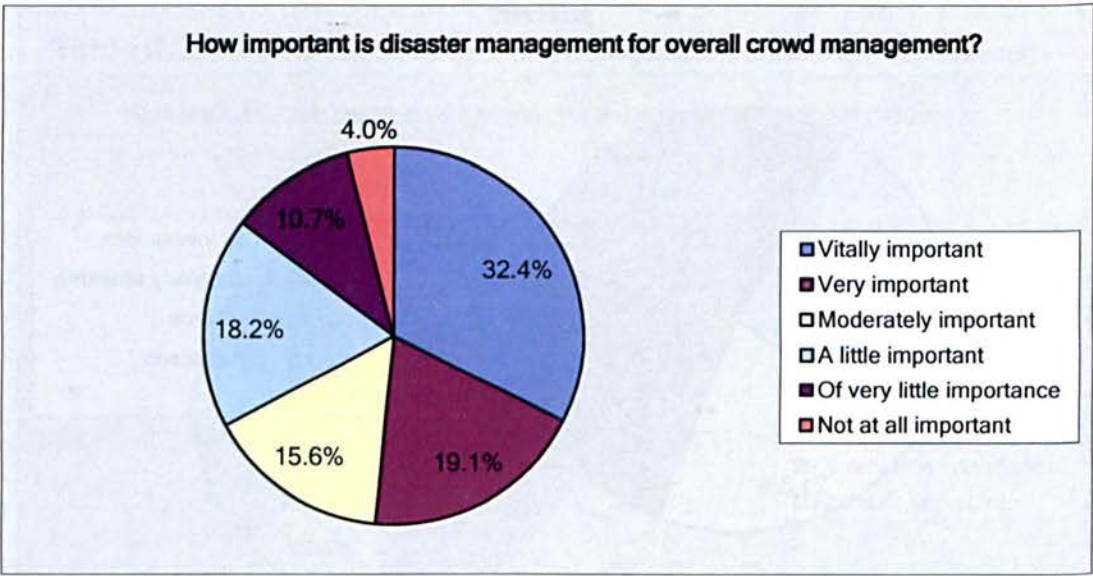


Figure 6.35- importance of disaster management for overall crowd management (Hajj respondents)

Interpretation:

The next question was about the financial measures that are deemed important for the crowd management process. Responses from almost 53% of respondents totaled to vitally important and very important. 15.6% of the respondents said moderately important, 18.2% of the respondents said it was a little important, 10.7% said it was of very little importance where as only 4% said that it was not at all important. Looking at the Table and Figure 6-35 above .

Question 36

What aspects of disaster management are dealt with as part of overall crowd management?		
Answer Options	Response Percent	Response Count
Identifying likely disaster threats	18.2%	41
Simulations to identify disaster threats	15.1%	34
Additional resources for disaster management	18.7%	42
Infrastructure changes	17.3%	39
Health and medical planning	13.3%	30
Liaising with 3rd party providers	10.2%	23
None	7.1%	16
answered question		225
skipped question		0

Table 6.36- aspects of disaster management dealt with as part of overall crowd management (Hajj respondents)

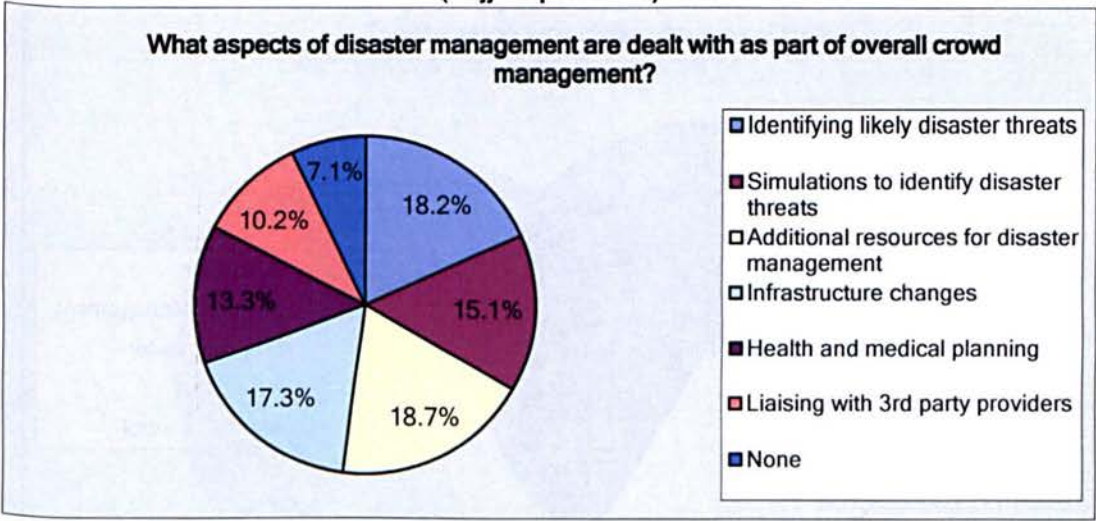


Figure 6.36- aspects of disaster management dealt with as part of overall crowd management (Hajj respondents)

Interpretation:

The next question was about the aspects of disaster management that are dealt with as part of overall crowd management. The responses were identifying likely disaster threats (18.2%), Simulations to identify disaster threats (15.1%), additional resources for disaster management (18.7%), Infrastructure changes (17.3%), Health and medical

planning (13.3%), Liaising with 3rd party providers (10.2%), whereas 7.1% said none of these factors were important. Looking at the Table and Figure 6-36 above .

6.1.3. Data collected from respondents of Olympics survey

Question 1:

What is your role within your organisation?		
Answer Options	Response Percent	Response Count
Director	19.0%	45
Higher Management	22.4%	53
Team Leader	25.7%	61
Security	12.7%	30
Crowd control	20.3%	48
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.37- role within your organisation (Olympics respondents)

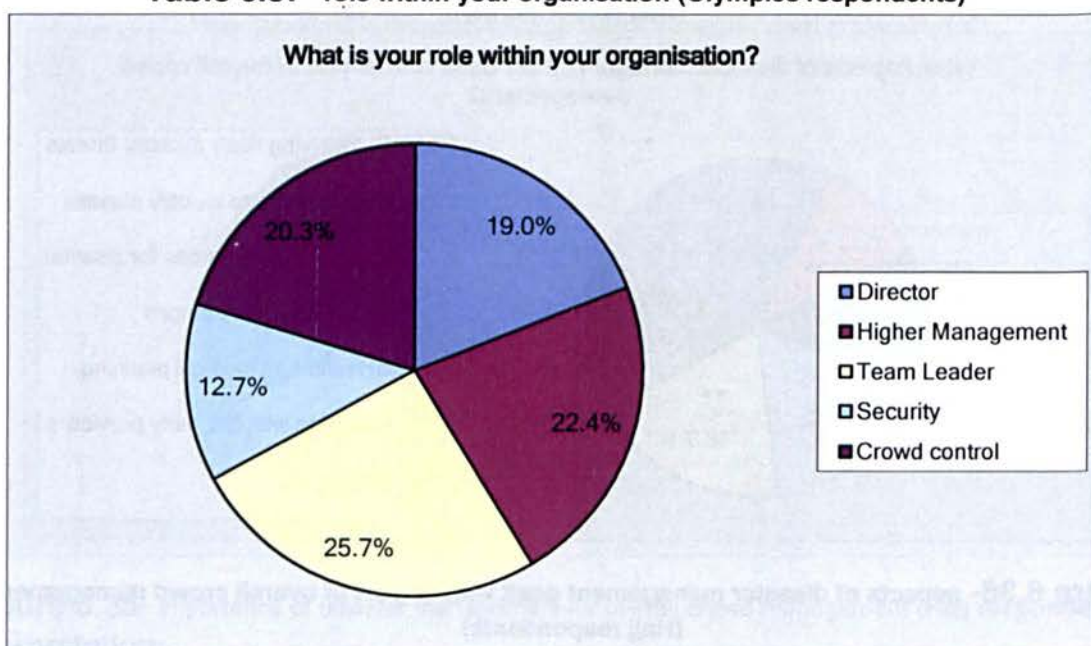


Figure 6.37 role within your organisation (Olympics respondents)

Interpretation:

The first question collected demographic information regarding the role of the respondent in the organization they worked for. 19.0% respondents were Directors, 22.4% belonged to Higher management, 25.7 % were Team Leaders, 12.7% were from

Security and 20.3% were from crowd control. Looking at the Table and Figure 6-37 above .

Question 2:

What type of organisation do you work for?		
Answer Options	Response Percent	Response Count
Event management	11.4%	27
Security management	13.5%	32
Sporting events	18.6%	44
Health and safety	14.8%	35
Fire-fighters	18.1%	43
Traffic	13.5%	32
The Ministry of Health	10.1%	24
answered question		237
skipped question		0

Table 6.38- organisation you work for (Olympics respondents)

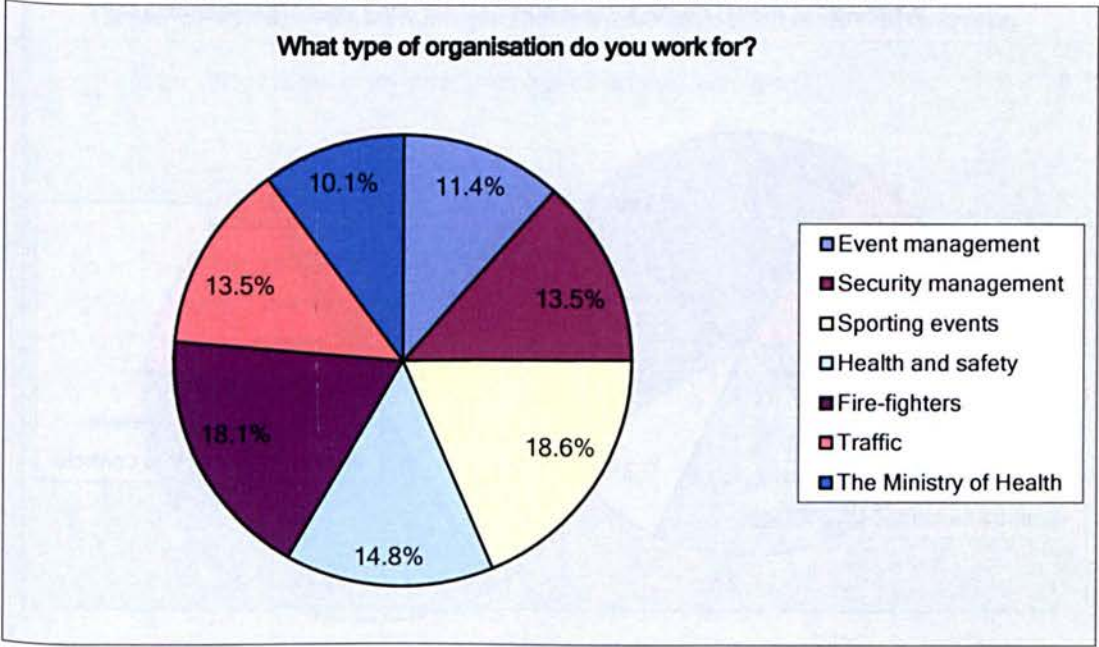


Figure 6.38- organisation you work for (Olympics respondents)

Interpretation:

The second question was about the type of organization the respondents worked for. Highest percentage of respondents (18.6%) was from sporting events, while the lowest among Olympics respondents were from the Ministry of health, which was almost 10.1%. Looking at the Table and Figure 6-38 above .

Part 1: SAFETY

Question 3:

What sort of crowd management approaches does your organisation use?		
Answer Options	Response Percent	Response Count
Ticket control	17.7%	42
Security staff	16.0%	38
Barriers	9.3%	22
Cameras	18.6%	44
Traffic calming	14.3%	34
Changing timing of event	14.8%	35
Using infrastructure controls	9.3%	22
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.39- crowd management approaches your organisation use (Olympics respondents)

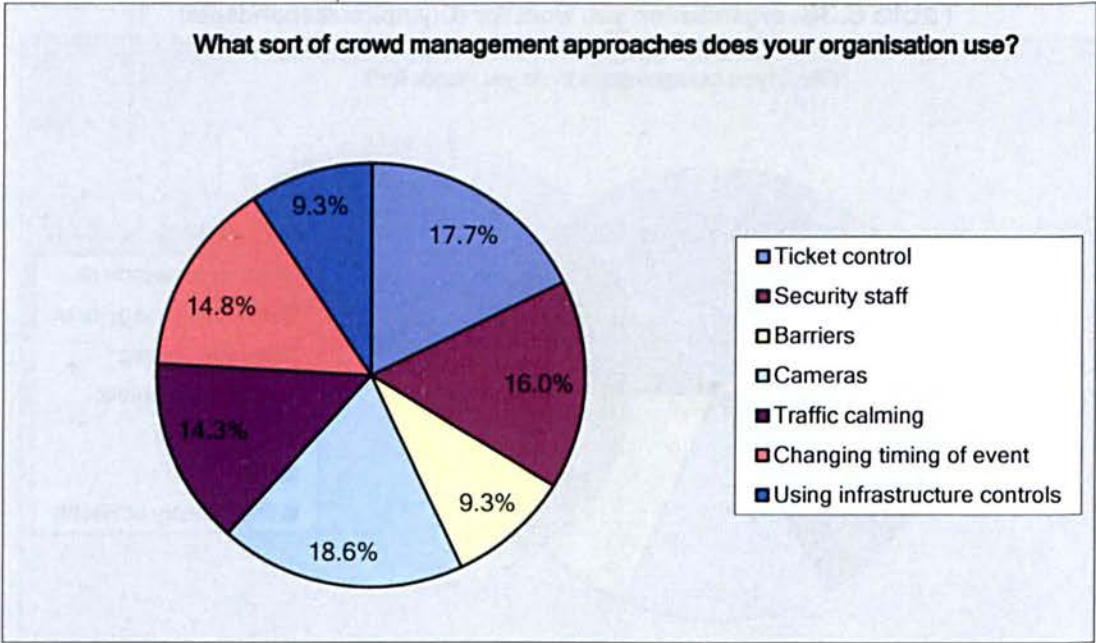


Figure 6.39- crowd management approaches your organisation use (Olympics respondents)
Interpretation:

The third question was about safety measures or approaches of crowd management used by the organization the respondents worked for. The most approach used was ticket control (17.7 %) and the least used was the ‘using infrastructure controls’ which

was 9.3% percent. Other techniques like security staff (16.0%), Barriers (9.3.3%), Cameras (18.6%), Traffic calming (14.3%) and changing timing of event (14.8%). Looking at the Table and Figure 6-39 above .

Question 4:

What is the main crowd management approach used?		
Answer Options	Response Percent	Response Count
Ticket control	10.1%	24
Security staff	12.7%	30
Barriers	18.1%	43
Cameras	24.9%	59
Traffic calming	11.0%	26
Changing timing of event	14.8%	35
Using infrastructure controls	8.4%	20
answered question		237
skipped question		0

Table 6.40- main crowd management approach used (Olympics respondents)

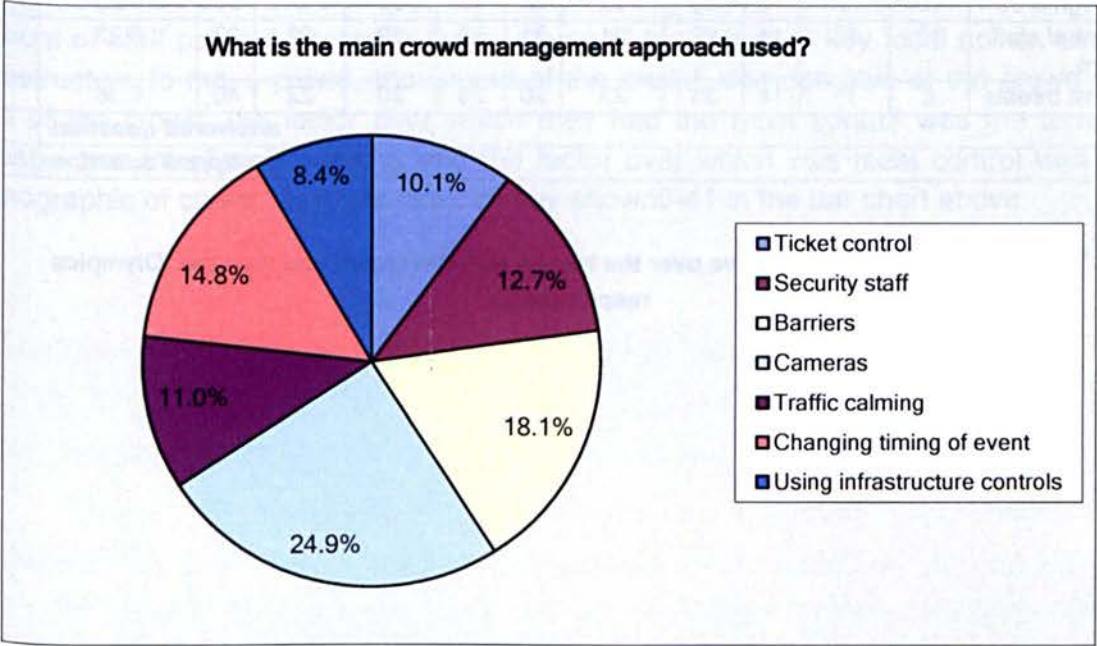


Figure 6.40- main crowd management approach used (Olympics respondents)

Interpretation:

The fourth question was about safety measures or approaches of crowd management used by the organization in the particular event of Olympics. The most approach used

was cameras (24.9%) and the least used was the 'using infrastructure controls' which was 8.4%. The 'changing time off event' (14.8%), Ticket control (10.1%), Barriers (18.1%), Traffic calming (11.0%) and security staff '12.7%'. Looking at the Table and Figure 6-40 above .

Part 2: CROWD CONTROL

Question 5:

On a scale of 1 - 10 (1 being none and 10 being total), how much control Do you have over the following Issues with the crowd you manage?												
Answer Options	1	2	3	4	5	6	7	8	9	10	Rating Average	Response Count
Size of the crowd	9	16	27	21	30	25	33	27	21	28	6.00	237
Demographic of the crowd	9	23	26	30	28	23	32	25	21	18	5.63	235
Movement of the crowd	11	12	20	21	31	38	26	29	24	24	6.07	236
Use of infrastructure to move crowd	8	13	12	20	35	37	42	25	23	20	6.16	235
Timing of the crowd at key focal points	9	11	18	23	33	24	34	33	27	23	6.22	235
Thoroughfares	13	8	18	28	22	24	40	36	17	30	6.23	236
Amount of staff present	13	13	14	22	21	31	28	39	26	23	6.23	230
Terrorist threats	8	15	14	33	23	20	28	30	22	40	6.36	233
answered question												237
skipped question												0

Table 6.41- control you have over the Issues with the crowd you manage (Olympics respondents)

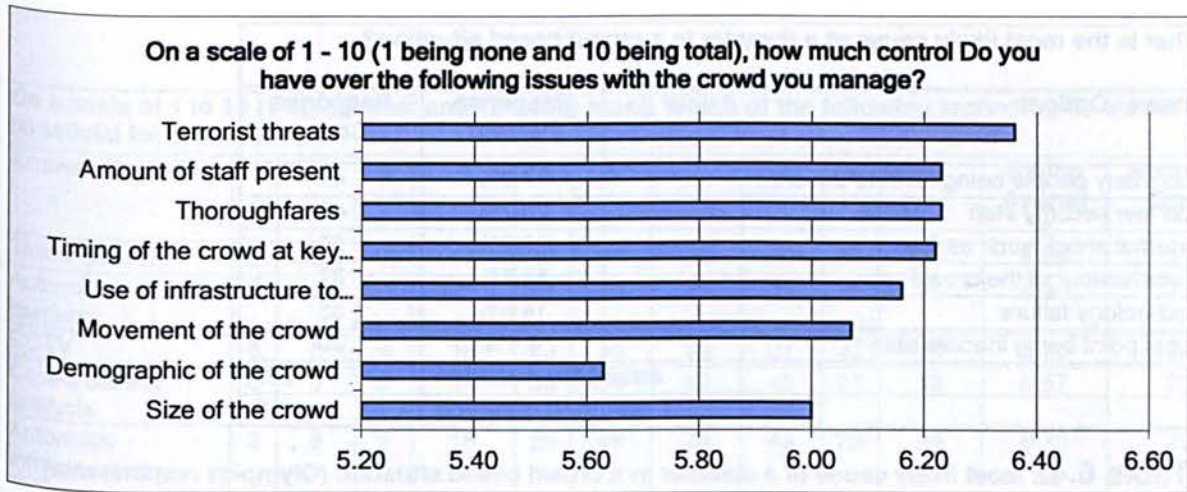


Figure 6.41- - control you have over the issues with the crowd you manage (Olympics respondents)

Interpretation:

The next question was a rating question, which enquired about the control that the respondents had over the crowd at the event. Among many factors like terrorist threats, amount of staff present, thorough fares, timing of the crowd at key focal points, use of infrastructure to move crowd, movement of the crowd, demographic of the crowd and size of the crowd, the factor over which they had the most control was the terrorist threats, amount of staff present, and the factor over which was least control was the demographic of crowd, as it has been clearly shown6-41 in the bar chart above.

Question 6:

What is the most likely cause of a disaster in a crowd based situation?		
Answer Options	Response Percent	Response Count
Too many people being let in to the area	17.3%	41
Too few security staff	20.7%	49
External shock such as fire	23.2%	55
Misbehaviour of the crowd	15.6%	37
Technology failure	14.8%	35
Focal point being inaccessible	8.4%	20
answered question		237
skipped question		0

Table 6.42 most likely cause of a disaster in a crowd based situation (Olympics respondents)

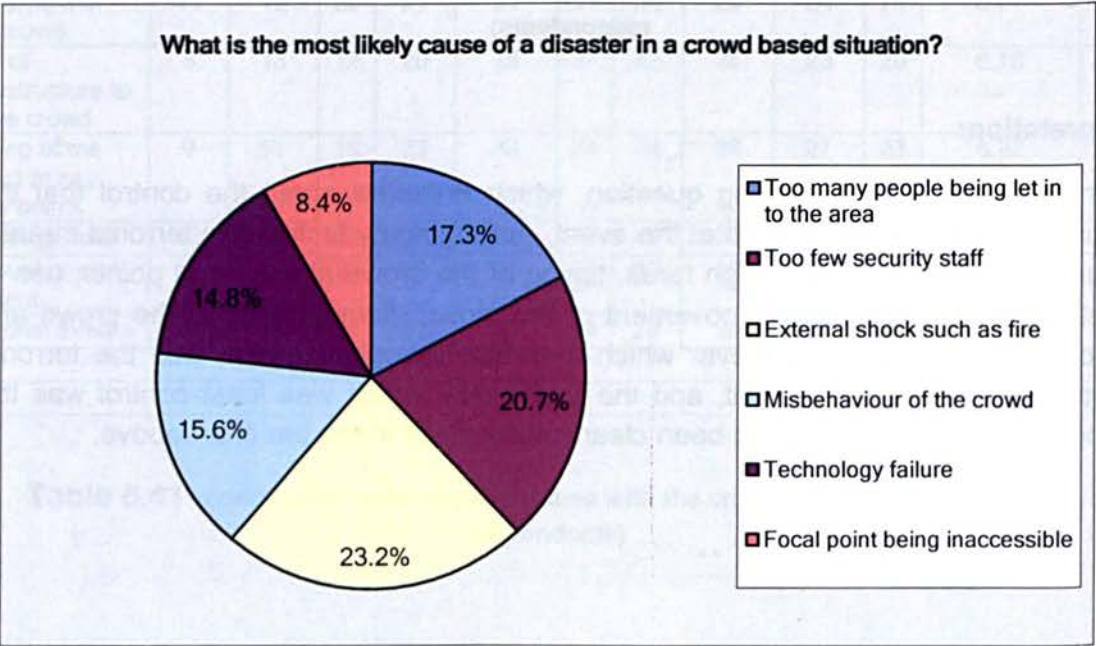


Figure 6.42- most likely cause of a disaster in a crowd based situation (Olympics respondents)
Interpretation:

The next question enquired about the likely cause of a disaster in a crowd based situation. According to responses of the survey the most likely cause of a disaster in a crowd based situation was when there was external shock such as fire (23.2%), too few security staff on the event (20.7%) and there were too many people were being let in to the area (17.3%). The rest of likely reasons of a disaster in a crowd based situation include like misbehavior of the crowd (15.6%), technology failure (14.8%) and focal point being inaccessible (8.4%). Looking at the Table and Figure 6-42 above .

Part 3: TECHNOLOGY

Question 7:

On a scale of 1 to 10 (1 being least and 10 being most) Which of the following technologies would be beneficial for crowd control												
Answer Options	1	2	3	4	5	6	7	8	9	10	Rating Average	Response Count
Ticket control	5	9	12	17	26	37	26	46	33	26	6.69	237
Automatic holding barriers	6	9	18	25	32	25	40	35	26	21	6.30	237
CCTV	8	8	9	19	23	36	35	27	33	39	6.78	237
Crowd density analysis	8	6	9	14	33	34	43	45	27	18	6.57	237
Automatic infrastructure changes	3	9	9	16	26	49	28	43	29	25	6.70	237
Alarms when density increases	6	4	7	23	28	44	35	35	25	30	6.67	237
answered question												237
skipped question												0

Table 6.43- technologies beneficial for crowd control (Olympics respondents)

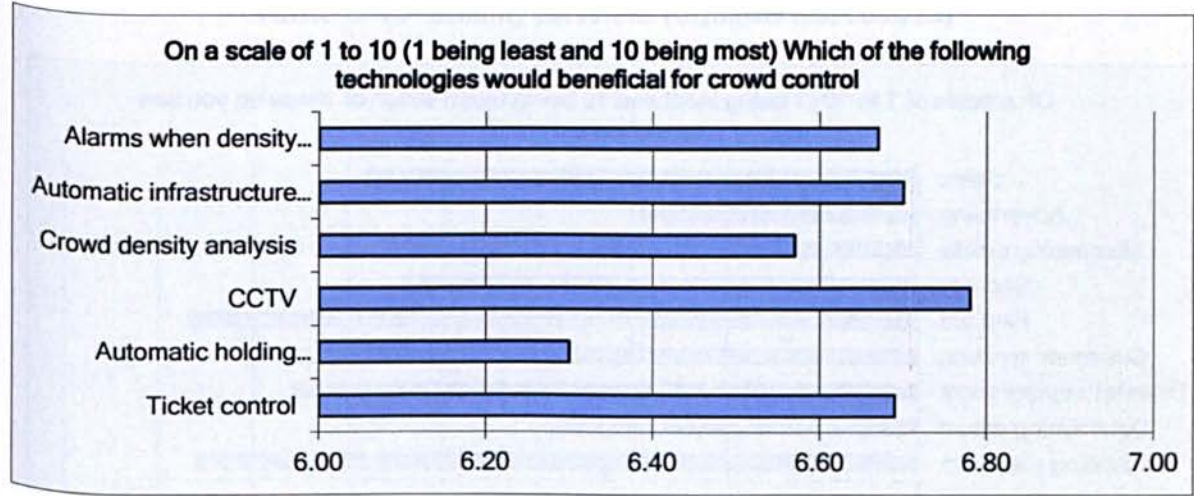


Figure 6.43- technologies beneficial for crowd control (Olympics respondents)

Interpretation:

The next question was a rating question, which enquired about which technologies would be beneficial for crowd control when it comes to a general crowd control. The most rating was achieved by the option of CCTV cameras. 'Automatic infrastructure changes' was the second most thought to be beneficial technology for crowd control. Among other technologies, there was crowd density analysis, alarms when density

increases and ticket control. The automatic holding barriers received the least rating as shown6-43 in the chart above.

Question 8:

On a scale of 1 to 10 (1 being least and 10 being most) which of these do you see as within your role?												
Answer Options	1	2	3	4	5	6	7	8	9	10	Rating Average	Response Count
Planning the event	8	7	7	19	28	38	32	28	33	37	6.76	237
Determining crowd movement	2	17	16	25	27	30	36	23	27	33	6.39	236
Disaster management	5	10	17	11	26	34	40	32	31	31	6.66	237
Customer services	4	8	9	22	32	37	31	32	33	29	6.65	237
First aid	3	8	11	16	30	31	33	35	36	27	6.77	230
Security	9	6	13	27	20	32	40	27	29	32	6.54	235
Maximising profits	7	8	10	26	28	27	29	43	29	27	6.57	234
Advertising	9	8	17	18	35	38	30	30	28	24	6.30	237
Sales	8	15	19	16	25	17	29	34	39	34	6.58	236
answered question												237
skipped question												0

Table 6.44- your role (Olympics respondents)

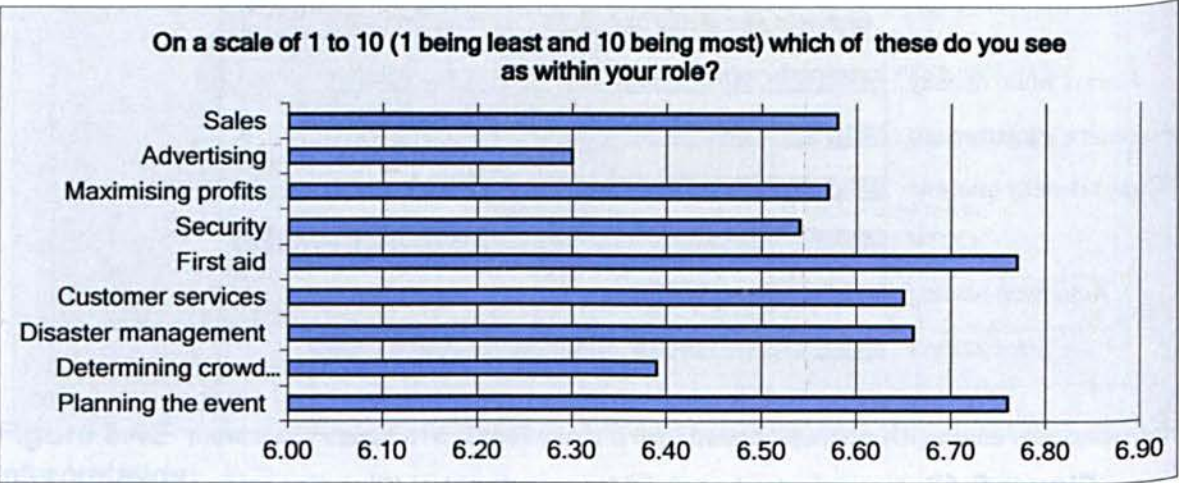


Figure 6.44- your role (Olympics respondents)

Interpretation:

The next question was a rating question, which enquired about which important things these respondents use the most as within their role. The first one is the first aid which received the most rating. It was closely followed by planning of the event, determining

crowd movement, disaster management, customer services, security, first aid, maximizing profits, sales and advertising. The least important factor was determining crowd movement found to be as shown6-44 in the chart above.

Part 4: SECURITY

Question 9:

Which of the following security personnel do you use during crowd management?		
Answer Options	Response Percent	Response Count
Private police	18.6%	44
Private undercover police	20.3%	48
Specialist crowd control teams	24.1%	57
Emergency services only	24.5%	58
No specialist security personnel	12.7%	30
answered question		237
skipped question		0

Table 6.45- security personnel (Olympics respondents)

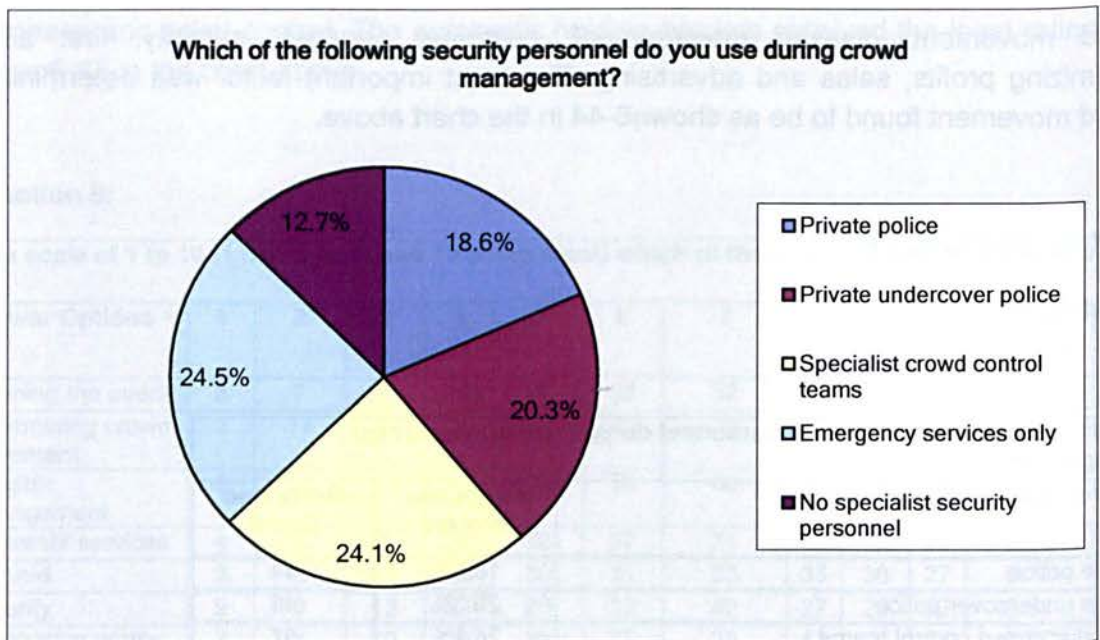


Figure 6.45- security personnel (Olympics respondents)

Interpretation:

The question was about type of security personnel do the respondents use for crowd management. The specialist crowd control teams (24.1%), private police (18.6%), emergency services only (24.5%), private undercover police (20.3%) and no specialist security personnel (12.7%). Looking at the Table and Figure 6-45 above .

Question 10:

How do you decide on the number of security personnel to be employed?		
Answer Options	Response Percent	Response Count
Size of the crowd	22.4%	53
Nature of the event	24.1%	57
Cost of security personnel	21.9%	52
Legal requirements	19.0%	45
Spread of the crowd (geographic)	12.7%	30
answered question		237
skipped question		0

Table 6.46- number of security personnel (Olympics respondents)

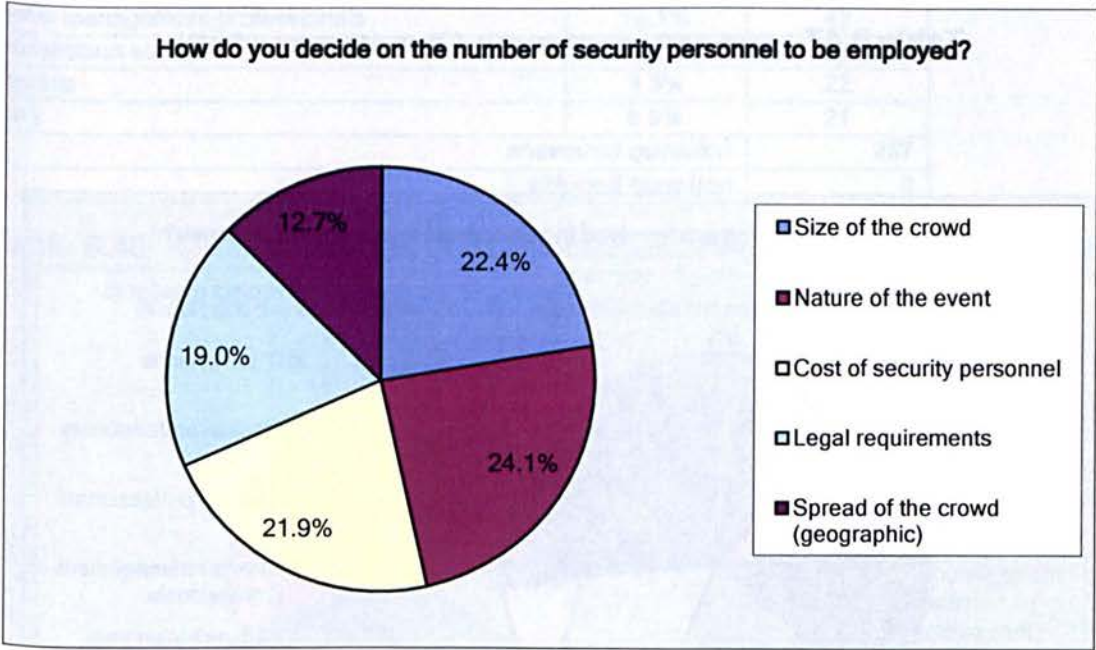


Figure 6.46- number of security personnel (Olympics respondents)

Interpretation:

The question was about how the number of security personnel to be employed was decided. The most method used was nature of the event (24.1%), followed by the cost of security personnel (21.9%), size of the crowd (22.4%), legal requirements (19.0%) and spread of the crowd (12.7%) Looking at the Table and Figure 6-46 above ..

Part 5: PEOPLE

Question 11:

Which of the following are involved in your crowd management process?		
Answer Options	Response Percent	Response Count
Project managers	11.4%	27
IT technicians	15.2%	36
Medical professionals	17.3%	41
Security professionals	19.8%	47
Disaster management professionals	14.3%	34
Administration staff	10.1%	24
Politicians	9.3%	22
Military	2.5%	6
answered question		237
skipped question		0

Table 6.47- crowd management process (Olympics respondents)

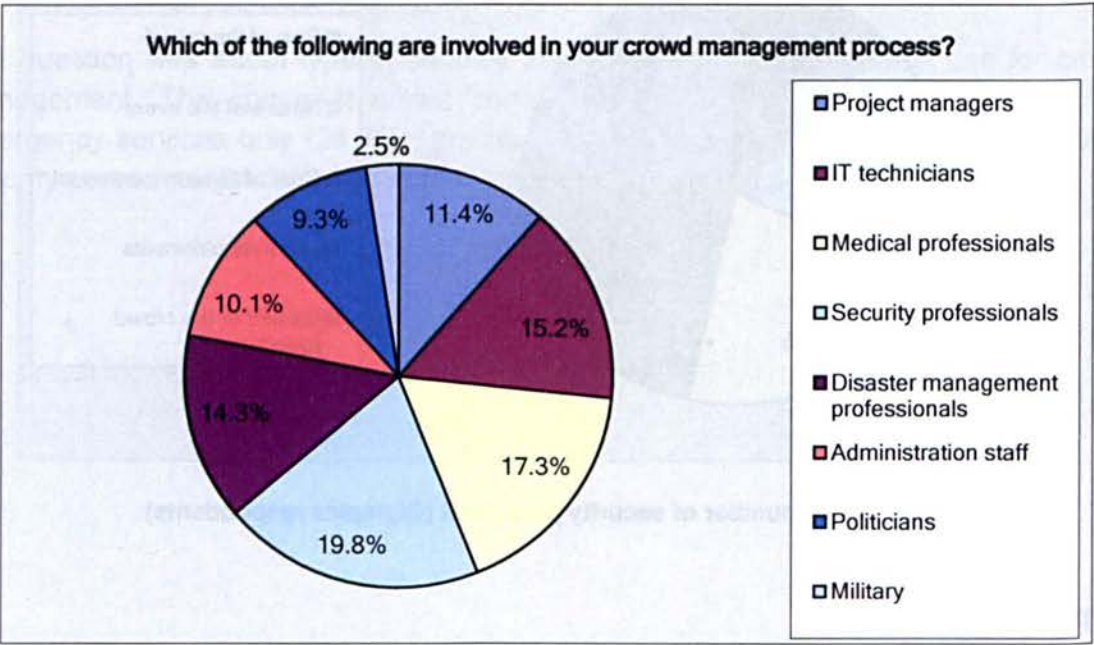


Figure 6.47- crowd management process (Olympics respondents)

Interpretation:

The next question was asked that who are the important officials involved in the crowd management process. According to the survey result, the project managers was selected by (11.4%) and medical professionals (17.3%), closely followed by Disaster management professionals (14.3%), IT technicians (15.2%). Small percentage of respondents opted for administration staff (10.1%), Military (11.4%) and Politicians (9.3%). Looking at the Table and Figure 6-47 above .

Question 12:

Which are the most influential people for the safe management of crowds?		
Answer Options	Response Percent	Response Count
Project managers	9.3%	22
IT technicians	8.4%	20
Medical professionals	16.9%	40
Security professionals	16.9%	40
Disaster management professionals	18.1%	43
Administration staff	12.2%	29
Politicians	9.3%	22
Military	8.9%	21
answered question		237
skipped question		0

Table 6.48- most influential people for the safe management of crowds (Olympics respondents)

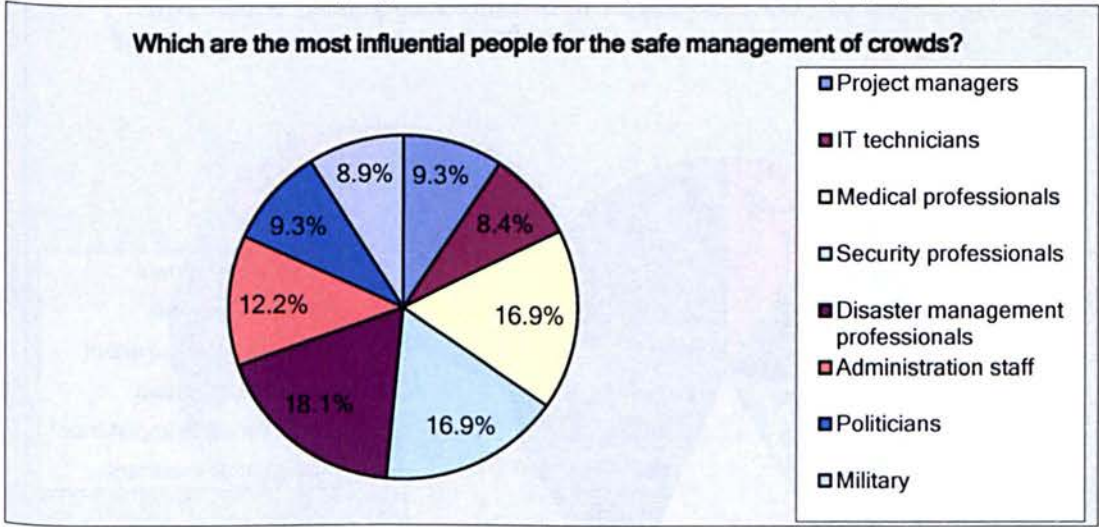


Figure 6.48- most influential people for the safe management of crowds (Olympics respondents)

Interpretation

The next question was asked that which are the most influential people for the safe management of crowds. According to the survey result, the project managers were

(9.3%) and medical professionals (16.9%), closely followed by Disaster management professionals (18.1%), IT technicians (8.4%). Small percentage of respondents opted for administration staff (12.2%), Military (8.9%) and Politicians (9.3%). Looking at the Table and Figure 6-48 above .

Part 6: ENVIRONMENTAL ISSUES

Question 13:

How relevant are environmental issues to crowd management and planning?		
Answer Options	Response Percent	Response Count
Vitally important	27.0%	64
Very important	16.5%	39
Moderately important	14.8%	35
A little important	13.9%	33
Of very little importance	17.7%	42
Not at all important	10.1%	24
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.49- environmental issues related to crowd management and planning (Olympics respondents)

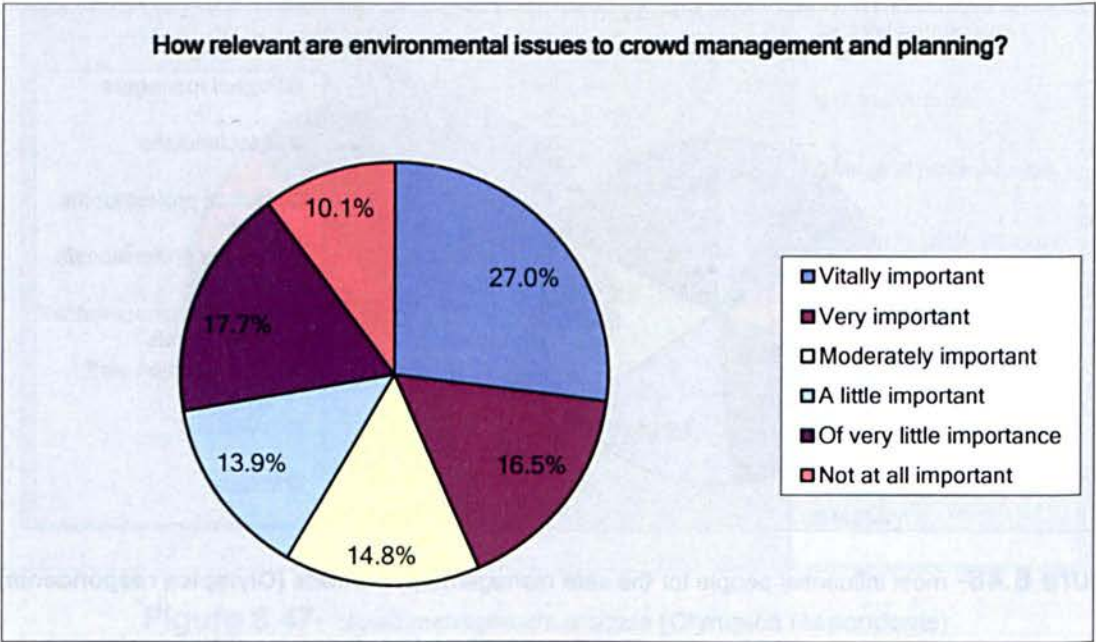


Figure 6.49- environmental issues related to crowd management and planning (Olympics respondents)

Interpretation:

The next question was about the relevance of environmental issues to crowd management and planning. Almost 27.0% of the people though that the environmental issues were vitally important. Most of the responses were positive and only 10.1% thought that it were not at all important. Looking at the Table and Figure 6-49 above .

Question 14:

Which of the following environmental issues are relevant to your crowd management?		
Answer Options	Response Percent	Response Count
Human waste	12.2%	29
Noise pollution	19.0%	45
Water pollution	16.9%	40
Air pollution	20.7%	49
Whatever the law requires	17.3%	41
Refuse generated	13.9%	33
answered question		237
skipped question		0

Table 6.50- environmental issues related to your crowd management and planning (Olympics respondents)

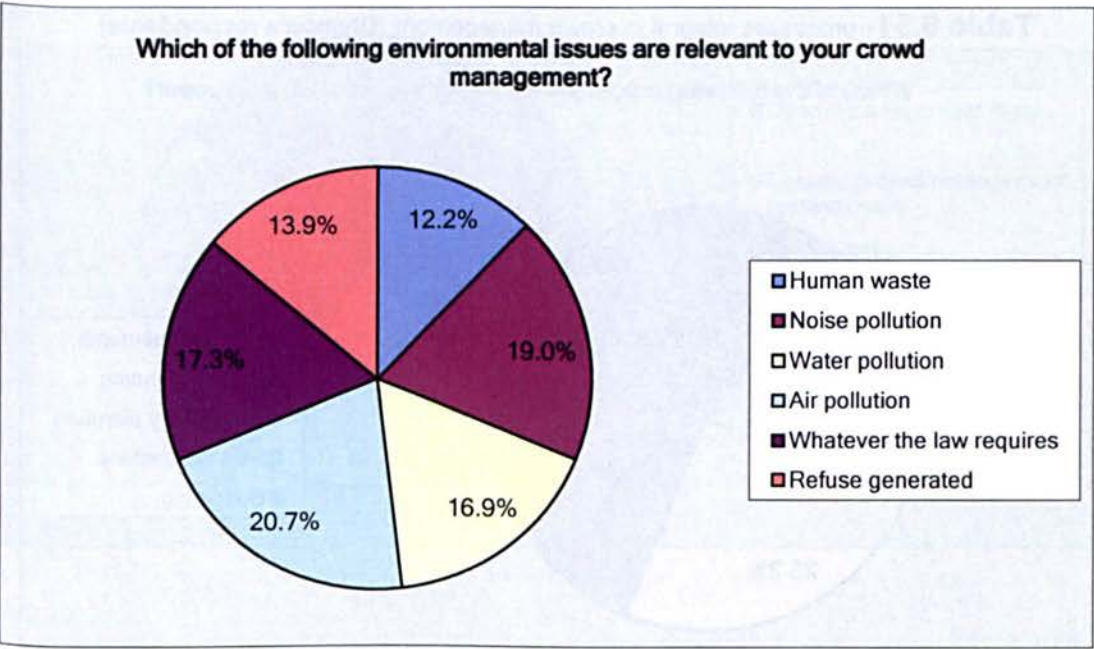


Figure 6.50- environmental issues related to your crowd management and planning (Olympics respondents)

Interpretation:

The next question was about the important environmental issues that are relevant to crowd management. The most important issue was human waste (12.2%), and other issues whatever the law requires (17.3%), noise pollution (19.0%) and air pollution (20.7%). The least was refuse generated (13.9%) and the least percentage was attained by water pollution (16.9%). Looking at the Table and Figure 6-50 above .

Part 7: PROJECT AND RISK MANAGEMENT

Question 15:

Which of the following processes are integral to crowd management?		
Answer Options	Response Percent	Response Count
Risk assessments	20.7%	49
Project planning	23.2%	55
Emergency planning	25.3%	60
Risk simulations	20.3%	48
Budgeting	10.5%	25
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.51- processes integral to crowd management (Olympics respondents)

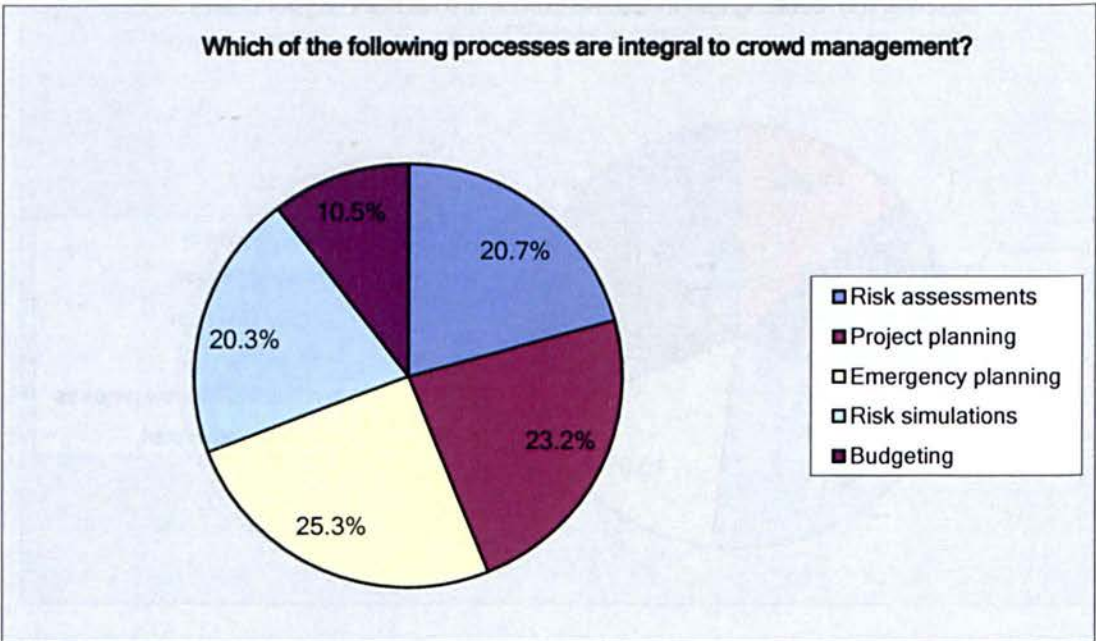


Figure 6.51- processes integral to crowd management (Olympics respondents)

Interpretation:

The next question was about the following processes that are integral to crowd management. According to the results of the survey, the project planning achieved 23.2%, which was followed by risk assessments to be 20.7%, risk simulations to be 20.3%, emergency planning to be 25.3% and budgeting to be 10.5%. Looking at the Table and Figure 6-51 above .

Question 16:

Whose responsibility is project and risk management?		
Answer Options	Response Percent	Response Count
Overall management team	16.9%	40
Specific project management professionals	21.9%	52
Private police	20.3%	48
Security professionals	26.2%	62
Depends on the area of risk	14.8%	35
answered question		237
skipped question		0

Table 6.52- project and risk management (Olympics respondents)

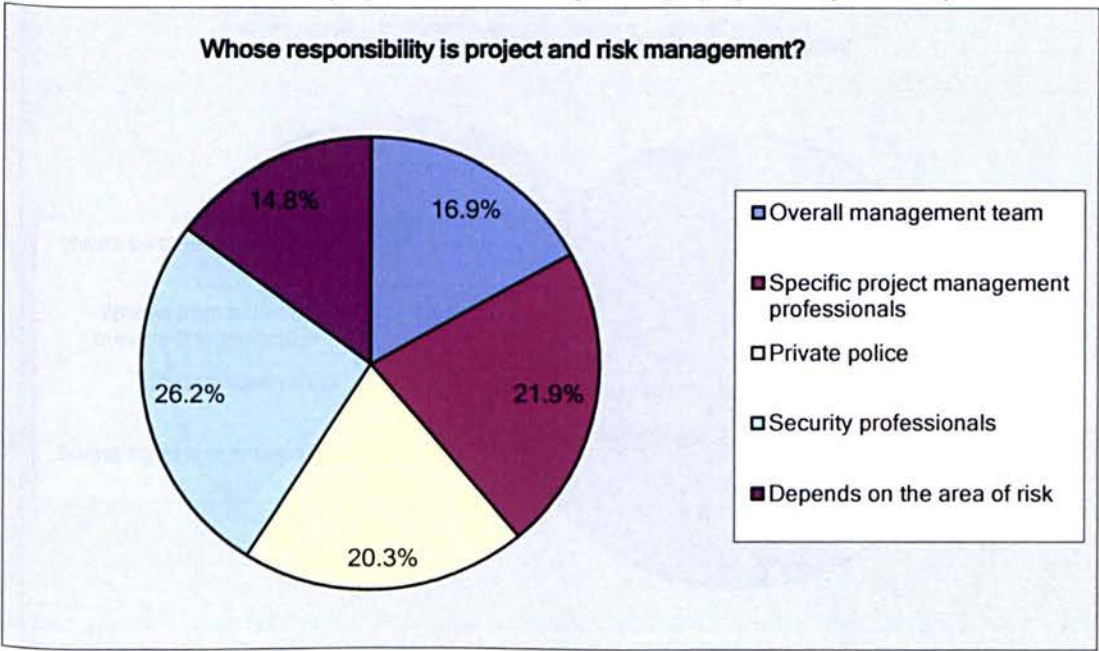


Figure 6.52- project and risk management (Olympics respondents)

Interpretation:

The next question enquired about the responsibility of the project and risk management. Specific project management professionals were found to be 21.9%, security

professionals (26.2%), private police (20.3%), the next selected option was 'depends on the area of risk, (14.8%) and overall management team was found to be (16.9%). Looking at the Table and Figure 6-52 above .

Part 8: EVENT MANAGEMENT

Question 17:

What is the main aim of event management?		
Answer Options	Response Percent	Response Count
To maintain crowd safety	24.1%	57
To make sure overall efficiency of the event	33.8%	80
To make a profit	25.3%	60
To achieve a large crowd	16.9%	40
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.53- main aim of event management (Olympics respondents)

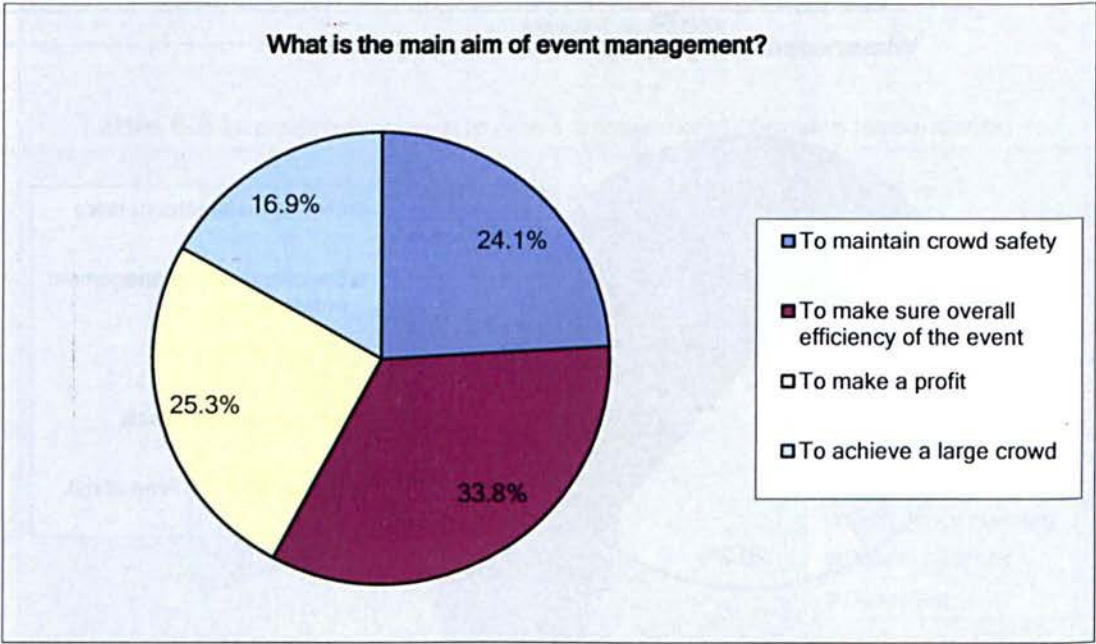


Figure 6.53- main aim of event management (Olympics respondents)

Interpretation:

The next question was about the main aim of event management. According to the responses of survey, the selected option was to maintain crowd safety (24.1%), the second selected option was to make sure of the overall efficiency of the event by

(33.8%), to make a profit (25.3%) and the least selected option was to achieve a large crowd (16.9%). Looking at the Table and Figure 6-53 above .

Question 18:

How important is event management to crowd safety?		
Answer Options	Response Percent	Response Count
Vitally important	26.2%	62
Very important	17.7%	42
Moderately important	18.1%	43
A little important	17.7%	42
Of very little importance	14.3%	34
Not at all important	5.9%	14
answered question		237
skipped question		0

Table 6.54- main aim of event management (Olympics respondents)

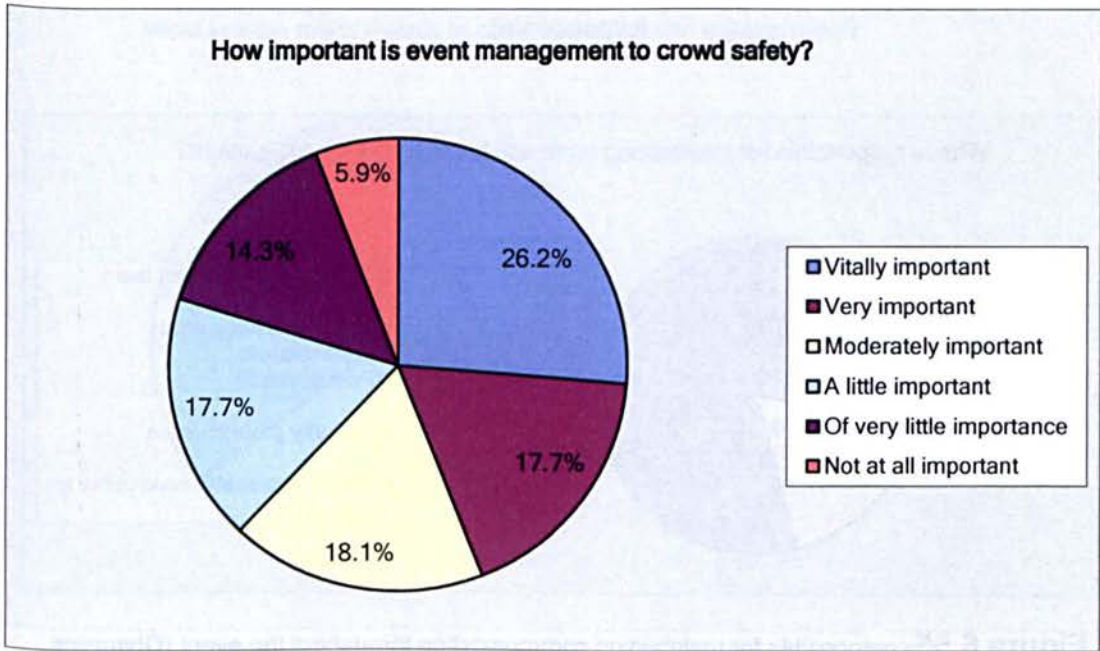


Figure 6.54- main aim of event management (Olympics respondents)

Interpretation:

The next question was about what respondents thought how important event management to crowd safety was. Most of the respondents gave a positive response, almost 26.2% said that they thought it was vitally important, 17.7% was very important, 18.1% said that it was moderately important, whereas only 17.7% thought it was of a

little importance, 14.3% thought that it was of very little importance and 5.9% said that it was not at all important. Looking at the Table and Figure 6-54 above .

Part 9: COMMUNICATION AND COLLABORATION

Question 19

Who is responsible for maintaining communication throughout the event?		
Answer Options	Response Percent	Response Count
Overall management team	26.2%	62
Project management professionals	27.8%	66
Private police	17.7%	42
Security professionals	16.9%	40
All professionals responsible for own area	11.4%	27
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.55- responsible for maintaining communication throughout the event (Olympics respondents)

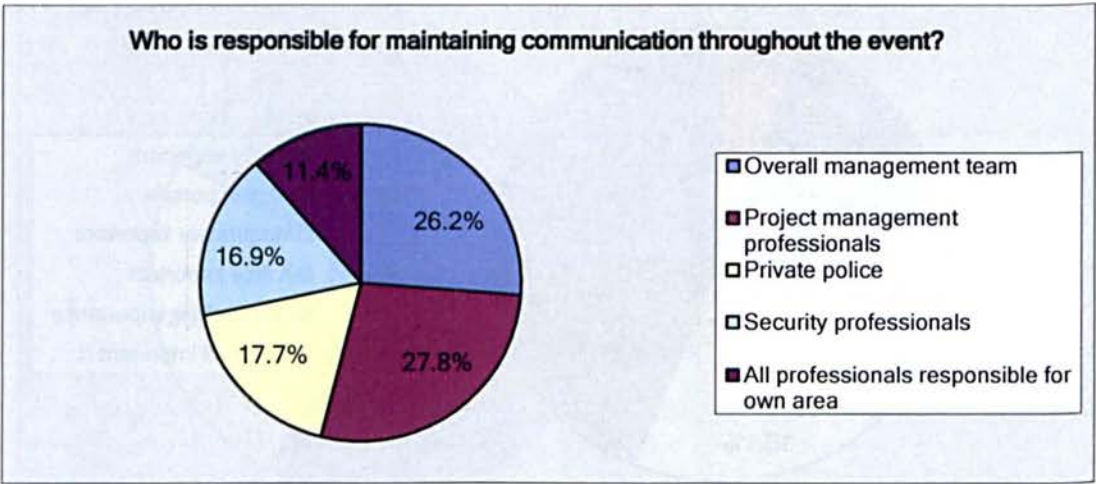


Figure 6.55- responsible for maintaining communication throughout the event (Olympics respondents)

Interpretation:

The next question was about what respondents thought that who is responsible for maintaining communication throughout the event. According to the results of the survey, the most important was the project management professionals which was

33.3%, overall management team was (24.4%), private police (15.1%), security professionals (13.8%) and the least percentage was achieved by all professionals responsible for own area (13.3%). Looking at the Table and Figure 6-55 above .

Question 20

What are the major threats to communication and collaboration?		
Answer Options	Response Percent	Response Count
Breakdown of IT	19.8%	47
Too many managers	21.9%	52
Conflict between the teams	22.8%	54
Lack of systems	21.9%	52
Too much bureaucracy	13.5%	32
answered question		237
skipped question		0

Table 6.56- major threats to communication and collaboration (Olympics respondents)

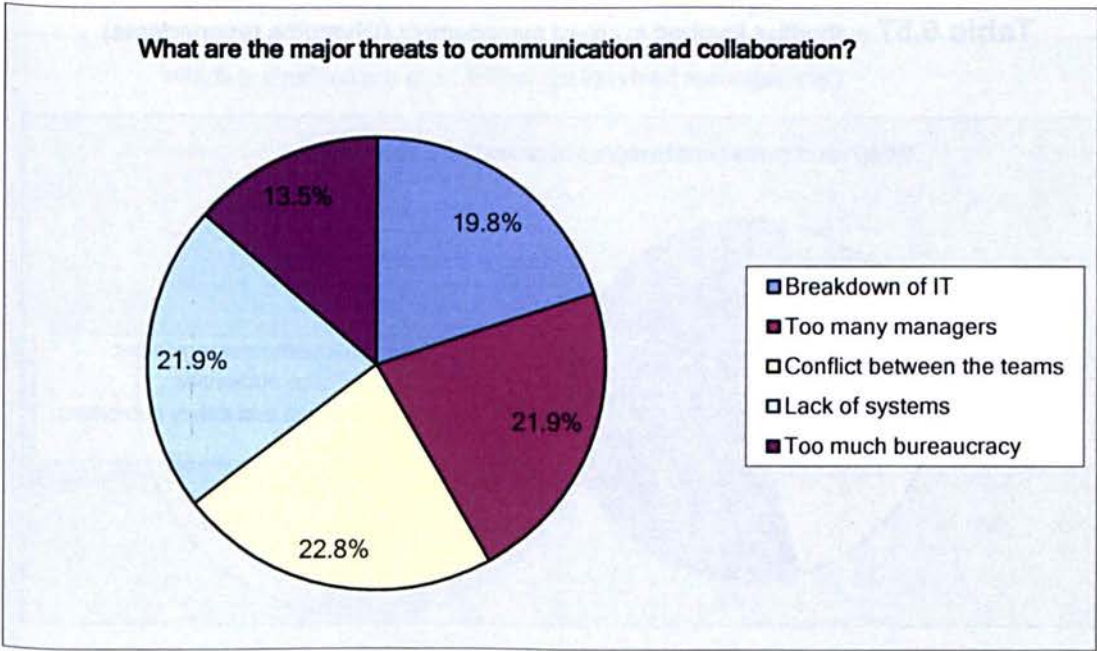


Figure 6.56- major threats to communication and collaboration (Olympics respondents)

Interpretation:

The next question in the communication and collaboration was about the major threats to communication and collaboration. The most identified threat by the respondents was that if there are too many managers (21.9%) and conflict between the teams (22.8%).

19.8% of the respondents thought that break down of IT could be a major threat to communication and collaboration. 21.9 % thought that lack of systems altogether could be a reason or threat to communication and collaboration. And 13.5% thought that too much bureaucracy was a reason or threat to communication and collaboration at the event. Looking at the Table and Figure 6-56 above .

Part 10: AUTHORITIES

Question 21

Which authorities are involved in crowd management?		
Answer Options	Response Percent	Response Count
Government regulators	26.6%	63
Police authorities	27.8%	66
Health and safety authorities	31.2%	74
None	14.3%	34
answered question		237
skipped question		0

Table 6.57 authorities involved in crowd management (Olympics respondents)

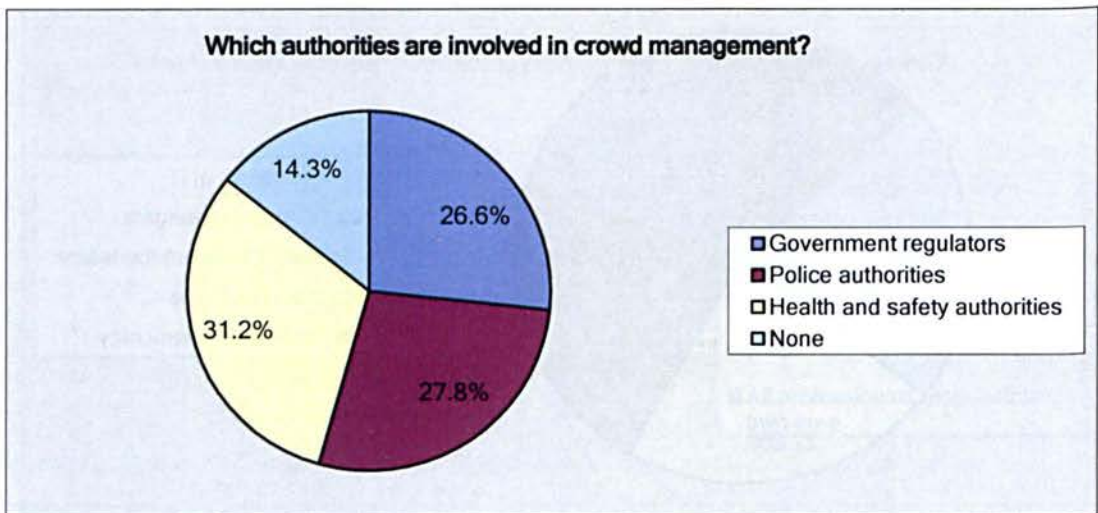


Figure 6.57- authorities involved in crowd management (Olympics respondents)

Interpretation:

The next section of the questionnaire enquired about the authority. According to the responses of the survey, the most involved authorities were government regulators as voted by 26.6% of the people. 27.8% of the people thought that the police authorities were also involved in crowd management. 31.2% of the respondents thought that the

health and safety authorities while 14.3% of the respondents thought that none of these were important. Looking at the Table and Figure 6-57 above .

Question 22

Which authorities are most influential to crowd management?		
Answer Options	Response Percent	Response Count
Government regulators	24.5%	58
Police authorities	28.7%	68
Health and safety authorities	30.4%	72
None	16.5%	39
answered question		237
skipped question		0

Table 6.58- authorities most influential to crowd management (Olympics respondents)

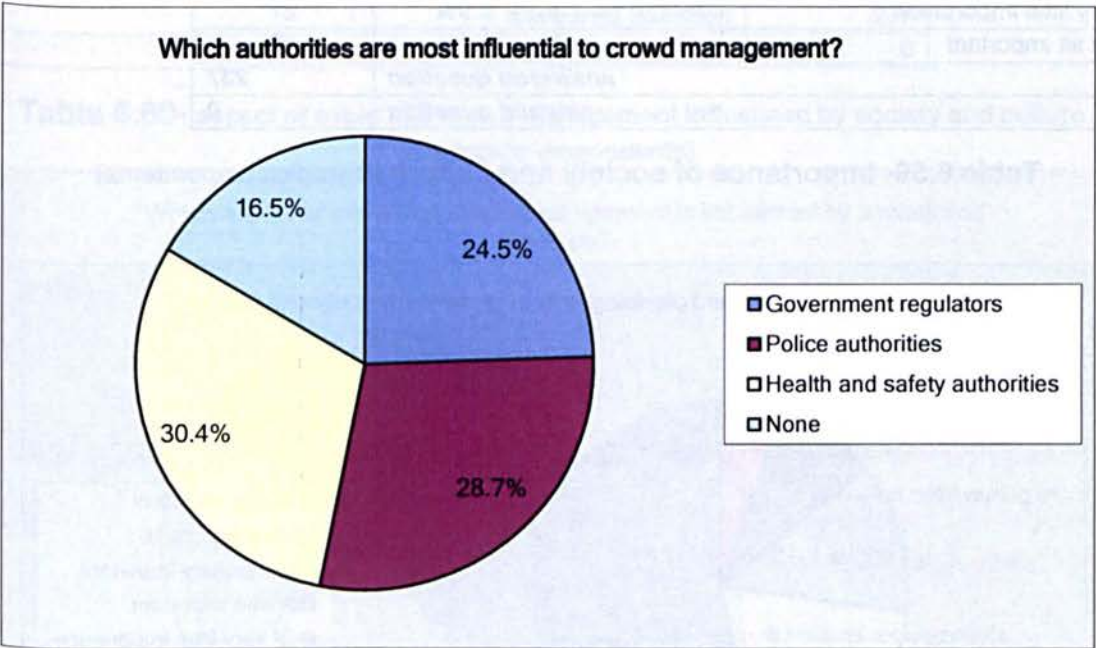


Figure 6.58 authorities most influential to crowd management (Olympics respondents)

Interpretation:

The next section of the questionnaire enquired about the authority that is most influential to crowd management. According to the responses of the survey, the health and safety authorities were thought to be the most influential as voted by 30.4% of the people. 28.7% of the people thought that police authorities each were most influential to crowd management followed by government regulators (24.5%). Looking at the Table and Figure 6-58 above .

Part 11: SOCIETY AND CULTURE

Question 23

When undertaking crowd planning how important is society and culture?		
Answer Options	Response Percent	Response Count
Vitally important	31.6%	75
Very important	21.9%	52
Moderately important	19.4%	46
A little important	13.1%	31
Of very little importance	8.9%	21
Not at all important	5.1%	12
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.59- importance of society and culture (Olympics respondents)

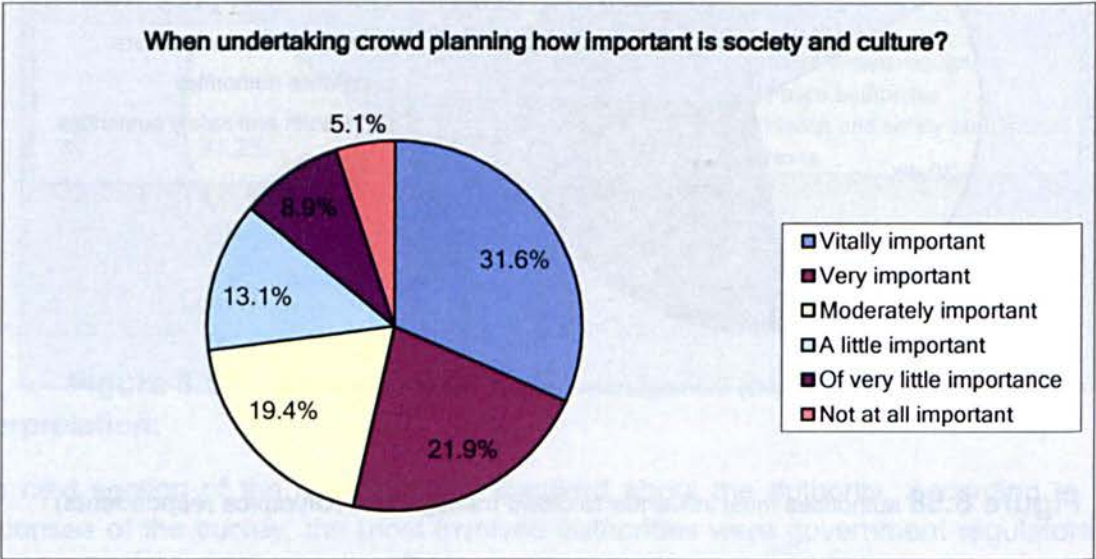


Figure 6.59- importance of society and culture (Olympics respondents)

Interpretation:

The next section of the questionnaire enquired society and culture. The first question was when undertaking crowd planning how important was society and culture. Almost 50% thought that it was vitally or very important. 19.4% said it was moderately important, whereas almost 26% thought it was less important, which was very less in comparison to the positive response of the people. Looking at the Table and Figure 6-59 above .

Question 24

Which aspect of event and crowd management is influenced by society and culture?		
Answer Options	Response Percent	Response Count
The crowd demographic	20.7%	49
The willingness to follow instructions	19.8%	47
The level of calm during an emergency	23.6%	56
The use of infrastructure	21.5%	51
Medical requirements	10.1%	24
None	4.2%	10
answered question		237
skipped question		0

Table 6.60- aspect of event and crowd management influenced by society and culture (Olympics respondents)

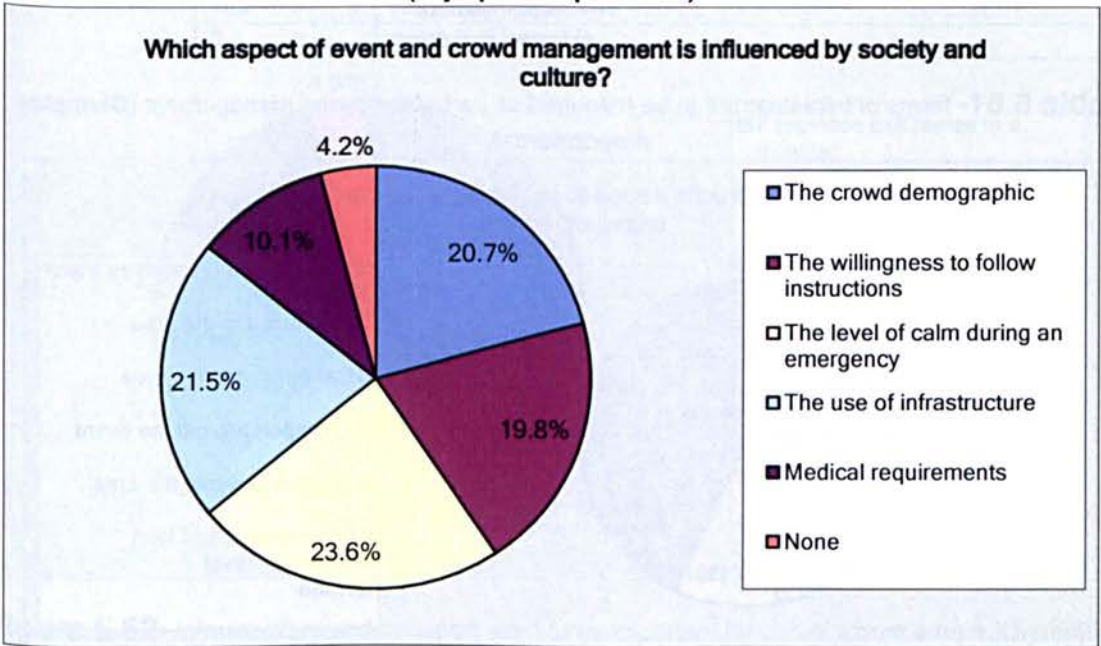


Figure 6.60- aspect of event and crowd management influenced by society and culture (Olympics respondents)

Interpretation:

The next section of the questionnaire enquired about what aspects of the event and crowd management was influenced by society and culture. The crowd demographics (20.7%) and the level of calm during an emergency (23.6%), was found to be the most influential factors. The use of infrastructure (21.5%) was next. 19.8% thought that willingness to follow instructions was the most influential, 10.1% thought that medical requirements was the most influential and 4.2% thought that none of these factors were influential. Looking at the Table and Figure 6-60 above .

Part 12: INFRASTRUCTURE AND TRANSPORT

Question 25

Which forms of infrastructure need to be managed as part of the crowd management?		
Answer Options	Response Percent	Response Count
Public transport such as trains and buses	27.8%	66
Car routes to the area	15.2%	36
Car parking in the area	10.1%	24
Transport around the event	21.1%	50
Walkways within the area	16.5%	39
International and long distance travel	7.6%	18
None	1.7%	4
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.61- forms of infrastructure to be managed as part of the crowd management (Olympics respondents)

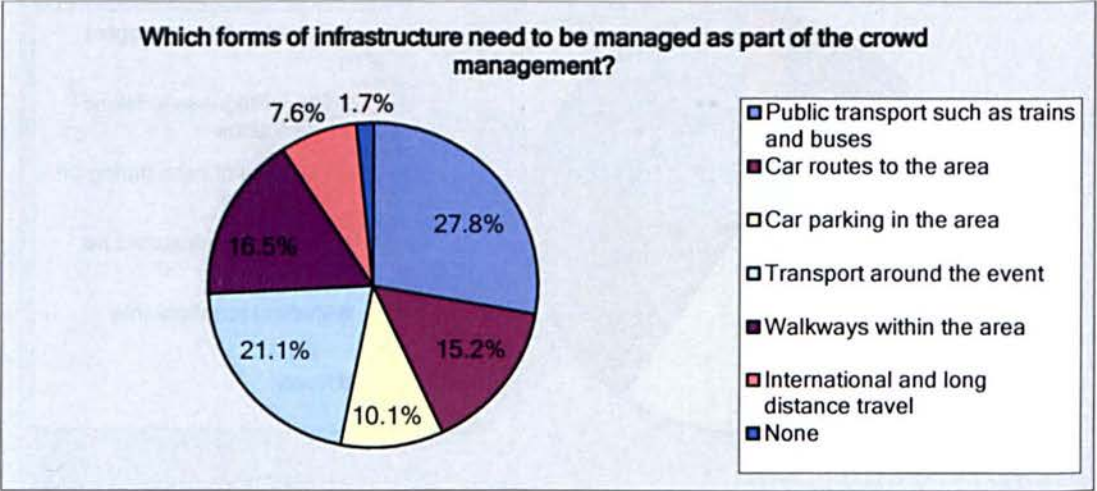


Figure 6.61- forms of infrastructure to be managed as part of the crowd management

Interpretation: The next section of the questionnaire enquired about the forms of infrastructure need to be managed as part of the crowd management. 27.8% thought that it was public transport such as trains and buses. 15.2% thought that it was car routes to the area. 10.1% thought that it was car parking in the area. 21.1% voted for transport around the event, 16.5% thought that it was the walkways within the area and 7.6% thought that it was international and long distance travel. Looking at the Table and Figure 6-61 above .

Question 26

Why is infrastructure and transport seen to be important for crowd management?		
Answer Options	Response Percent	Response Count
It provides exit routes in a disaster	13.5%	32
Ensures lack of crowding at pressure points	27.4%	65
Encourages people to visit the event	20.7%	49
Allows people to be tracked and followed	20.3%	48
Opportunity for greater revenue	13.5%	32
None	4.6%	11
answered question		237
skipped question		0

Table 6.62- infrastructure and transport seen to be important for crowd management (Olympics respondents)

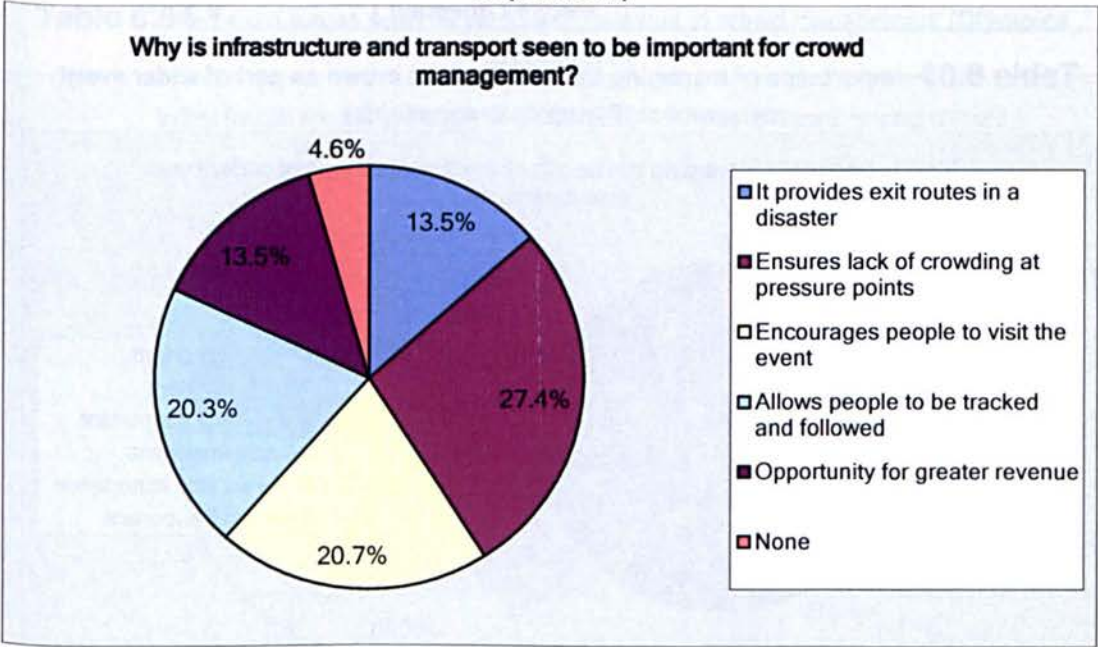


Figure 6.62- infrastructure and transport seen to be important for crowd management (Olympics respondents)

Interpretation:

The next section of the questionnaire enquired about the importance of infrastructure and transport to be important for crowd management. About 27.4% said that it was because it ensures lack of crowding at pressure points, 20.7% said that it was because it encourages people to visit the event, 20.3% said that it was because it allows people to be tracked and followed, 13.5% thought that it was because it was an opportunity for greater revenue, whereas only 4.6% said that none of these factors were important. Looking at the Table and Figure 6-62 above .

Part 13: HEALTH

Question 27

How important is managing the health of the crowd as part of wider event management?		
Answer Options	Response Percent	Response Count
Vitally important	40.1%	95
Very important	21.5%	51
Moderately important	13.9%	33
A little important	10.5%	25
Of very little importance	9.7%	23
Not at all important	4.2%	10
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.63- importance of managing the health of the crowd as part of wider event management (Olympics respondents)

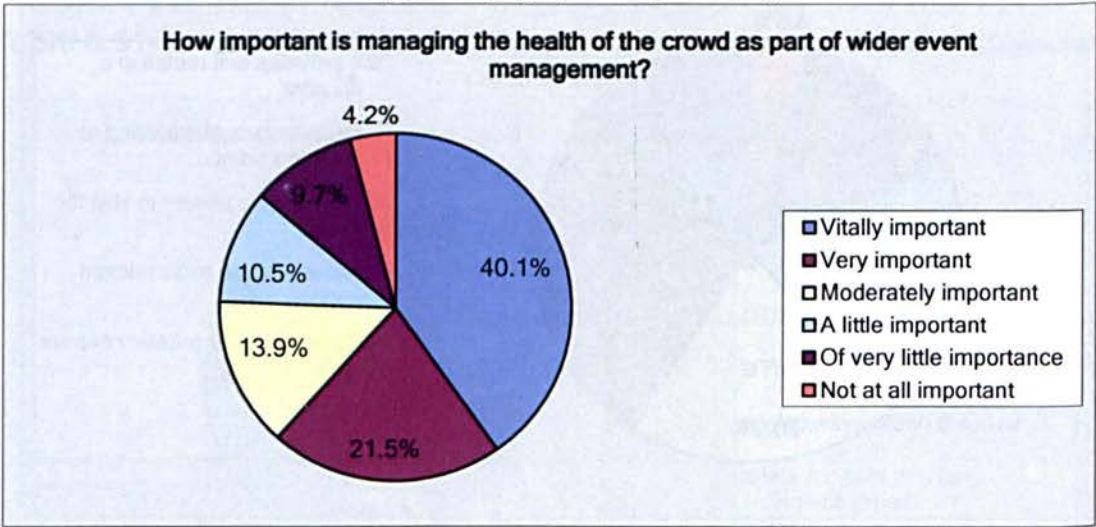


Figure 6.63- importance of managing the health of the crowd as part of wider event management (Olympics respondents)

Interpretation:

The next section of the questionnaire enquired about the importance of managing health of the crowd as part of wider event management. More than 50% of the respondents gave a positive response and thought that it was very important. 13.9% of the respondents thought that it was moderately important. Rest of the respondents thought that it was either very little or not important at all. Looking at the Table and Figure 6-63 above .

Question 28

What health issues are seen as particularly relevant to crowd management?		
Answer Options	Response Percent	Response Count
Injuries through crushes	19.8%	47
Illness and injury whilst attending event	21.5%	51
Contamination across attendees	16.5%	39
External threats such as terrorism	18.6%	44
Natural threats such as flooding	16.5%	39
None	7.2%	17
answered question		237
skipped question		0

Table 6.64- health issues seen as particularly relevant to crowd management (Olympics respondents)

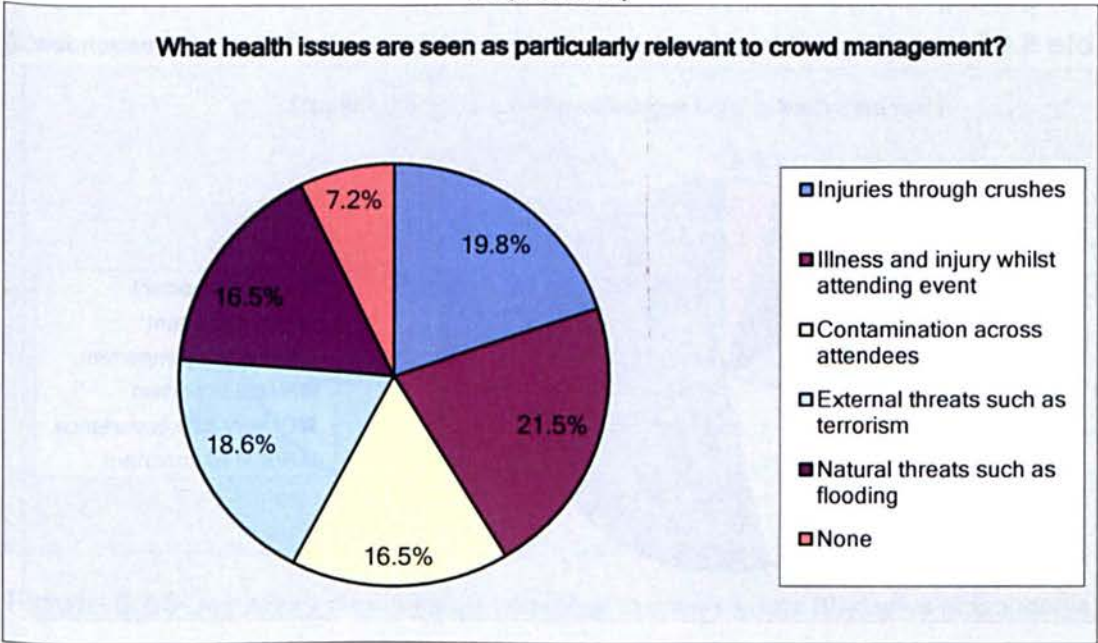


Figure 6.64 health issues seen as particularly relevant to crowd management (Olympics respondents)

Interpretation: The next section of the questionnaire enquired about the health issues that are particularly relevant to crowd management. Almost 19.8% of the respondents thought that injuries through crushes were particularly relevant to crowd management. 21.5% of the respondents thought that illness and injury while attending the event was relevant. 16.5% thought that contamination across attendees was important, where as external threats such as terrorism was thought by 18.6%, 16.5% thought that natural threats such as flooding was thought important where as only 7.2% thought that none of this was important. Looking at the Table and Figure 6-64 above .

Part 14: LEGAL AND REGULATORY

Question 29

How important is legal regulation when planning an event?		
Answer Options	Response Percent	Response Count
Vitally important	31.6%	75
Very important	21.9%	52
Moderately important	17.7%	42
A little important	12.2%	29
Of very little importance	11.8%	28
Not at all important	4.6%	11
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.65- importance of legal regulation when planning an event (Olympics respondents)

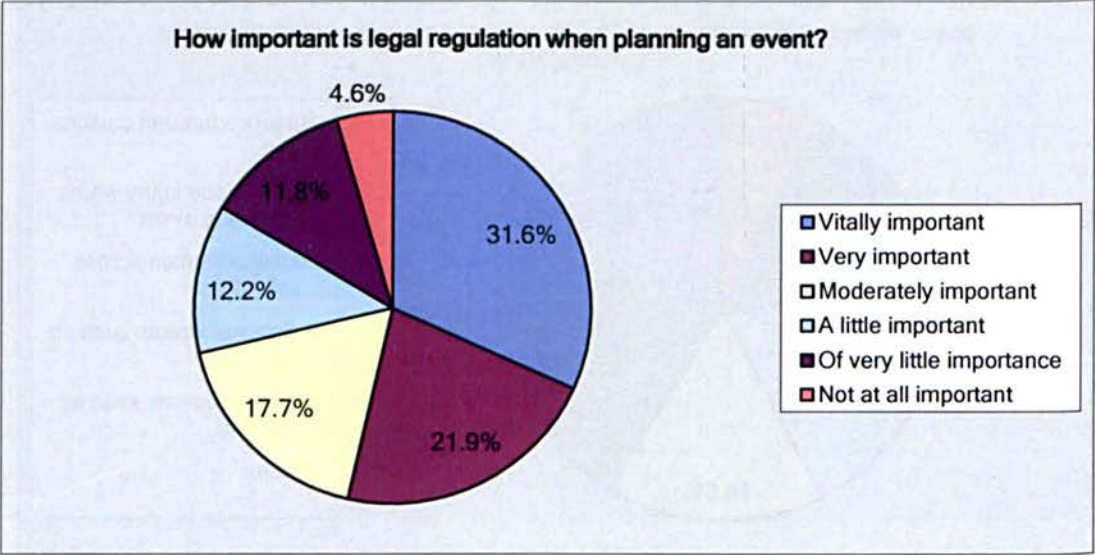


Figure 6.65- importance of legal regulation when planning an event (Olympics respondents)

Interpretation:

The next section of the questionnaire enquired about how important is the legal regulations when there is a planning of an event. 31.6% opted for vitally important and 21.9% opted for very important, 17.7% opted for moderately important, 12.2% opted for a little important, 11.8% opted for of very little importance, and 4.6% thought that it was not important at all. Looking at the Table and Figure 6-65 above .

Question 30

Do you feel that regulatory requirements are beneficial to crowd safety?		
Answer Options	Response Percent	Response Count
Yes – incredibly	25.7%	61
Yes – slightly	25.3%	60
Moderately	24.5%	58
Rarely	18.6%	44
Never	5.9%	14
answered question		237
skipped question		0

Table 6.66- regulatory requirements beneficial to crowd safety (Olympics respondents)

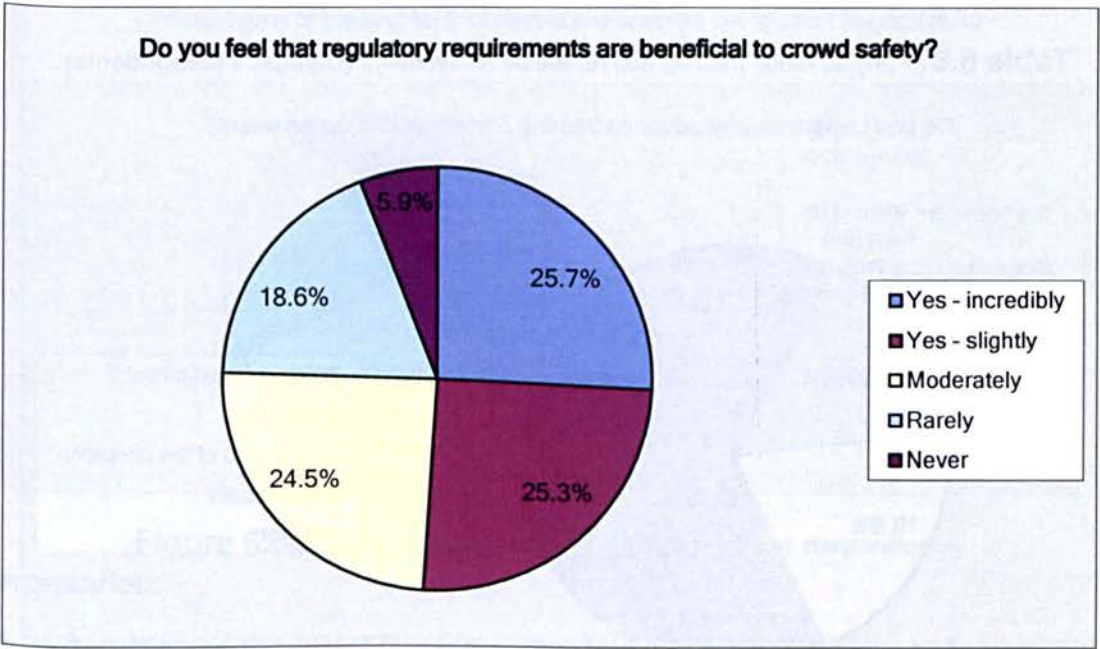


Figure 6.66- regulatory requirements beneficial to crowd safety (Olympics respondents)

Interpretation:

The next section of the questionnaire enquired about how beneficial was the regulatory requirements to crowd safety. Most of the respondents thought that incredibly yes it was incredibly, 25.3 % chose the option 'yes slightly', 24.5% thought that it was 'moderately'. '18.6% thought that it was rarely beneficial, and 5.9% said never. Looking at the Table and Figure 6-66 above .

Part 15: TRAINING AND REHERSAL

Question 31

Do you undertake any advance training and rehearsal for an event?		
Answer Options	Response Percent	Response Count
Yes, several times	34.2%	81
Yes once	22.8%	54
Yes parts of the operation	19.8%	47
Not usually	15.6%	37
Never	7.6%	18
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.67- any advance training and rehearsal for an event (Olympics respondents)

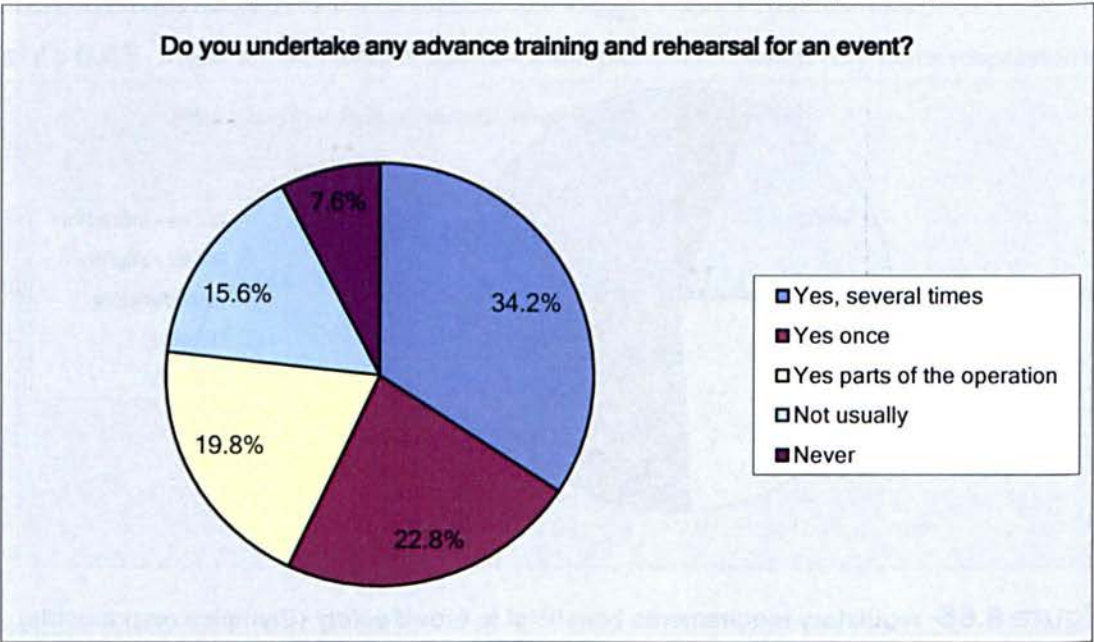


Figure 6.67- any advance training and rehearsal for an event (Olympics respondents)

Interpretation:

The next section of the questionnaire was about training and rehearsal for the event. 19.8% respondents answered as 'yes parts of the operation' are about training and rehearsal for the event. 15.6% of the respondents answered 'not usually', 22.8% of the respondents were 'yes once', 7.6% of the respondents said 'never' and 34.2% of the respondents were 'yes, several times'. Looking at the Table and Figure 6-67 above .

Question 32

What types of training and rehearsal are seen as being most important for crowd management?		
Answer Options	Response Percent	Response Count
Simulation	14.3%	34
Disaster management practices	24.1%	57
Training to use specific technology	29.1%	69
Overall event rehearsal	23.2%	55
None	9.3%	22
answered question		237
skipped question		0

Table 6.68- types of training and rehearsal (Olympics respondents)

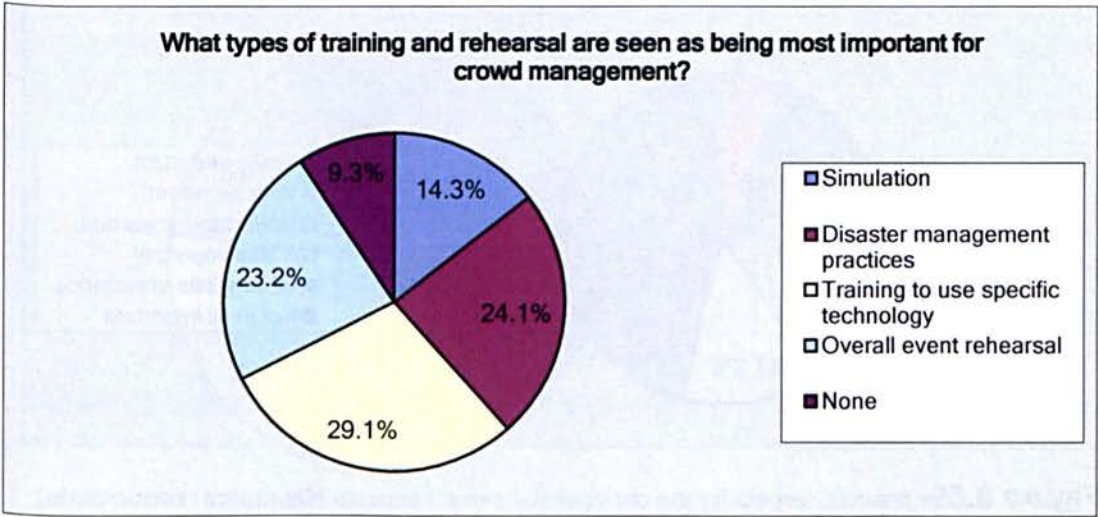


Figure 6.68- types of training and rehearsal (Olympics respondents)

Interpretation:

The next section of the questionnaire was about the types training and rehearsal as being most important for crowd management. 24.1% of the respondents said that disaster management practices were a type of training and rehearsal are seen as being most important for crowd management. The second selected option was 'overall event rehearsal' which was 23.2%. Training to use specific technology was opted by '29.1%' and simulation was opted by '14.3%'. Looking at the Table and Figure 6-68 above .

Part 16: FINANCIAL

Question 33

How important are the financial targets for the crowd management process?		
Answer Options	Response Percent	Response Count
Vitally important	25.3%	60
Very important	20.7%	49
Moderately important	13.5%	32
A little important	22.4%	53
Of very little importance	12.2%	29
Not at all important	5.9%	14
<i>answered question</i>		237
<i>skipped question</i>		0

Table 6.69- financial targets for the crowd management process (Olympics respondents)

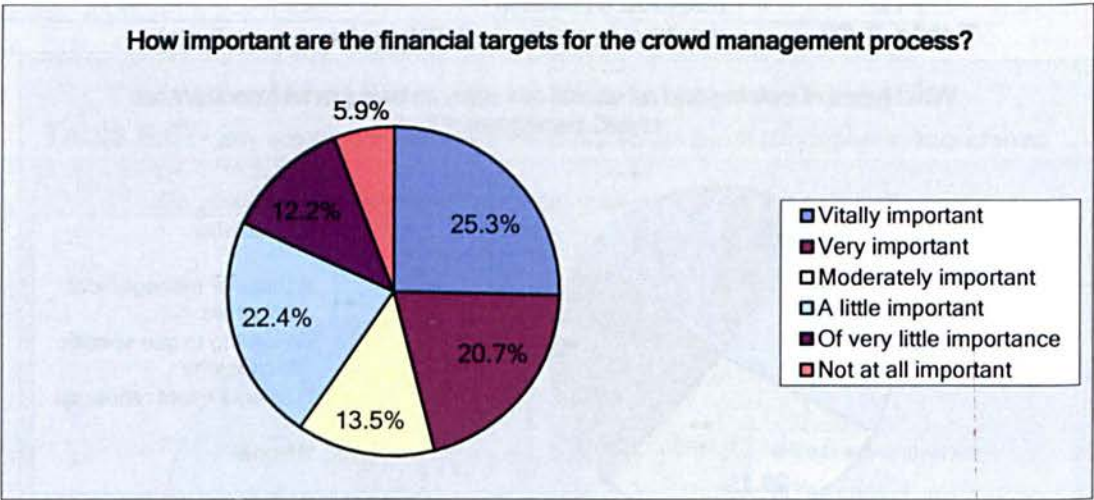


Figure 6.69- financial targets for the crowd management process (Olympics respondents)

Interpretation:

The next section of the questionnaire covered the financial aspects. The question asked about the importance of the financial targets for the crowd management process. Almost more than 50% thought that was vitally important or very important or moderately important which is a large percentage. In comparison to this only 5.9% of the respondents thought that it was not important at all. Looking at the Table and Figure 6-59 above .

Question 34

Which financial measures are deemed important for the crowd management process?		
Answer Options	Response Percent	Response Count
Return on investment	21.1%	50
Income for every attendee	23.6%	56
Overall income	32.1%	76
Overall expenses	16.5%	39
None	6.8%	16
answered question		237
skipped question		0

Table 6.70- financial measures deemed important for the crowd management process (Olympics respondents)

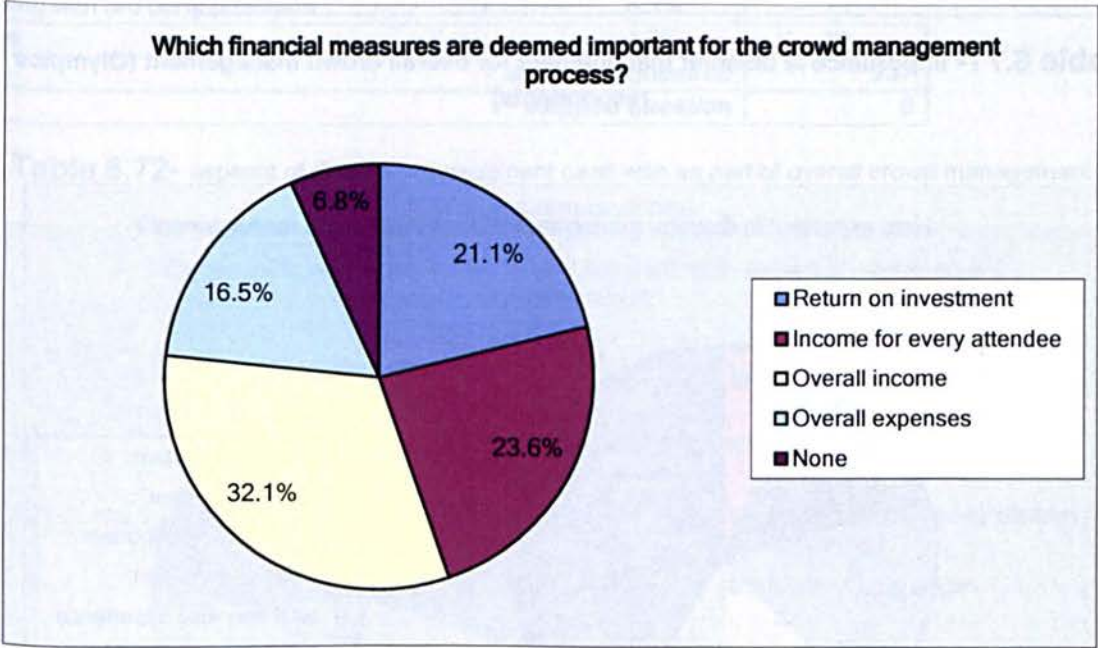


Figure 6.70- financial measures deemed important for the crowd management process (Olympics respondents)

Interpretation:

The next question was about the financial measures that are deemed important for the crowd management process. Almost 236% of the respondents said that the income for every attendee was very important, 32.1% said that the overall income was important,

16.5% said about the overall expenses, 21.1% said that the return on investment, where as 6.8% said that none of that was important. Looking at the Table and Figure 6-70 above .

Part 17: DISASTER MANAGEMENT

Question 35

How important is disaster management for overall crowd management?		
Answer Options	Response Percent	Response Count
Vitally important	23.2%	55
Very important	18.1%	43
Moderately important	21.1%	50
A little important	16.9%	40
Of very little importance	13.9%	33
Not at all important	6.8%	16
answered question		237
skipped question		0

Table 6.71- importance is disaster management for overall crowd management (Olympics respondents)

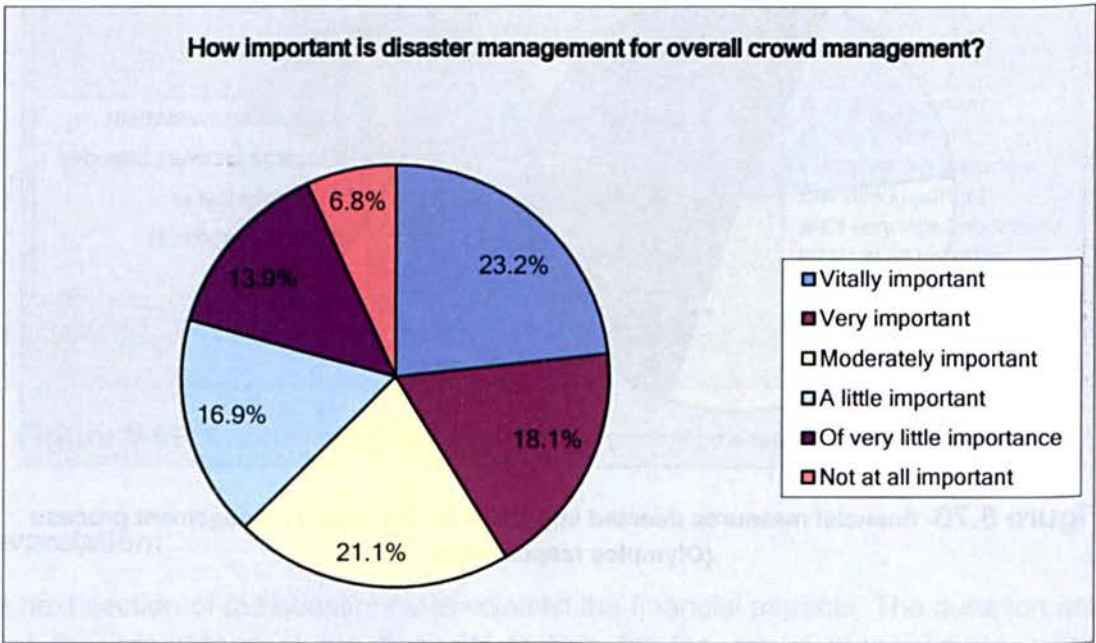


Figure 6.71- importance is disaster management for overall crowd management (Olympics respondents)

Interpretation:

The next question was about the financial measures that are deemed important for the crowd management process. Responses from almost 40% of respondents totaled to vitally important and very important. 21.1% of the respondents said moderately important, 16.9% of the respondents said it was a little important, 13.9% said it was of very little importance whereas only 6.8% said that it was not at all important. Looking at the Table and Figure 6-71 above .

Question 36

What aspects of disaster management are dealt with as part of overall crowd management?		
Answer Options	Response Percent	Response Count
Identifying likely disaster threats	11.4%	27
Simulations to identify disaster threats	18.6%	44
Additional resources for disaster management	22.4%	53
Infrastructure changes	21.9%	52
Health and medical planning	15.2%	36
Liaising with 3rd party providers	6.3%	15
None	4.2%	10
answered question		237
skipped question		0

Table 6.72- aspects of disaster management dealt with as part of overall crowd management (Olympics respondents)

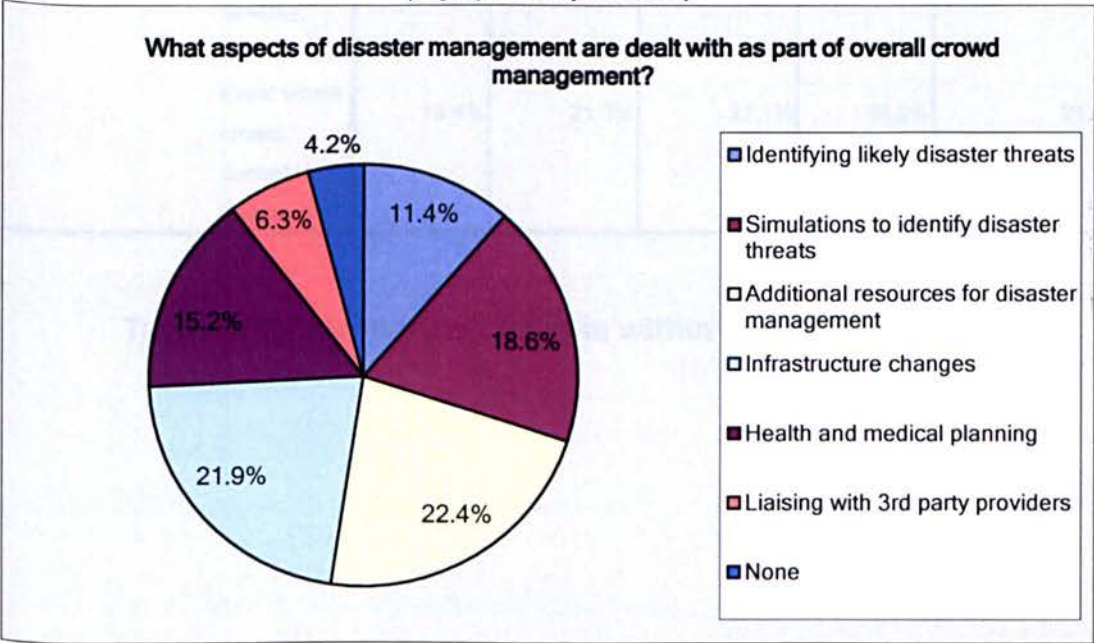


Figure 6.72- aspects of disaster management dealt with as part of overall crowd management (Olympics respondents)

Interpretation:

The next question was about the aspects of disaster management that are dealt with as part of overall crowd management. The responses were identifying likely disaster threats (11.4%), Simulations to identify disaster threats (18.6%), additional resources for disaster management (22.4%), Infrastructure changes (21.9%), Health and medical planning (15.2%), Liaising with 3rd party providers (6.3%), whereas 4.2% said none of these factors were important. Looking at the Table and Figure 6-72 above .

6.1.4. Cross tabulations: Comparative Analysis of Data collected from Hajj and Olympics respondents

The second part of the quantitative analysis done for the data collected in this research through a questionnaire was the comparative cross tabulated analysis. This analysis will help to compare and analyze which options or factors are significant according to the responses of Hajj and respondents of Olympics. The data is analyzed through presenting percentages and count in cross tabulation and was illustrated in graphical forms through bar charts. The important questions in the questionnaire are analyzed below:

Question 1:

What is the event where crowd control is required? * What is your role within your organisation? Crosstabulation

			What is your role within your organisation?					Total
			Director	Higher Management	Team Leader	Security	Crowd Control	
What is the event where crowd control is required?	Hajj	Count	40	44	41	48	52	225
		% within What is the event where crowd control is required?	17.8%	19.6%	18.2%	21.3%	23.1%	100.0%
	Olympics	Count	45	53	61	30	48	237
		% within What is the event where crowd control is required?	19.0%	22.4%	25.7%	12.7%	20.3%	100.0%
Total		Count	85	97	102	78	100	462
		% within What is the event where crowd control is required?	18.4%	21.0%	22.1%	16.9%	21.6%	100.0%

Table 6.73- comparison for role within the organization

Bar Chart

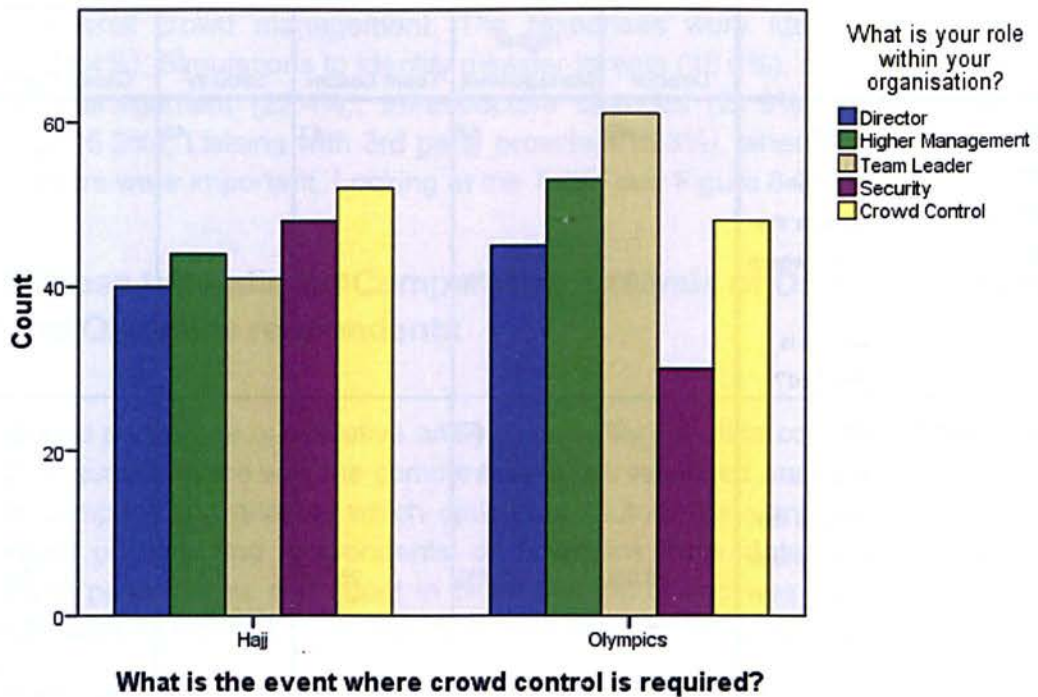


Figure 6.73- comparison for role within the organization

Interpretation:

As the above figure illustrates very clearly, that most of the respondents in the survey had a role of a team leader. The lowest percentage for the hajj respondents was of the Director and for Olympics respondents it was security. Looking at the Table and Figure 6-73 above .

Question 2:

What is the event where crowd control is required? * What type of organisation do you work for? Crosstabulation

		What type of organisation do you work for?										Total
		Event Manage ment	Security Manage ment	Sporting events	Health and Safety	Fire- fighters	Traffic	The Ministry of Health	Ministry of Hajj	Ministry of the Interior	Affairs of the Two Holy Mosques	
What is the Hajj event where crowd control is required?	Count	15	37	2	23	13	36	21	38	25	15	225
	% within What is the event where crowd control is required?	6.7%	16.4%	.9%	10.2%	5.8%	16.0%	9.3%	16.9%	11.1%	6.7%	100.0%
Olympi cs	Count	27	32	44	35	43	32	24	0	0	0	237
	% within What is the event where crowd control is required?	11.4%	13.5%	18.6%	14.8%	18.1%	13.5%	10.1%	.0%	.0%	.0%	100.0%
Total	Count	42	69	46	58	56	68	45	38	25	15	462
	% within What is the event where crowd control is required?	9.1%	14.9%	10.0%	12.6%	12.1%	14.7%	9.7%	8.2%	5.4%	3.2%	100.0%

Table 6.74- comparison for Type of organization

Bar Chart

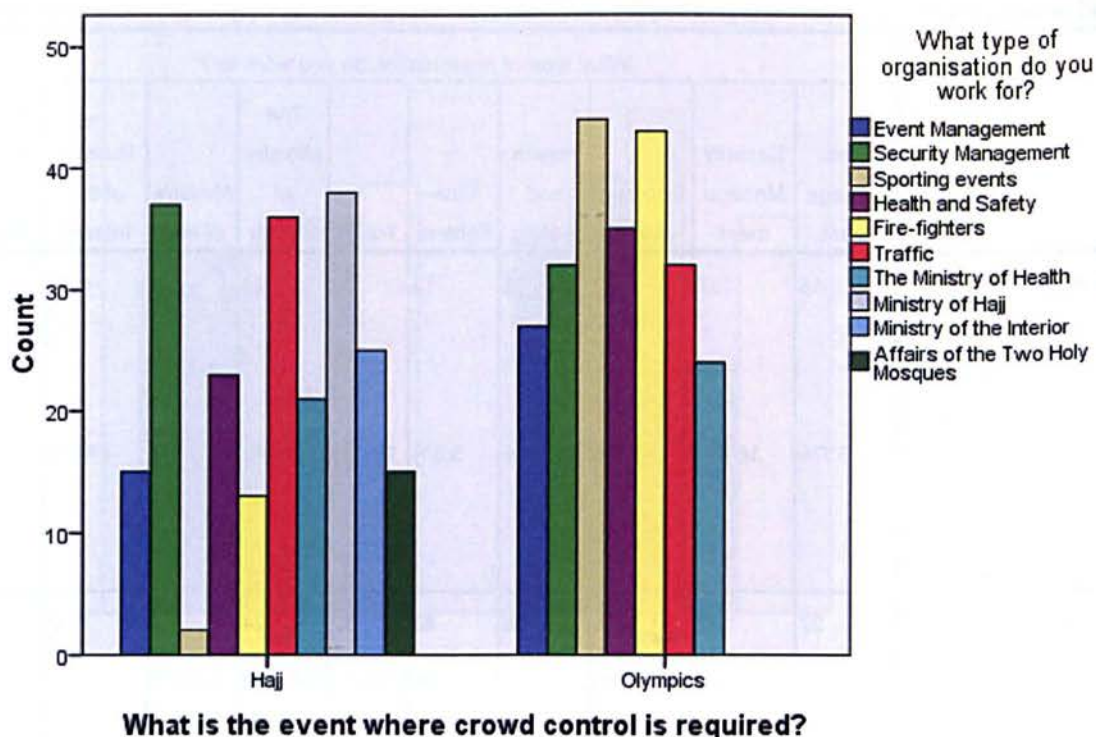


Figure 6.74- comparison for Type of organization

Interpretation

For the second question in the questionnaire, as the above figure illustrates very clearly, that most of the respondents in the survey had a role of a Ministry of Hajj and security management for respondents of Hajj and sporting events and firefighters for the Olympics respondents. The lowest percentage was achieved by the option of sporting events from Hajj respondents and Ministry of Interior for the Olympics respondents. Looking at the Table and Figure 6-74 above .

Part 1: SAFETY

Question 4:

What is the event where crowd control is required? * What is the main crowd management approach used?

		Crosstabulation							
		What is the main crowd management approach used?							
		Ticket control	Security staff	Barriers	Cameras	Traffic Calming	Changing timing of event	Using infrastructure controls	
What is the Hajj event where crowd control is required?	Count	24	67	31	36	20	4	43	225
	% within What is the event where crowd control is required?	10.7%	29.8%	13.8%	16.0%	8.9%	1.8%	19.1%	100.0%
	Olympics Count	24	30	43	59	26	35	20	237
	% within What is the event where crowd control is required?	10.1%	12.7%	18.1%	24.9%	11.0%	14.8%	8.4%	100.0%
Total	Count	48	97	74	95	46	39	63	462
	% within What is the event where crowd control is required?	10.4%	21.0%	16.0%	20.6%	10.0%	8.4%	13.6%	100.0%

Table 6.75- comparison for main crowd management approach used

Bar Chart

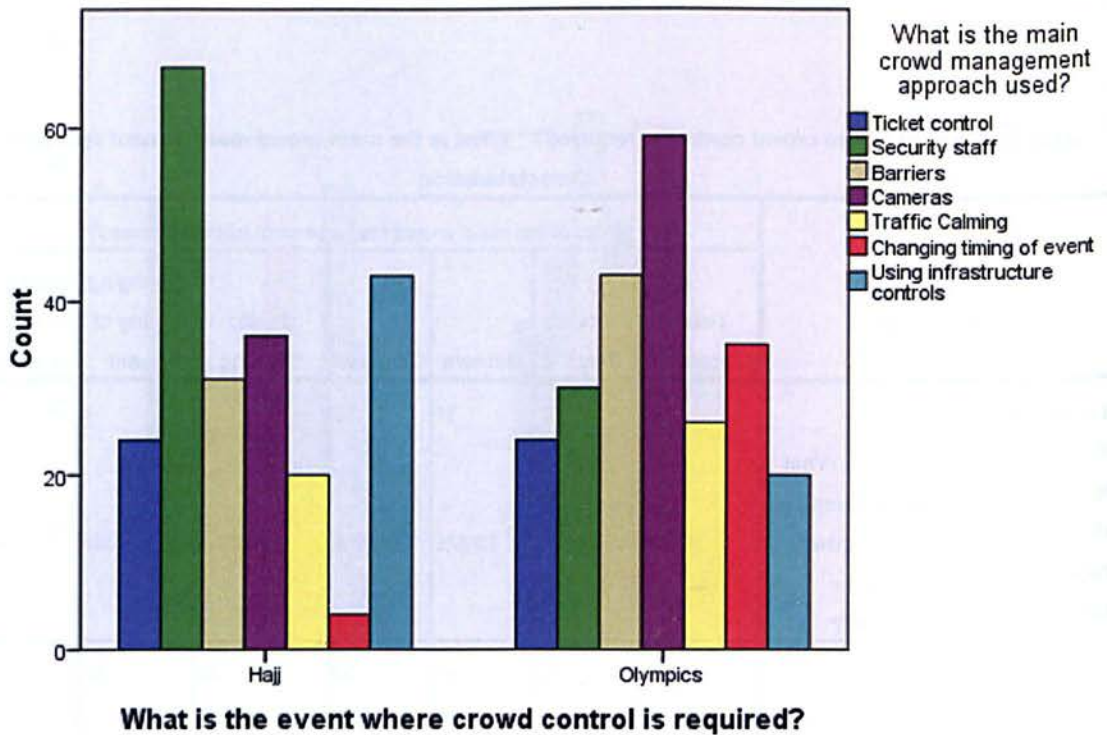


Figure 6.75- comparison for main crowd management approach used

Interpretation

The next section of the questionnaire was of security. The second question in this section was about the main crowd management approach used. For this question in the questionnaire, as the above figure illustrates very clearly, that most of the respondents in the survey thought that security staff was used a crowd management approach and cameras were used as the main crowd management approach according to Olympics respondents. Looking at the Table and Figure 6-75 above .

Part 2: CROWD CONTROL

Question 6:

What is the event where crowd control is required? * What is the most likely cause of a disaster in a crowd based situation? Crosstabulation

		What is the most likely cause of a disaster in a crowd based situation?						Total
		Too many people being let in to the area	Too few security staff	External shock such as fire	Misbehaviour of the crowd	Technology failure	Focal point being inaccessible	
What is the Hajj event where crowd control is required?	Count	45	47	49	30	31	23	225
	% within What is the event where crowd control is required?	20.0%	20.9%	21.8%	13.3%	13.8%	10.2%	100.0%
Olympics	Count	41	49	55	37	35	20	237
	% within What is the event where crowd control is required?	17.3%	20.7%	23.2%	15.6%	14.8%	8.4%	100.0%
Total	Count	86	96	104	67	66	43	462
	% within What is the event where crowd control is required?	18.6%	20.8%	22.5%	14.5%	14.3%	9.3%	100.0%

Table 6.76- comparison for most likely cause of disaster management

Bar Chart

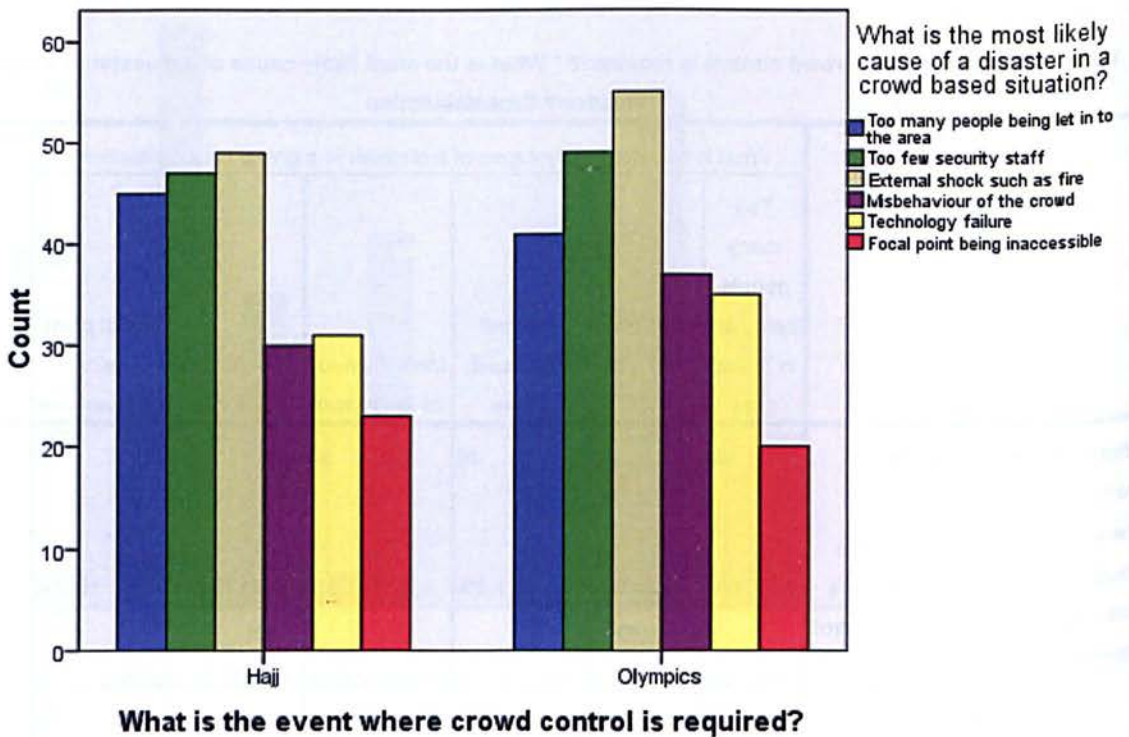


Figure 6.76- comparison for most likely cause of disaster management

Interpretation

The next question in the questionnaire was about the most likely cause of a disaster in a crowd based situation. According to the responses of the survey, in both cases of Hajj and Olympics, the most likely cause of a disaster in a crowd based situation was found to be external shock such as fire and the least likely cause was the focal point being inaccessible. Looking at the Table and Figure 6-76 above .

Part 4: SECURITY

Question 9:

What is the event where crowd control is required? * Which of the following security personnel do you use during crowd management? Crosstabulation

			Which of the following security personnel do you use during crowd management?					Total
			Private police	Private undercover police	Specialist crowd control teams	Emergency services only	No specialist security personnel	
What is the event where crowd control is required?	Hajj	Count	49	41	61	46	28	225
		% within What is the event where crowd control is required?	21.8%	18.2%	27.1%	20.4%	12.4%	100.0%
	Olympics	Count	44	48	57	58	30	237
		% within What is the event where crowd control is required?	18.6%	20.3%	24.1%	24.5%	12.7%	100.0%
Total		Count	93	89	118	104	58	462
		% within What is the event where crowd control is required?	20.1%	19.3%	25.5%	22.5%	12.6%	100.0%

Table 6.77- comparison for security personnel

Bar Chart

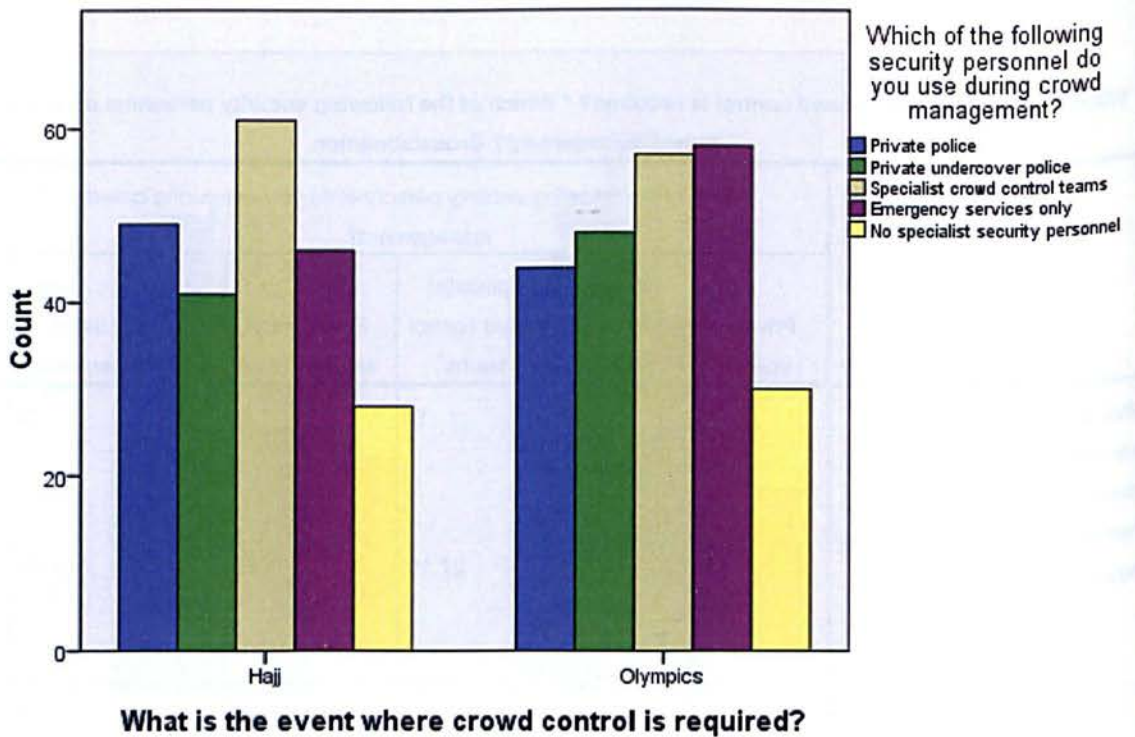


Figure 6.77- comparison for security personnel

Interpretation

The next question in the questionnaire was about the type of security personnel used in the crowd management. According to the responses of the survey, in the case of Hajj, specialist crowd control teams was the most selected option and in the Olympics case, the emergency services only was the most selected option. The least selected option in both cases was 'no specialist security personal. Looking at the Table and Figure 6-77 above .

Question 10:

What is the event where crowd control is required? * How do you decide on the number of security personnel to be employed? Crosstabulation

			How do you decide on the number of security personnel to be employed?					Total
			Size of the crowd	Nature of the event	Cost of security personnel	Legal requirements	Spread of the crowd (geographic)	
What is the event where crowd control is required?	Hajj	Count	66	57	43	32	27	225
		% within What is the event where crowd control is required?	29.3%	25.3%	19.1%	14.2%	12.0%	100.0%
	Olympics	Count	53	57	52	45	30	237
		% within What is the event where crowd control is required?	22.4%	24.1%	21.9%	19.0%	12.7%	100.0%
Total		Count	119	114	95	77	57	462
		% within What is the event where crowd control is required?	25.8%	24.7%	20.6%	16.7%	12.3%	100.0%

Table 6.78- comparison for number of security personnel

Bar Chart

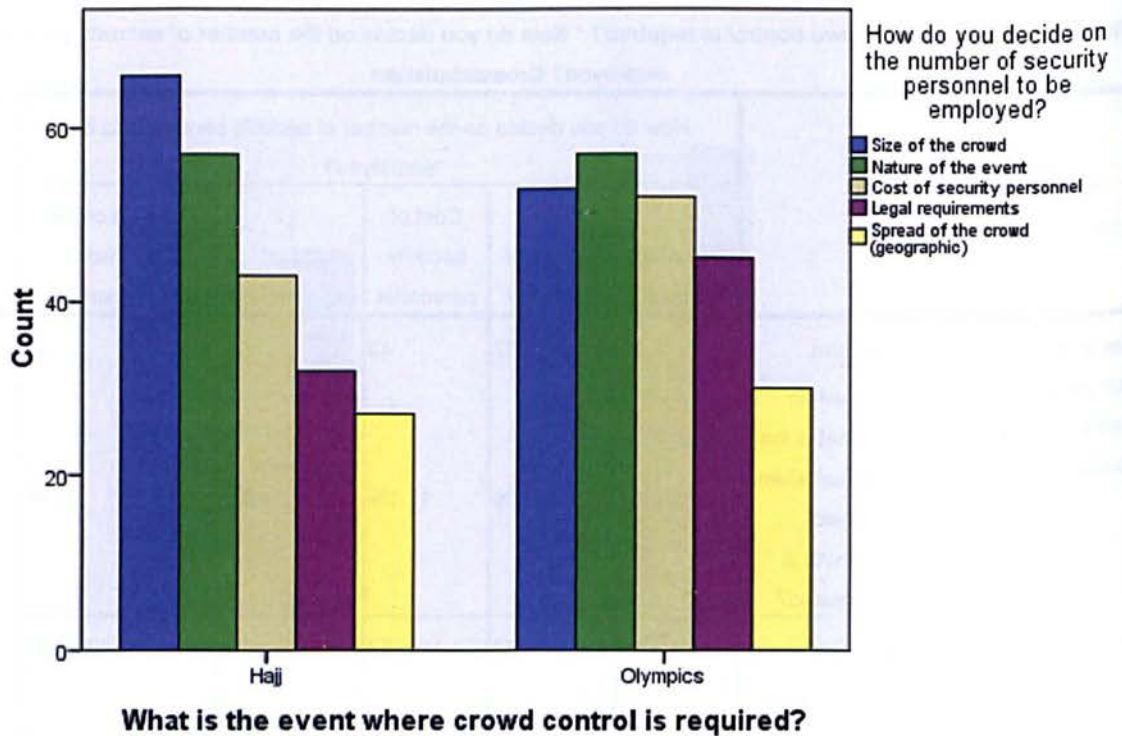


Figure 6.78- comparison for number of security personnel

Interpretation

The next question in the questionnaire was about the type of security personnel used in the crowd management. According to the responses of the survey, in the case of Hajj, specialist crowd control teams was the most selected option and in the Olympics case, the emergency services only was the most selected option. The least selected option in both cases was 'no specialist security personal. Looking at the Table and Figure 6-78 above .

Part 5: PEOPLE

Question 11:

What is the event where crowd control is required? * Which of the following are involved in your crowd management process? Cross-tabulation

			Which of the following are involved in your crowd management process?							Total	
			Project manage rs	IT technicia ns	Medical profession als	Security profession als	Disaster management professionals	Administrati on staff	Politicians		Military
What is the event where crowd control is require d?	Hajj	Count	42	36	41	32	37	17	9	11	225
		% within What is the event where crowd control is required?	18.7%	16.0%	18.2%	14.2%	16.4%	7.6%	4.0%	4.9%	100.0%
	Olympic s	Count	27	36	41	47	34	24	22	6	237
		% within What is the event where crowd control is required?	11.4%	15.2%	17.3%	19.8%	14.3%	10.1%	9.3%	2.5%	100.0%
Total		Count	69	72	82	79	71	41	31	17	462
		% within What is the event where crowd control is required?	14.9%	15.6%	17.7%	17.1%	15.4%	8.9%	6.7%	3.7%	100.0%

Table 6.79- comparison for crowd management process

Bar Chart

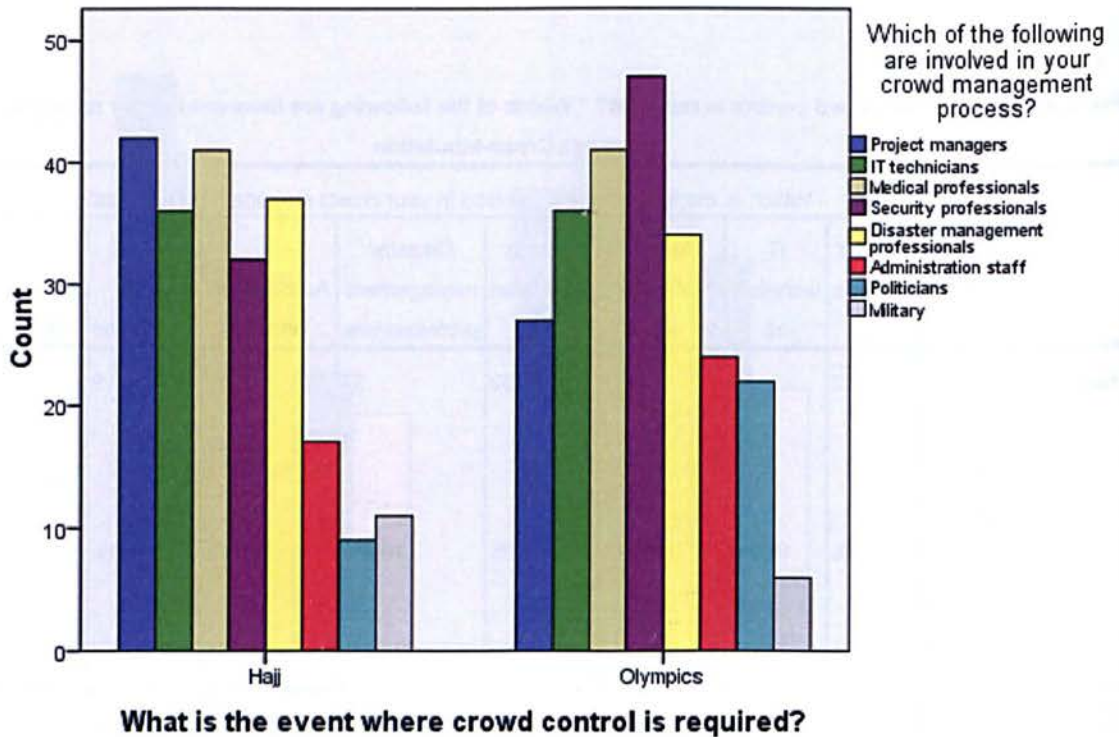


Figure 6.79- comparison for crowd management process

Interpretation

The next question in the questionnaire was about the event where crowd control is required. According to the responses of the survey, in the case of Hajj, security professional was the most selected option and in the Olympics case, the most selected option was the option of project managers. The least selected option was politicians and military for both types of respondents. Looking at the Table and Figure 6-79 above .

Question 12:

What is the event where crowd control is required? * Which are the most influential people for the safe management of crowds? Crosstabulation

			Which are the most influential people for the safe management of crowds?								Total
			Project managers	IT technicians	Medical professionals	Security professionals	Disaster management professionals	Administration staff	Politicians	Military	
What is the event where crowd control is required?	Hajj	Count	31	34	41	31	28	29	13	18	225
		% within What is the event where crowd control is required?	13.8%	15.1%	18.2%	13.8%	12.4%	12.9%	5.8%	8.0%	100.0%
	Olympics	Count	22	20	40	40	43	29	22	21	237
		% within What is the event where crowd control is required?	9.3%	8.4%	16.9%	16.9%	18.1%	12.2%	9.3%	8.9%	100.0%
Total		Count	53	54	81	71	71	58	35	39	462
		% within What is the event where crowd control is required?	11.5%	11.7%	17.5%	15.4%	15.4%	12.6%	7.6%	8.4%	100.0%

Table 6.80- comparison of most influential people for the safe management of crowd

Bar Chart

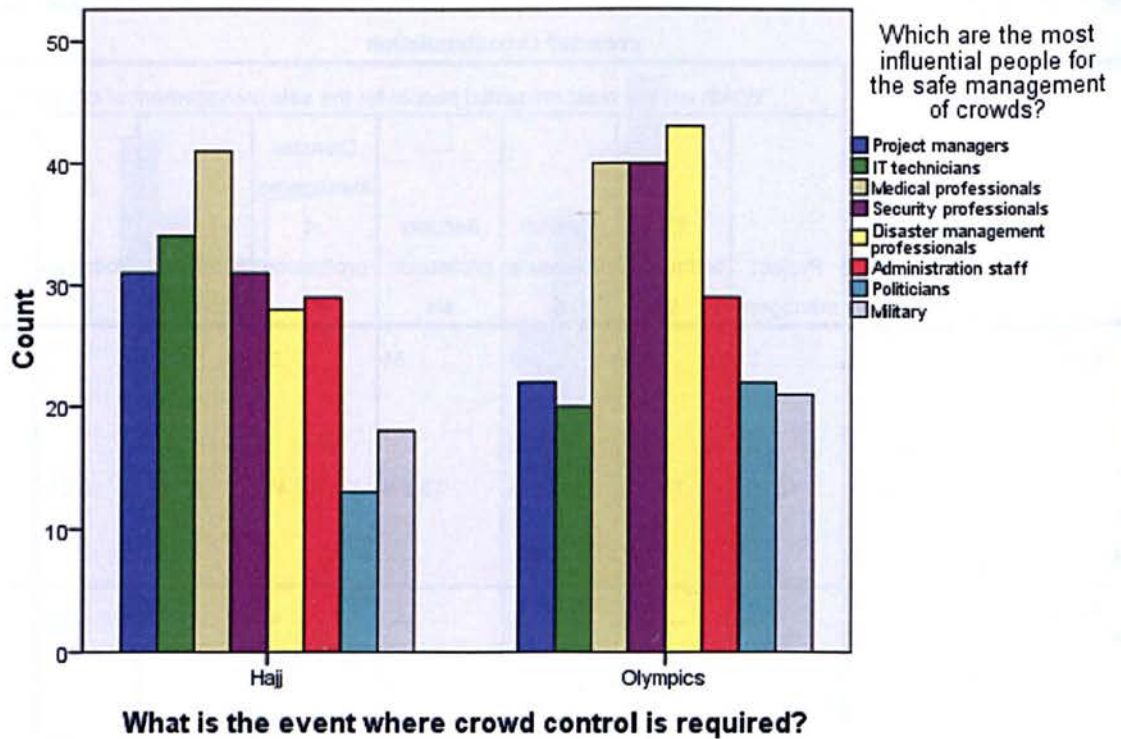


Figure 6.80- comparison of most influential people for the safe management of crowd

Interpretation

The next question in the questionnaire in the people section was about the most influential people for the safe management of crowds. According to the responses of the survey, in the case of Hajj, the medical professionals was the most selected option and in the Olympics case, the most selected option was the option of disaster management professionals. The least selected option was politicians for Hajj respondents and the IT technicians for the Olympics respondents. Looking at the Table and Figure 6-80 above .

Part 6 : ENVIRONMENTAL ISSUES

Question 14:

What is the event where crowd control is required? * Which of the following environmental issues are relevant to your crowd management? Crosstabulation

			Which of the following environmental issues are relevant to your crowd management?						Total
			Human waste	Noise pollution	Water pollution	Air pollution	Whatever the law requires	Refuse generated	
What is the event where crowd control is required?	Hajj	Count	47	38	33	36	45	26	225
		% within What is the event where crowd control is required?	20.9%	16.9%	14.7%	16.0%	20.0%	11.6%	100.0%
	Olympics	Count	29	45	40	49	41	33	237
		% within What is the event where crowd control is required?	12.2%	19.0%	16.9%	20.7%	17.3%	13.9%	100.0%
Total		Count	76	83	73	85	86	59	462
		% within What is the event where crowd control is required?	16.5%	18.0%	15.8%	18.4%	18.6%	12.8%	100.0%

Table 6.81- comparison for environmental issues

Bar Chart

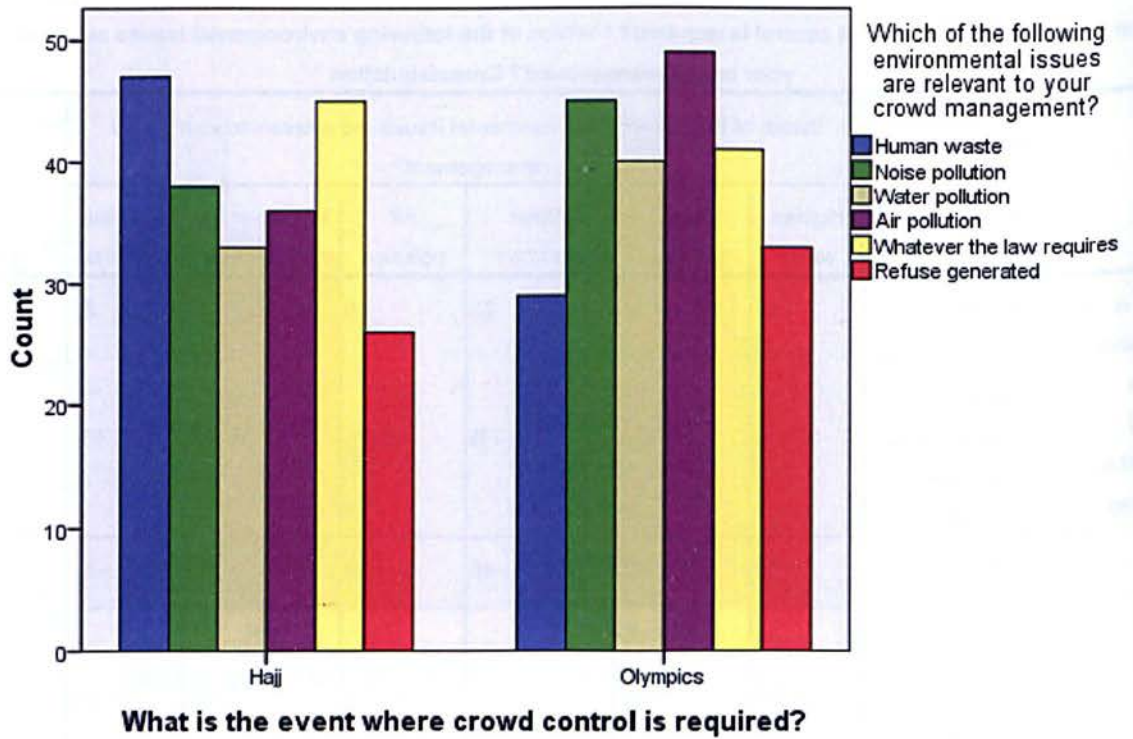


Figure 6.81- comparison for environmental issues

Interpretation

'Environmental issues' was the next section in the questionnaire, in which the next question was about the environmental issues that are most relevant to crowd management. According to the responses of the survey, in the case of Hajj, the human waste was the most important issue, whereas, air pollution was the most important issue in case of the respondents of Olympics. The least selected option was refused generated for Hajj respondents and the human waste was for the Olympics respondents Looking at the Table and Figure 6-81 above ..

Part 7: PROJECT AND RISK MANAGEMENT

Question 15:

What is the event where crowd control is required? * Which of the following processes are integral to crowd management? Cross-tabulation

		Which of the following processes are integral to crowd management?					Total
		Risk assessments	Project planning	Emergency planning	Risk simulations	Budgeting	
What is the Hajj event where crowd control is required?	Count	52	60	43	50	20	225
	% within What is the event where crowd control is required?	23.1%	26.7%	19.1%	22.2%	8.9%	100.0%
Olympics	Count	49	55	60	48	25	237
	% within What is the event where crowd control is required?	20.7%	23.2%	25.3%	20.3%	10.5%	100.0%
Total	Count	101	115	103	98	45	462
	% within What is the event where crowd control is required?	21.9%	24.9%	22.3%	21.2%	9.7%	100.0%

Table 6.82- comparison of processes integral for crowd management

Bar Chart

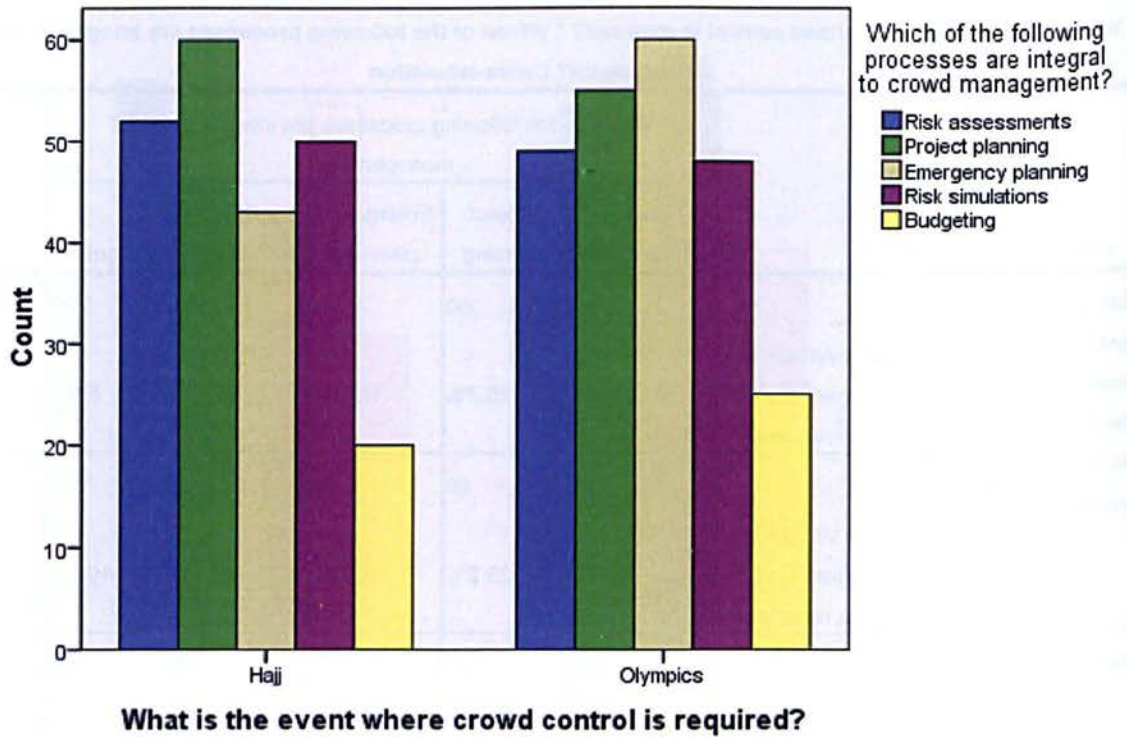


Figure 6.82- comparison of processes integral for crowd management

Interpretation

'Project and Risk Management' was the next section in the questionnaire, in which the next question was about the processes which are integral to crowd management. According to the responses of the survey, in the case of Hajj, project planning was the most important process that is integral to crowd management, whereas, emergency planning was the most important process that is integral to crowd management in case of the respondents of Olympics. The least selected option was budgeting for both the respondents in Hajj respondents and Olympics respondents. Looking at the Table and Figure 6-82 above .

Question 16:

What is the event where crowd control is required? * Whose responsibility is project and risk management?

			Crosstabulation					
			Whose responsibility is project and risk management?					
			Overall management team	Specific project management professionals	Private police	Security professionals	Depends on the area of risk	
What is the event where crowd control is required?	Hajj	Count	36	49	47	53	40	225
		% within What is the event where crowd control is required?	16.0%	21.8%	20.9%	23.6%	17.8%	100.0%
	Olympics	Count	40	52	48	62	35	237
		% within What is the event where crowd control is required?	16.9%	21.9%	20.3%	26.2%	14.8%	100.0%
Total		Count	76	101	95	115	75	462
		% within What is the event where crowd control is required?	16.5%	21.9%	20.6%	24.9%	16.2%	100.0%

Table 6.83- comparison for responsibility in risk management

Bar Chart

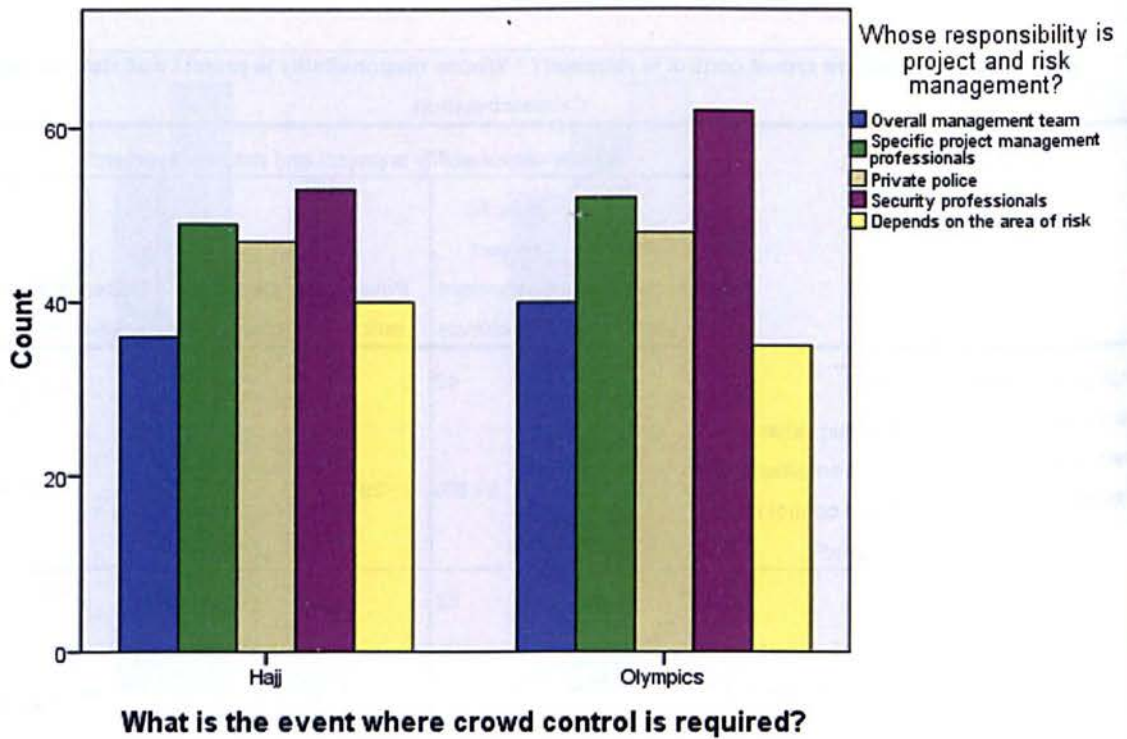


Figure 6.83- comparison for responsibility in risk management

Interpretation

The next question in the 'Project and Risk Management' section was about the responsibility regarding project and risk management. According to the responses of the survey, in the case of both Hajj and Olympics, the security professionals had the most important responsibility in project and risk management. On the other hand, in the case of Hajj, the least selected option was overall management team and in case of Olympics respondents, 'depends on area of risk' was the least selected option. Looking at the Table and Figure 6-83 above .

Part 8: EVENT MANAGEMENT

Question 17:

What is the event where crowd control is required? * What is the main aim of event management? Crosstabulation							
			What is the main aim of event management?				Total
			To maintain crowd safety	To make sure overall efficiency of the event	To make a profit	To achieve a large crowd	
What is the event where crowd control is required?	Hajj	Count	79	60	57	29	225
		% within What is the event where crowd control is required?	35.1%	26.7%	25.3%	12.9%	100.0%
	Olympics	Count	57	80	60	40	237
		% within What is the event where crowd control is required?	24.1%	33.8%	25.3%	16.9%	100.0%
Total		Count	136	140	117	69	462
		% within What is the event where crowd control is required?	29.4%	30.3%	25.3%	14.9%	100.0%

Table 6.84- comparison for main aim of event management

Bar Chart

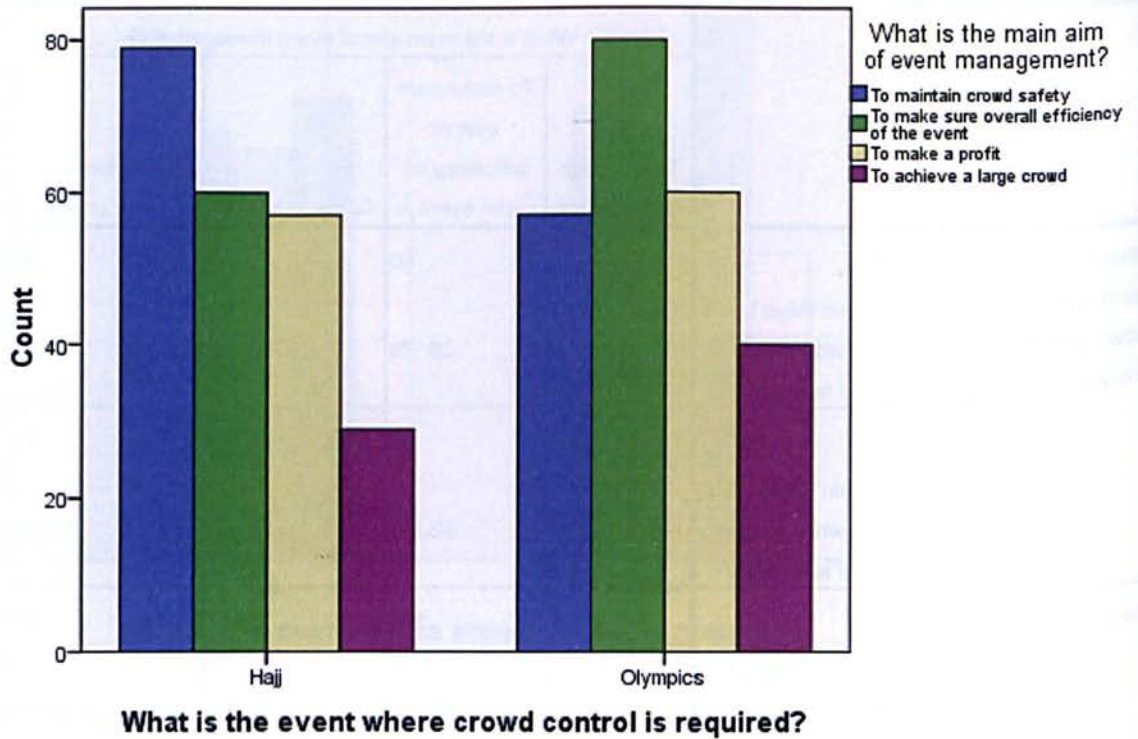


Figure 6.84- comparison for main aim of event management

Interpretation

'Project and Risk Management' was the next section in the questionnaire, in which the next question was about the processes which are integral to crowd management. According to the responses of the survey, in the case of Hajj, project planning was the most important process that is integral to crowd management, whereas, emergency planning was the most important process that is integral to crowd management in case of the respondents of Olympics. The least selected option was budgeting for both the respondents in Hajj respondents and Olympics respondents. Looking at the Table and Figure 6-84 above .

Part 9 : COMMUNICATION AND COLLABORATION

Question 20

What is the event where crowd control is required? * What are the major threats to communication and collaboration?

Crosstabulation

			What are the major threats to communication and collaboration?					Total
			Breakdown of IT	Too many managers	Conflict between the teams	Lack of systems	Too much bureaucracy	
What is the event where crowd control is required?	Hajj	Count	45	62	50	44	24	225
		% within What is the event where crowd control is required?	20.0%	27.6%	22.2%	19.6%	10.7%	100.0%
	Olympics	Count	47	52	54	52	32	237
		% within What is the event where crowd control is required?	19.8%	21.9%	22.8%	21.9%	13.5%	100.0%
Total		Count	92	114	104	96	56	462
		% within What is the event where crowd control is required?	19.9%	24.7%	22.5%	20.8%	12.1%	100.0%

Table 6.85- comparison for major threats to communication and collaboration

Bar Chart

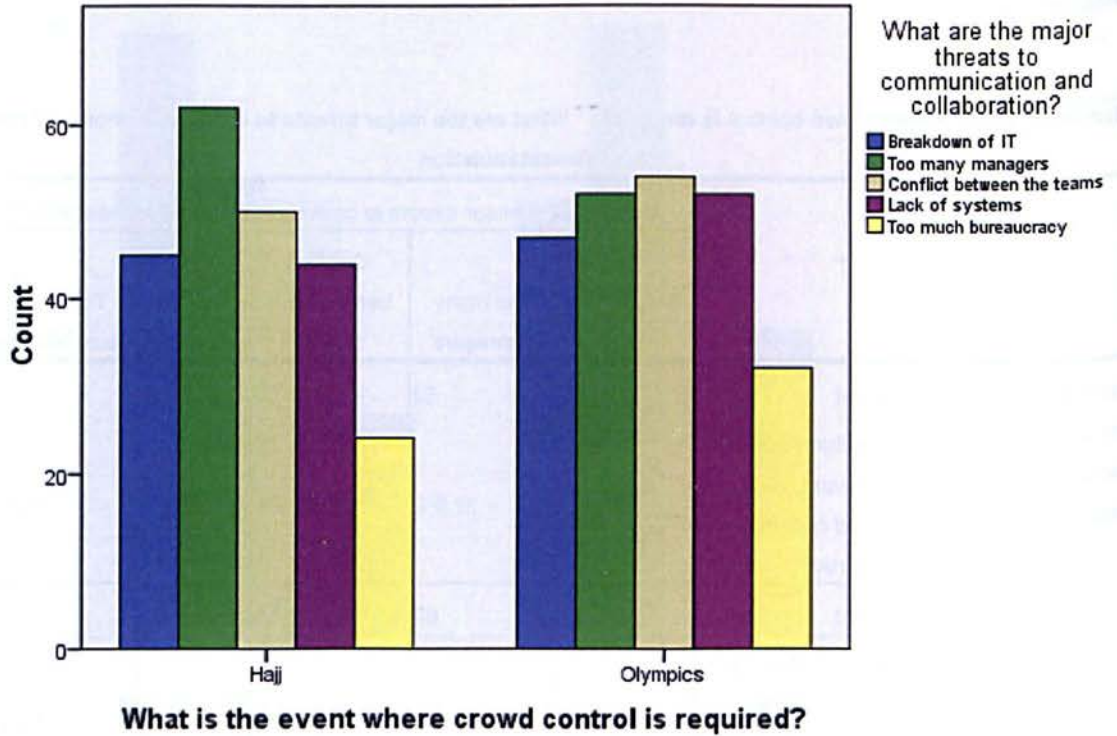


Figure 6.85- comparison for major threats to communication and collaboration

Interpretation

'Communication and Collaboration' was the next section in the questionnaire, in which the question was about the major threats to communication and collaboration. According to the responses of the survey, in the case of Hajj, too many managers was the most selected option that could be a threat to the communication and collaboration, whereas, conflict between the teams was the most selected option from the Olympics respondents. The least selected option was too much bureaucracy for both the respondents in Hajj respondents and Olympics respondents. Looking at the Table and Figure 6-85 above .

Part 10: AUTHORITIES

Question 21

What is the event where crowd control is required? * Which authorities are involved in crowd management?

Crosstabulation							
			Which authorities are involved in crowd management?				
			Government regulators	Police authorities	Health and safety authorities	None	
What is the event where crowd control is required?	Hajj	Count	71	67	61	26	225
		% within What is the event where crowd control is required?	31.6%	29.8%	27.1%	11.6%	100.0%
	Olympics	Count	63	66	74	34	237
		% within What is the event where crowd control is required?	26.6%	27.8%	31.2%	14.3%	100.0%
Total		Count	134	133	135	60	462
		% within What is the event where crowd control is required?	29.0%	28.8%	29.2%	13.0%	100.0%

Table 6.86- comparison for authorities involved in crowd management

Bar Chart

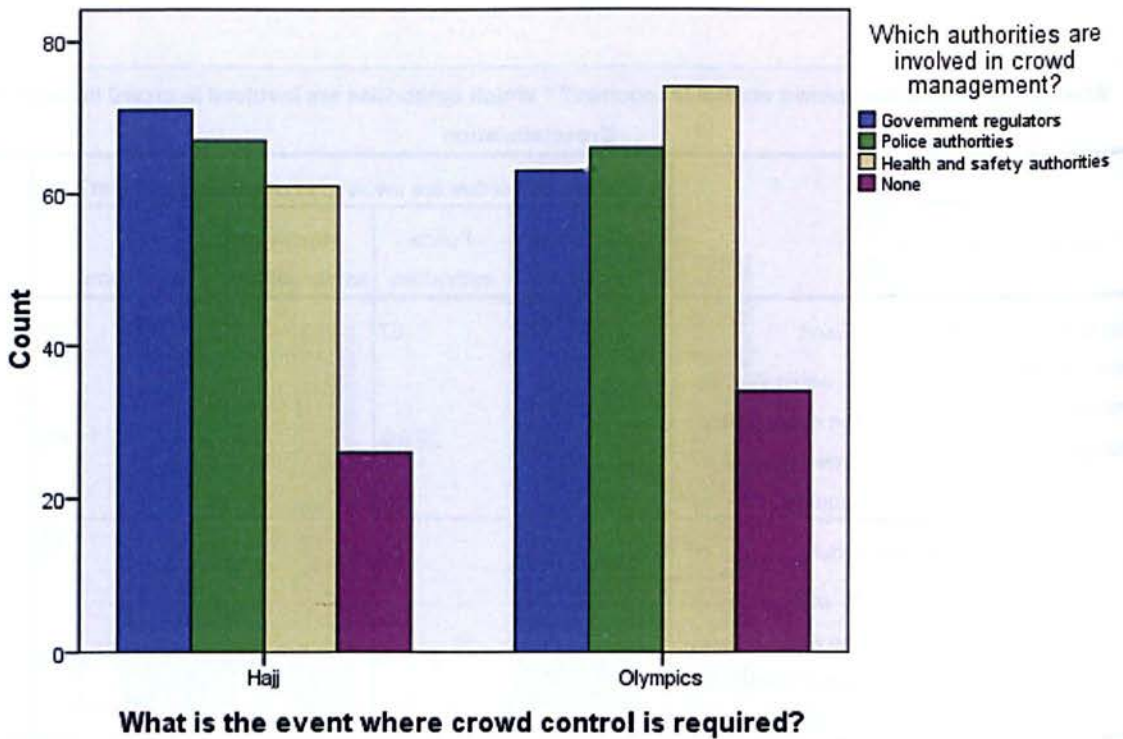


Figure 6.86- comparison for authorities involved in crowd management

Interpretation

'Authorities' was the next section in the questionnaire, in which the question was about the authorities that are involved in crowd management. According to the responses of the survey, in the case of Hajj, government regulators was the most selected option that the respondents thought was the most important authorities involved in the crowd management. For the Olympics respondents, the most selected option was health and safety authorities. The least selected option was 'none' for both the respondents in Hajj respondents and Olympics respondents which refers to the fact that all parties involved in the process of crowd management are equally involved to keep up with the process equally. Looking at the Table and Figure 6-86 above .

Question 22

What is the event where crowd control is required? * Which authorities are most influential to crowd management?

Crosstabulation

			Which authorities are most influential to crowd management?				
			Government regulators	Police authorities	Health and safety authorities	None	
What is the event where crowd control is required?	Hajj	Count	69	66	66	24	225
		% within What is the event where crowd control is required?	30.7%	29.3%	29.3%	10.7%	100.0%
	Olympics	Count	58	68	72	39	237
		% within What is the event where crowd control is required?	24.5%	28.7%	30.4%	16.5%	100.0%
Total		Count	127	134	138	63	462
		% within What is the event where crowd control is required?	27.5%	29.0%	29.9%	13.6%	100.0%

Table 6.87- comparison for authorities influential for crowd management

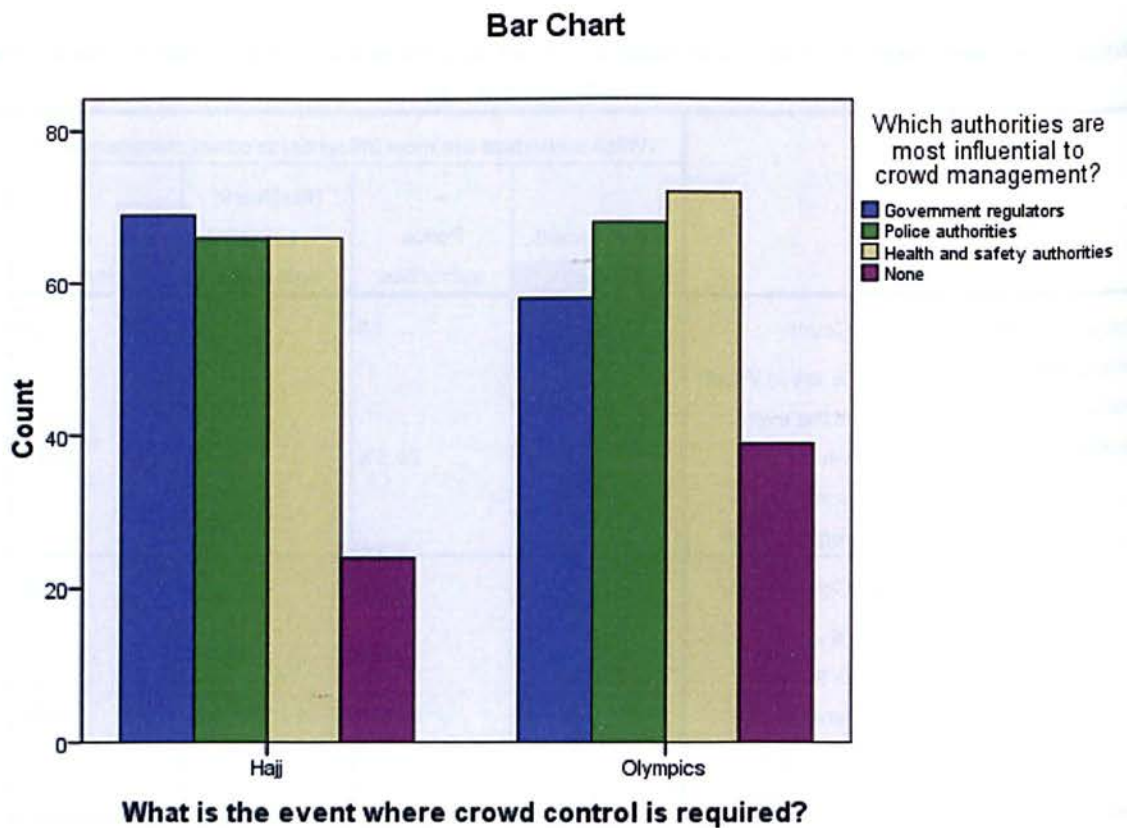


Figure 6.87- comparison for authorities influential for crowd management

Interpretation

The second question the section related to 'Authorities' was about the authorities that are most influential in crowd management. According to the responses of the survey, in the case of Hajj, government regulators was the most selected option that the respondents thought was the most important authorities that are influential in the crowd management. For the Olympics respondents, the most selected option was health and safety authorities. The least selected option was 'none' for both the respondents in Hajj respondents and Olympics respondents which refers to the fact that all parties involved in the process of crowd management are equally influential to keep up with the process equally. Looking at the Table and Figure 6-87 above .

Part 11: SOCIETY AND CULTURE

Question 24

What is the event where crowd control is required? * Which aspect of event and crowd management is influenced by society and culture? Crosstabulation

			Which aspect of event and crowd management is influenced by society and culture?						Total
			The crowd demographic	The willingness to follow instructions	The level of calm during an emergency	The use of infrastructure	Medical requirements	None	
What is the event where crowd control is required?	Hajj	Count	54	54	38	39	27	13	225
		% within What is the event where crowd control is required?	24.0%	24.0%	16.9%	17.3%	12.0%	5.8%	100.0%
	Olympics	Count	49	47	56	51	24	10	237
		% within What is the event where crowd control is required?	20.7%	19.8%	23.6%	21.5%	10.1%	4.2%	100.0%
Total		Count	103	101	94	90	51	23	462
		% within What is the event where crowd control is required?	22.3%	21.9%	20.3%	19.5%	11.0%	5.0%	100.0%

Table 6.88- comparison for society and culture

Bar Chart

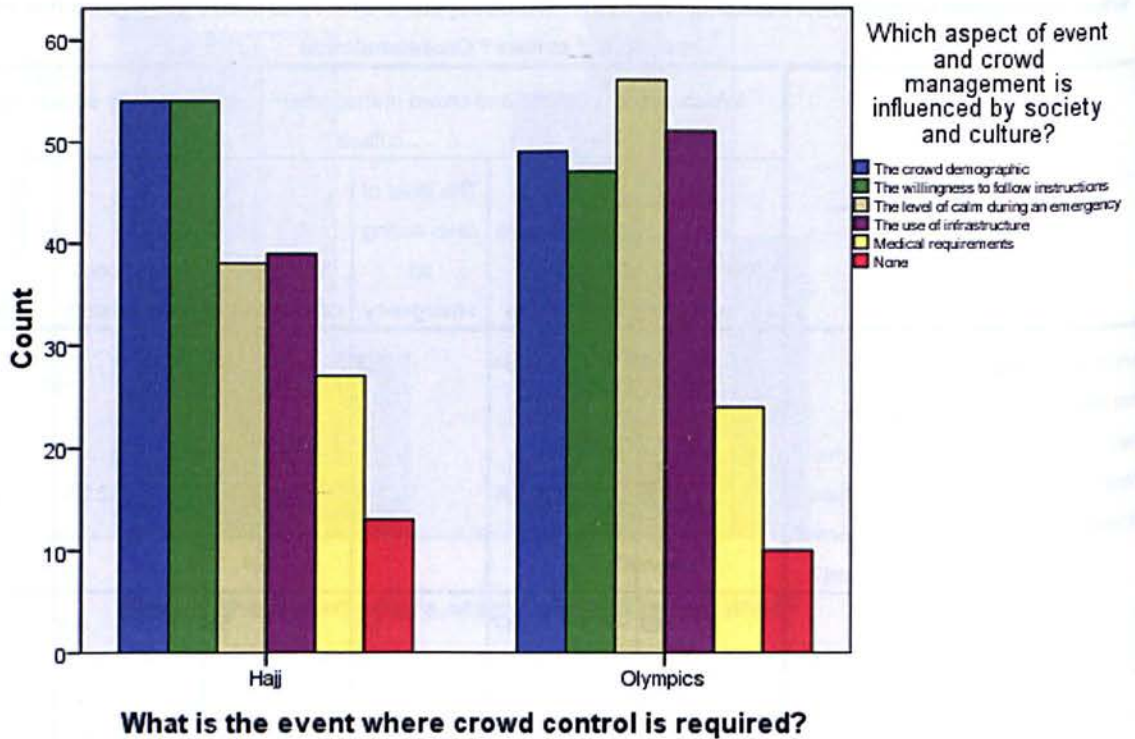


Figure 6.88- comparison for society and culture

Interpretation

The second question the section related to 'Authorities' was about the authorities that are most influential in crowd management. According to the responses of the survey, in the case of Hajj, government regulators was the most selected option that the respondents thought was the most important authorities that are influential in the crowd management. For the Olympics respondents, the most selected option was health and safety authorities. The least selected option was 'none' for both the respondents in Hajj

respondents and Olympics respondents which refers to the fact that all parties involved in the process of crowd management are equally influential to keep up with the process equally. Looking at the Table and Figure 6-88 above .

Part 12: INFRASTRUCTURE AND TRANSPORT

Question 25

What is the event where crowd control is required? * Which forms of infrastructure need to be managed as part of the crowd management? Crosstabulation

			Which forms of infrastructure need to be managed as part of the crowd management?							Total
			Public transport such as trains and buses	Car routes to the area	Car parking in the area	Transport around the event	Walkways within the area	International and long distance travel	None	
What is the event where crowd control is required?	Hajj	Count	41	44	30	44	35	24	7	225
		% within What is the event where crowd control is required?	18.2%	19.6%	13.3%	19.6%	15.6%	10.7%	3.1%	100.0%
	Olympics	Count	66	36	24	50	39	18	4	237
		% within What is the event where crowd control is required?	27.8%	15.2%	10.1%	21.1%	16.5%	7.6%	1.7%	100.0%
Total		Count	107	80	54	94	74	42	11	462
		% within What is the event where crowd control is required?	23.2%	17.3%	11.7%	20.3%	16.0%	9.1%	2.4%	100.0%

Table 6.89- comparison for forms of infrastructure

Bar Chart

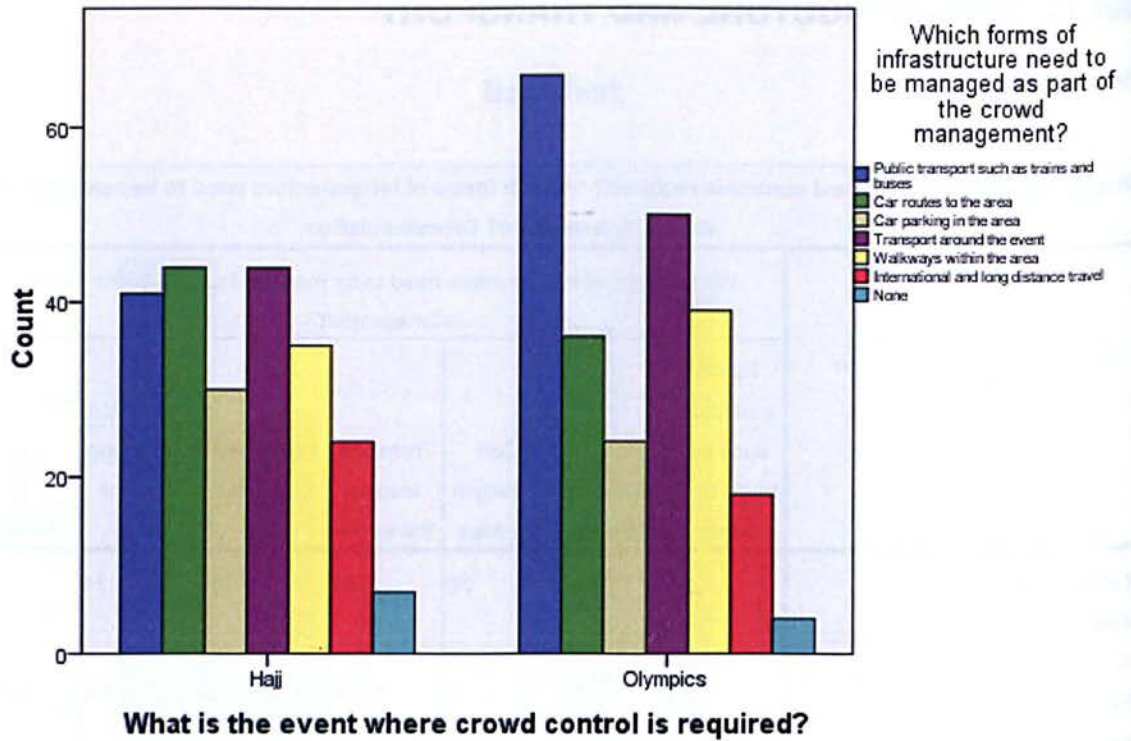


Figure 6.89- comparison for forms of infrastructure

Interpretation

'Infrastructure and transport' was the next section in the questionnaire, in which the question was about the various forms of infrastructure that is needed to be managed as part of the crowd management. According to the responses of the survey, in the case of Hajj, the car routes to the area and the transport around the event were voted the most. On the other hand, the option of public transport such as trains and buses, was the most selected option in case of Olympics respondents. Apart from the option of 'none' the international and long distance travel was voted the least for both Hajj respondents and Olympics respondents. Looking at the Table and Figure 6-89 above .

Question 26

What is the event where crowd control is required? * Why is infrastructure and transport seen to be important for crowd management? Crosstabulation

			Why is infrastructure and transport seen to be important for crowd management?						Total
			It provides exit routes in a disaster	Ensures lack of crowding at pressure points	Encourages people to visit the event	Allows people to be tracked and followed	Opportunity for greater revenue	None	
What is the event where crowd control is required?	Hajj	Count	34	61	53	36	32	9	225
		% within What is the event where crowd control is required?	15.1%	27.1%	23.6%	16.0%	14.2%	4.0%	100.0%
	Olympics	Count	32	65	49	48	32	11	237
		% within What is the event where crowd control is required?	13.5%	27.4%	20.7%	20.3%	13.5%	4.6%	100.0%
Total		Count	66	126	102	84	64	20	462
		% within What is the event where crowd control is required?	14.3%	27.3%	22.1%	18.2%	13.9%	4.3%	100.0%

Table 6.90- comparison for Infrastructure and transport important for crowd management

Bar Chart

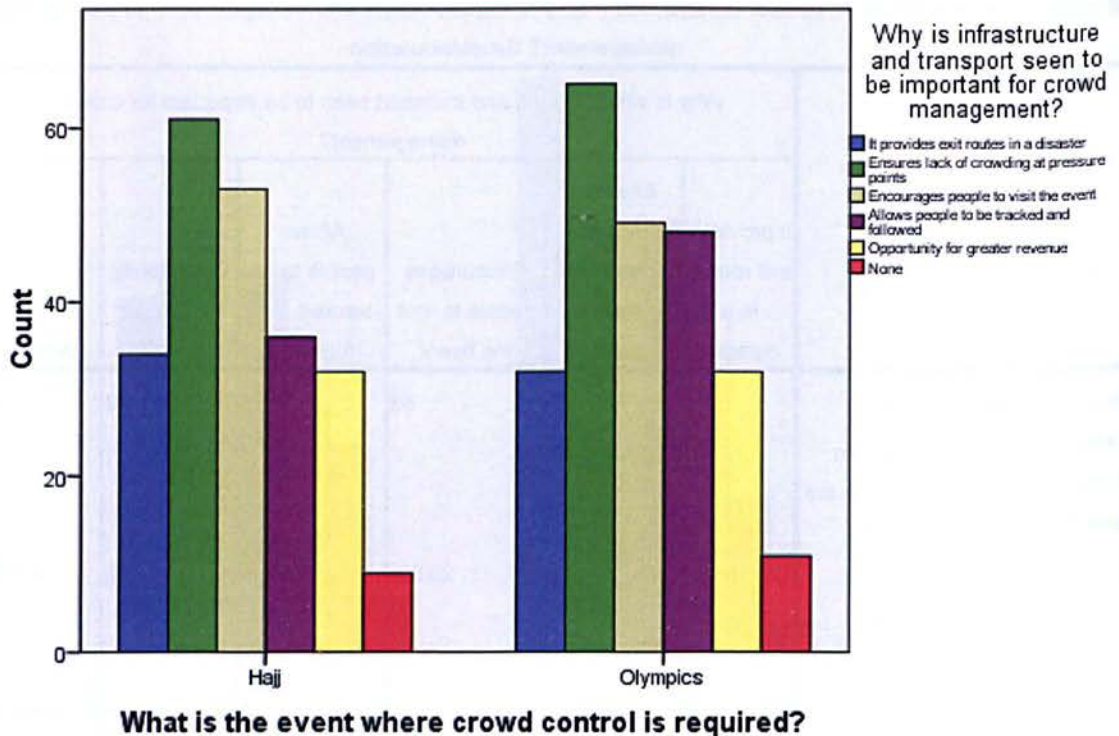


Figure 6.90- comparison for infrastructure and transport important for crowd management

Interpretation

'Infrastructure and transport' was the next section in the questionnaire, in which the question was about the various forms of infrastructure that is needed to be managed as part of the crowd management. According to the responses of the survey, in the case of Hajj, the car routes to the area and the transport around the event were voted the most. On the other hand, the option of public transport such as trains and buses, was the most selected option in case of Olympics respondents. Apart from the option of 'none' the international and long distance travel was voted the least for both Hajj respondents and Olympics respondents. Looking at the Table and Figure 6-90 above .

Part 13: HEALTH

Question 28

What is the event where crowd control is required? * What health issues are seen as particularly relevant to crowd management? Crosstabulation

			What health issues are seen as particularly relevant to crowd management?						Total
			Injuries through crushes	Illness and injury whilst attending event	Contamination across attendees	External threats such as terrorism	Natural threats such as flooding	None	
What is the event where crowd control is required?	Hajj	Count	54	40	45	46	31	9	225
		% within What is the event where crowd control is required?	24.0%	17.8%	20.0%	20.4%	13.8%	4.0%	100.0%
	Olympics	Count	47	51	39	44	39	17	237
		% within What is the event where crowd control is required?	19.8%	21.5%	16.5%	18.6%	16.5%	7.2%	100.0%
Total		Count	101	91	84	90	70	26	462
		% within What is the event where crowd control is required?	21.9%	19.7%	18.2%	19.5%	15.2%	5.6%	100.0%

Table 6.91- comparison for health issues relevant for crowd management

Bar Chart

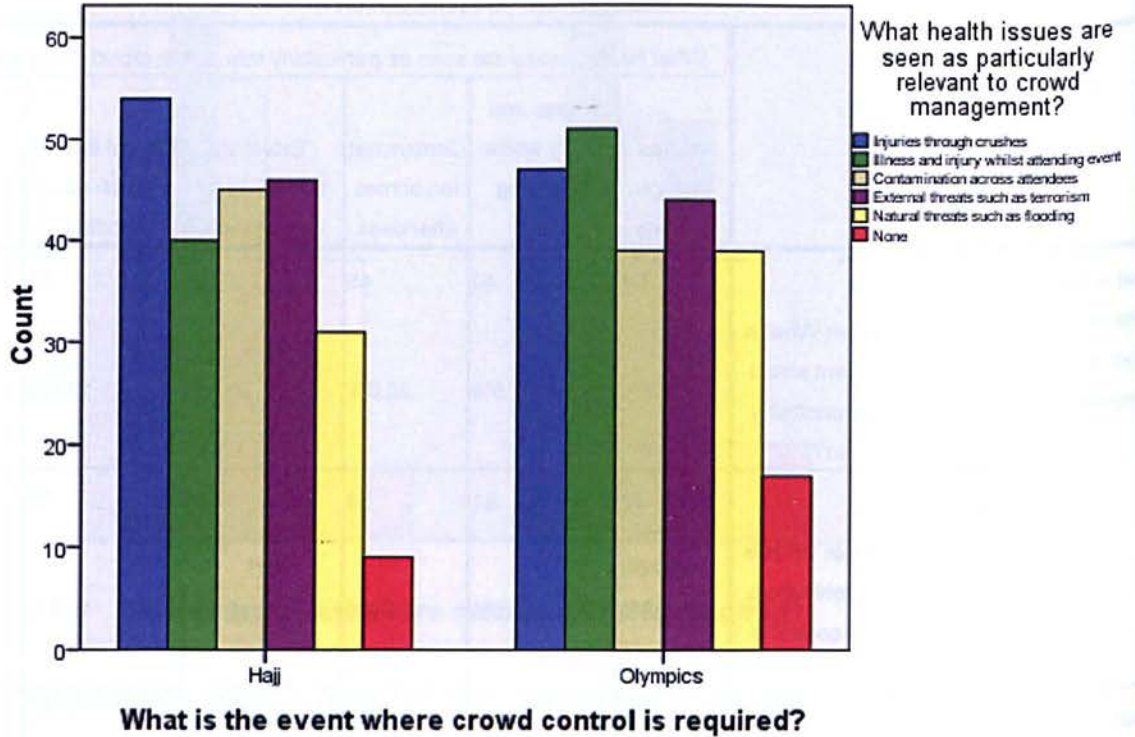


Figure 6.91- comparison for health issues relevant for crowd management

Interpretation

'Health' was the next section in the questionnaire, in which the question was about the health issues that are seen as particularly relevant to crowd management. According to the responses of the survey, in the case of Hajj, the 'injuries through crushes' was selected by the most respondents. On the other hand, the option of illness and injury while attending the event was the most selected option in case of the Olympics respondents. Apart from the option of 'none' the 'natural threats such as flooding' was voted the least for both Hajj respondents and Olympics respondents. Looking at the Table and Figure 6-91 above .

Part 14: LEGAL AND REGULATORY

Question 29

What is the event where crowd control is required? * How important is legal regulation when planning an event?

Crosstabulation

		How important is legal regulation when planning an event?						Total
		Vitally important	Very important	Moderately important	A little important	Of very little importance	Not at all important	
What is the Hajj event where crowd control is required?	Count	75	48	30	35	22	15	225
	% within What is the event where crowd control is required?	33.3%	21.3%	13.3%	15.6%	9.8%	6.7%	100.0%
	Olympics Count	75	52	42	29	28	11	237
	% within What is the event where crowd control is required?	31.6%	21.9%	17.7%	12.2%	11.8%	4.6%	100.0%
Total	Count	150	100	72	64	50	26	462
	% within What is the event where crowd control is required?	32.5%	21.6%	15.6%	13.9%	10.8%	5.6%	100.0%

Table 6.92- comparison for importance of legal regulation

Bar Chart

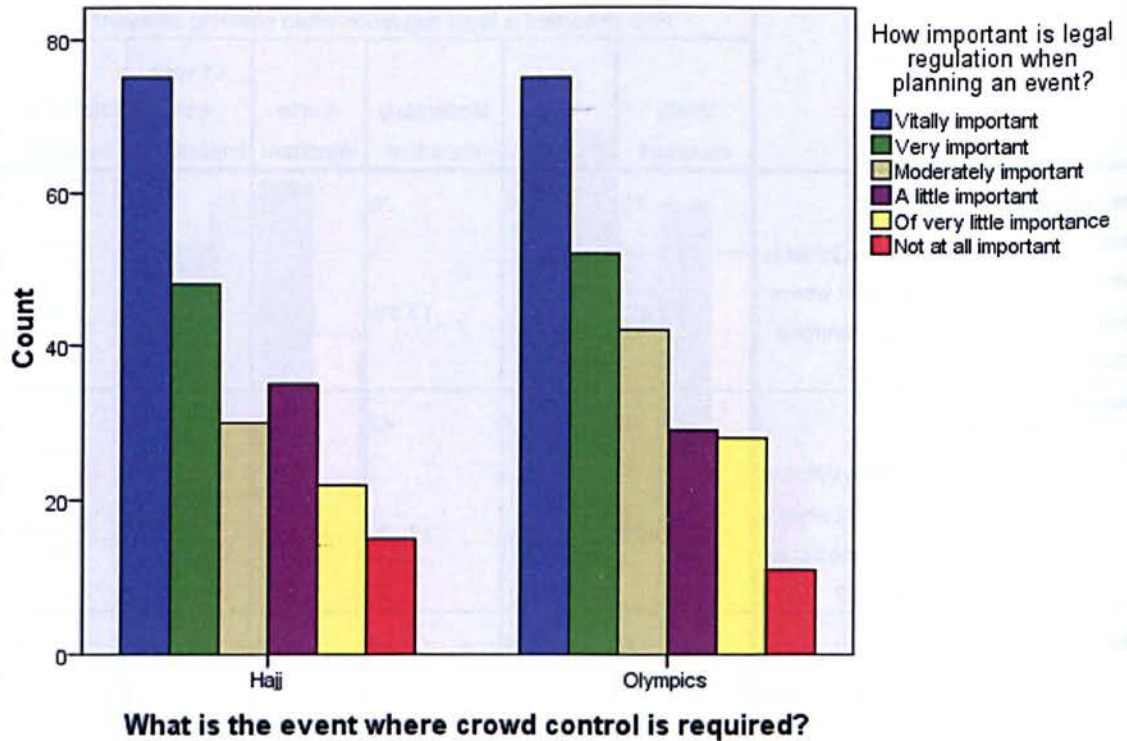


Figure 6.92- comparison for importance of legal regulation

Interpretation

'Legal and Regulatory' was the next section in the questionnaire, in which the question was about how important, is the legal regulation when planning an event. According to the responses of the survey, both in the case of Hajj and Olympics respondents, vitally important was the most important option and very few people in both cases voted that it is not important at all for both Hajj respondents and Olympics respondents. Looking at the Table and Figure 6-92 above .

Question 30

What is the event where crowd control is required? * Do you feel that regulatory requirements are beneficial to crowd safety? Crosstabulation

			Do you feel that regulatory requirements are beneficial to crowd safety?					Total
			Yes – incredibly	Yes – slightly	Moderately	Rarely	Never	
What is the event where crowd control is required?	Hajj	Count	69	44	61	37	14	225
		% within What is the event where crowd control is required?	30.7%	19.6%	27.1%	16.4%	6.2%	100.0%
	Olympics	Count	61	60	58	44	14	237
		% within What is the event where crowd control is required?	25.7%	25.3%	24.5%	18.6%	5.9%	100.0%
Total		Count	130	104	119	81	28	462
		% within What is the event where crowd control is required?	28.1%	22.5%	25.8%	17.5%	6.1%	100.0%

Table 6.93- comparison for regulatory requirements beneficial for crowd safety

Bar Chart

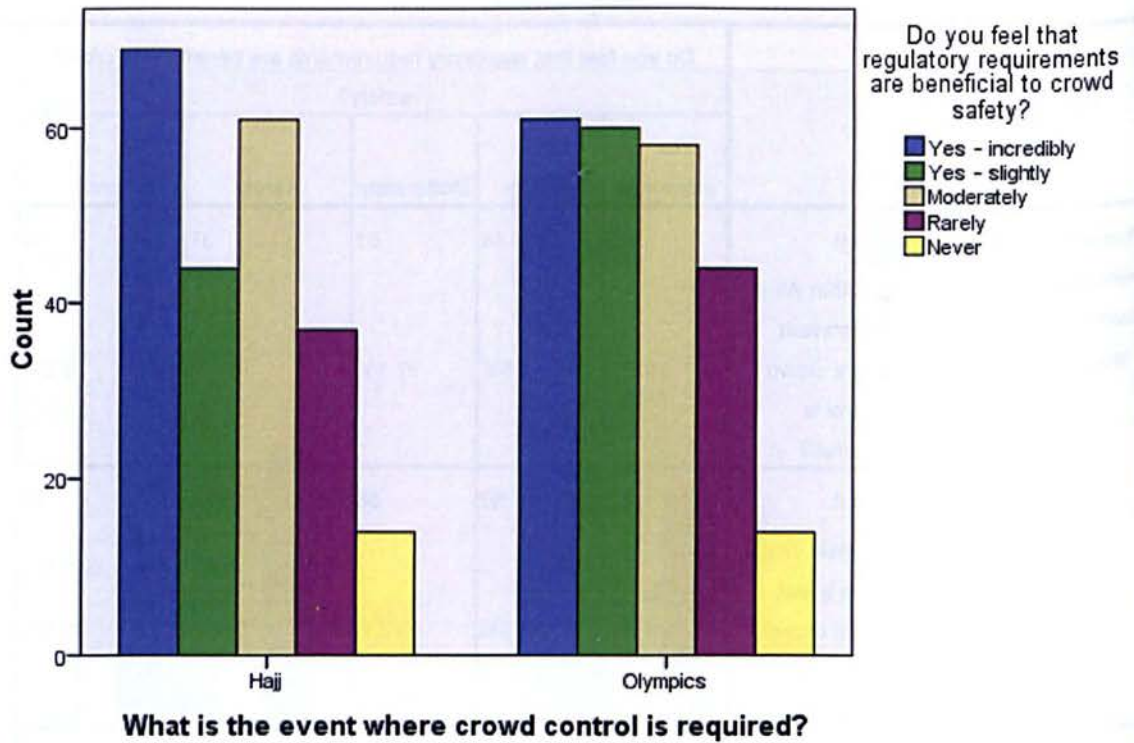


Figure 6.93- comparison for regulatory requirements beneficial for crowd safety

Interpretation

'Legal and Regulatory' was the next section in the questionnaire, in which the question was about that regulatory requirements are beneficial to crowd safety. According to the responses of the survey, both in the case of Hajj and Olympics respondents, yes incredibly was the most important option and very few people voted that never at all for both Hajj respondents and Olympics respondents. Looking at the Table and Figure 6-93 above .

Part 15: TRAINING AND REHERSAL

Question 31

What is the event where crowd control is required? * Do you undertake any advance training and rehearsal for an event? Crosstabulation

			Do you undertake any advance training and rehearsal for an event?					Total
			Yes, several times	Yes once	Yes parts of the operation	Not usually	Never	
What is the event where crowd control is required?	Hajj	Count	21	33	86	61	24	225
		% within What is the event where crowd control is required?	9.3%	14.7%	38.2%	27.1%	10.7%	100.0%
	Olympics	Count	81	54	47	37	18	237
		% within What is the event where crowd control is required?	34.2%	22.8%	19.8%	15.6%	7.6%	100.0%
Total		Count	102	87	133	98	42	462
		% within What is the event where crowd control is required?	22.1%	18.8%	28.8%	21.2%	9.1%	100.0%

Table 6.94- comparison for advance training and rehearsal

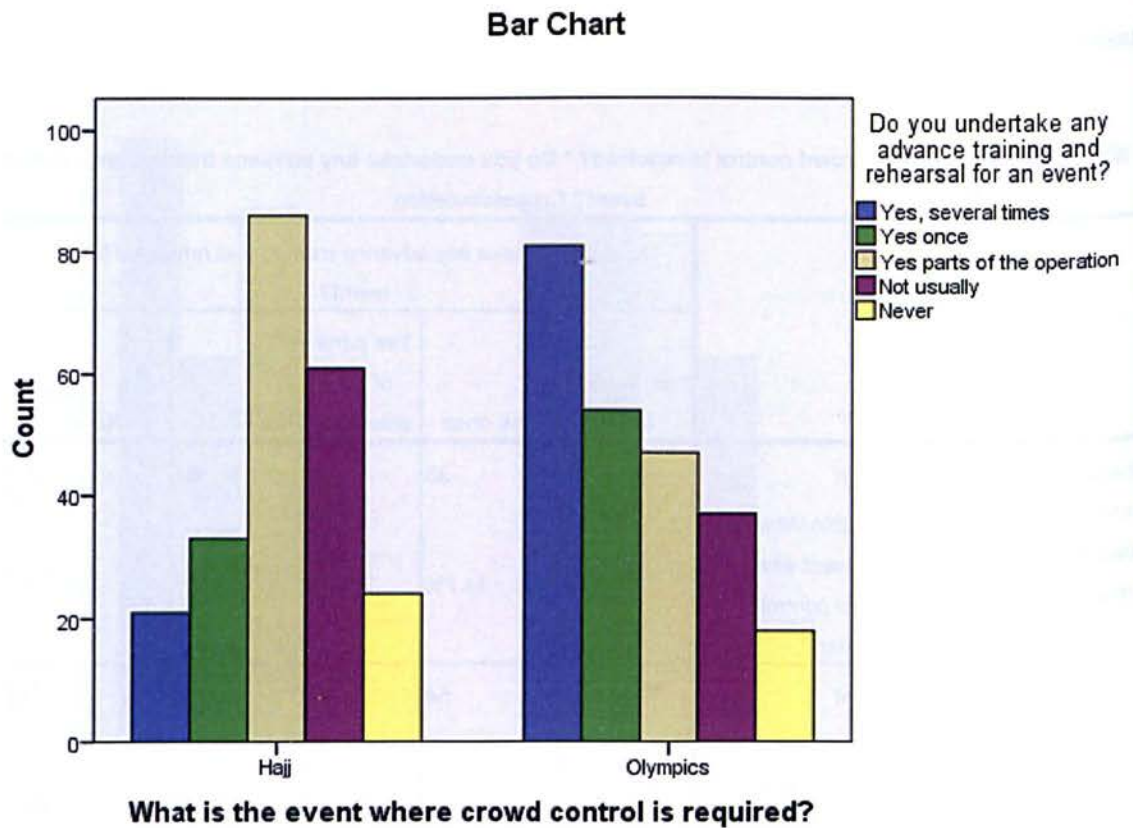


Figure 6.94- comparison for advance training and rehearsal

Interpretation

'Training and Rehearsal' was the next section in the questionnaire, in which the question was regarding if any advance training and rehearsal for an event was undertaken. According to the responses of the survey, in the case of Hajj, the 'yes part of the operation' was selected by the most respondents. However, for Olympics, the most selected option was 'yes several times'. This meant that the training and rehearsal was done for Olympics, but not for Hajj event most of the times. Looking at the Table and Figure 6-94 above .

Question 32

What is the event where crowd control is required? * What types of training and rehearsal are seen as being most important for crowd management? Crosstabulation

			What types of training and rehearsal are seen as being most important for crowd management?					Total
			Simulation	Disaster management practices	Training to use specific technology	Overall event rehearsal	None	
What is the event where crowd control is required?	Hajj	Count	43	70	44	52	16	225
		% within What is the event where crowd control is required?	19.1%	31.1%	19.6%	23.1%	7.1%	100.0%
	Olympics	Count	34	57	69	55	22	237
		% within What is the event where crowd control is required?	14.3%	24.1%	29.1%	23.2%	9.3%	100.0%
Total		Count	77	127	113	107	38	462
		% within What is the event where crowd control is required?	16.7%	27.5%	24.5%	23.2%	8.2%	100.0%

Table 6.95- comparison for training and rehearsal important for crowd management

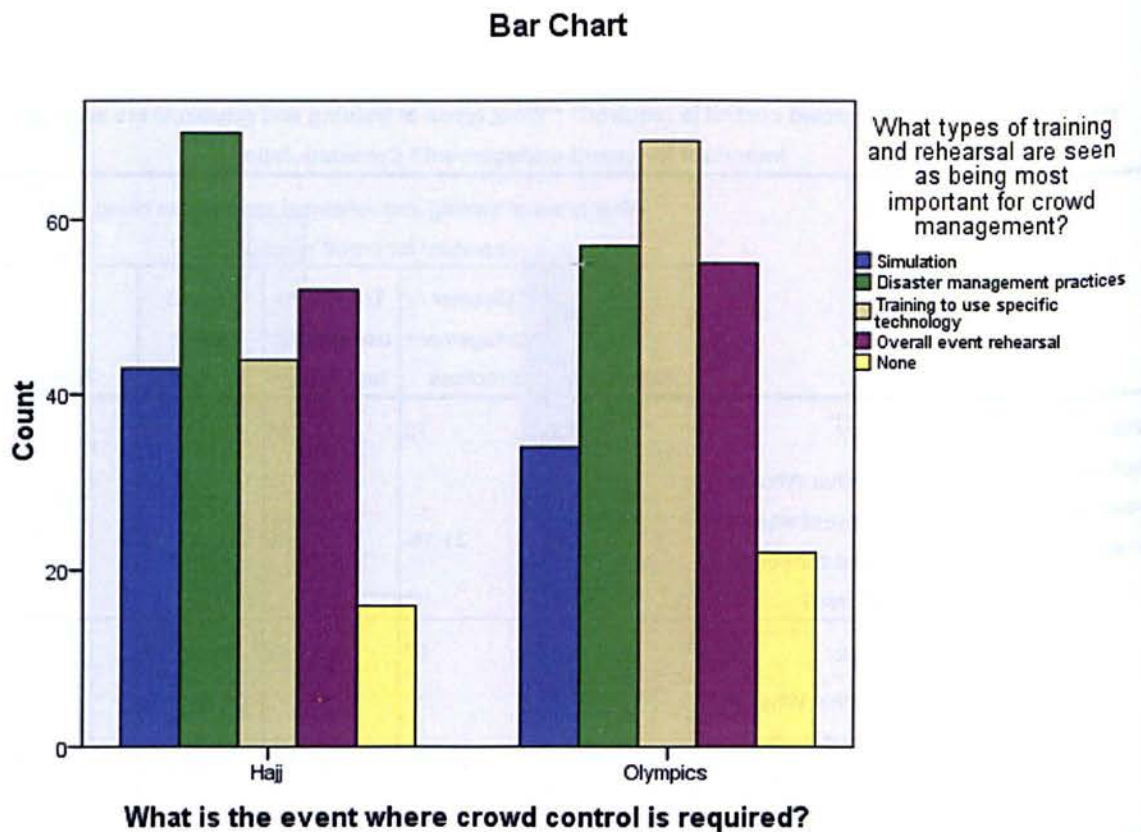


Figure 6.95- comparison for training and rehearsal important for crowd management

Interpretation

The next question in the 'Training and Rehearsal' was about the types of training and rehearsal that are most important for crowd management. According to the responses of the survey, in the case of Hajj, the 'disaster management practices' were the most selected option and for Olympics respondents the most selected option was 'training to use specific technology'. It is also important to mention here that the 'overall event rehearsal' was also equally important for both Hajj and Olympics respondents and was selected by many respondents in both surveys. Looking at the Table and Figure 6-95 above .

Part 16: FINANCIAL

Question 34

What is the event where crowd control is required? * Which financial measures are deemed important for the crowd management process? Crosstabulation

			Which financial measures are deemed important for the crowd management process?					Total
			Return on investment	Income for every attendee	Overall income	Overall expenses	None	
What is the event where crowd control is required?	Hajj	Count	46	53	48	59	19	225
		% within What is the event where crowd control is required?	20.4%	23.6%	21.3%	26.2%	8.4%	100.0%
	Olympics	Count	50	56	76	39	16	237
		% within What is the event where crowd control is required?	21.1%	23.6%	32.1%	16.5%	6.8%	100.0%
Total		Count	96	109	124	98	35	462
		% within What is the event where crowd control is required?	20.8%	23.6%	26.8%	21.2%	7.6%	100.0%

Table 6.96- comparison of financial measures Important for crowd management process

Bar Chart

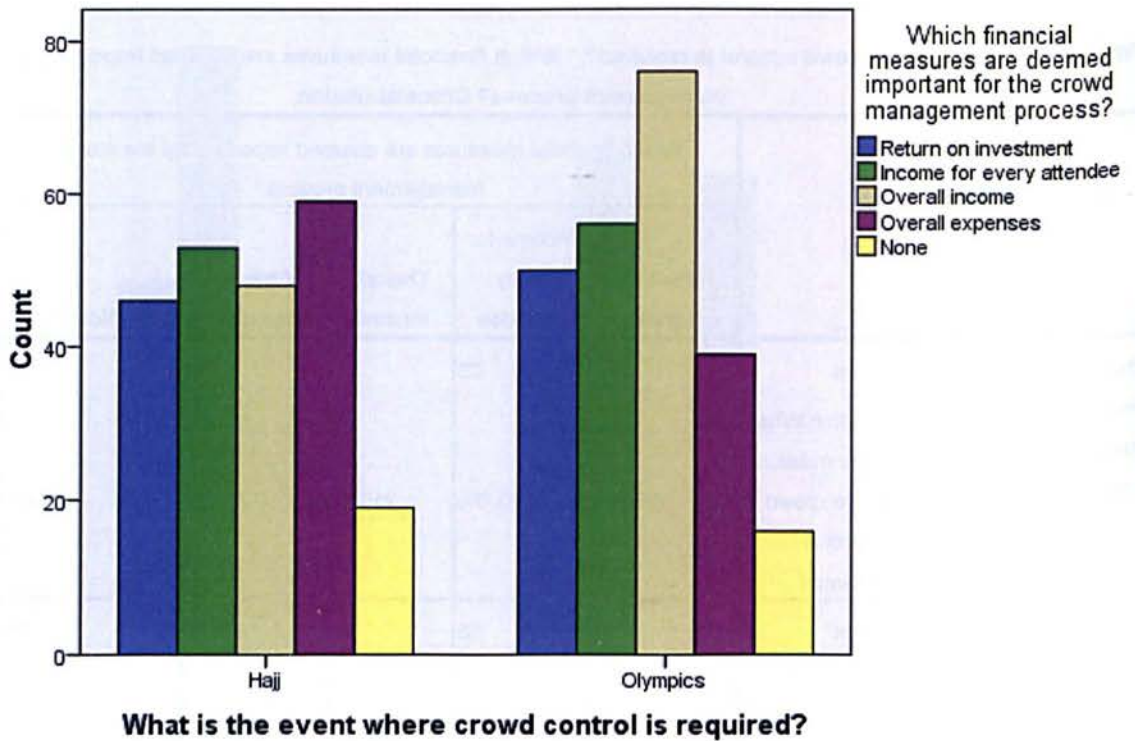


Figure 6.96- comparison of financial measures important for crowd management process

Interpretation

'Financial' was the next section in the questionnaire, in which the question was about the financial measures that are deemed important for the crowd management process. According to the responses of the survey, in the case of Hajj, the 'overall expenses' was selected by the most respondents. On the other hand, the option of overall income was the most selected option in case of the Olympics respondents. Looking at the Table and Figure 6-96 above .

Part 17: DISASTER MANAGEMENT

Question 36

What is the event where crowd control is required? * What aspects of disaster management are dealt with as part of overall crowd management? Crosstabulation

			What aspects of disaster management are dealt with as part of overall crowd management?							
			Identifying likely disaster threats	Simulations to identify disaster threats	Additional resources for disaster management	Infrastructure changes	Health and medical planning	Liaising with 3rd party providers	None	Total
What is the event where crowd control is required?	Hajj	Count	41	34	42	39	30	23	16	225
		% within What is the event where crowd control is required?	18.2%	15.1%	18.7%	17.3%	13.3%	10.2%	7.1%	100.0%
	Olympics	Count	27	44	53	52	36	15	10	237
		% within What is the event where crowd control is required?	11.4%	18.6%	22.4%	21.9%	15.2%	6.3%	4.2%	100.0%
	Total	Count	68	78	95	91	66	38	26	462
		% within What is the event where crowd control is required?	14.7%	16.9%	20.6%	19.7%	14.3%	8.2%	5.6%	100.0%

Table 6.97- comparison of aspects of disaster management Important for crowd management

Bar Chart

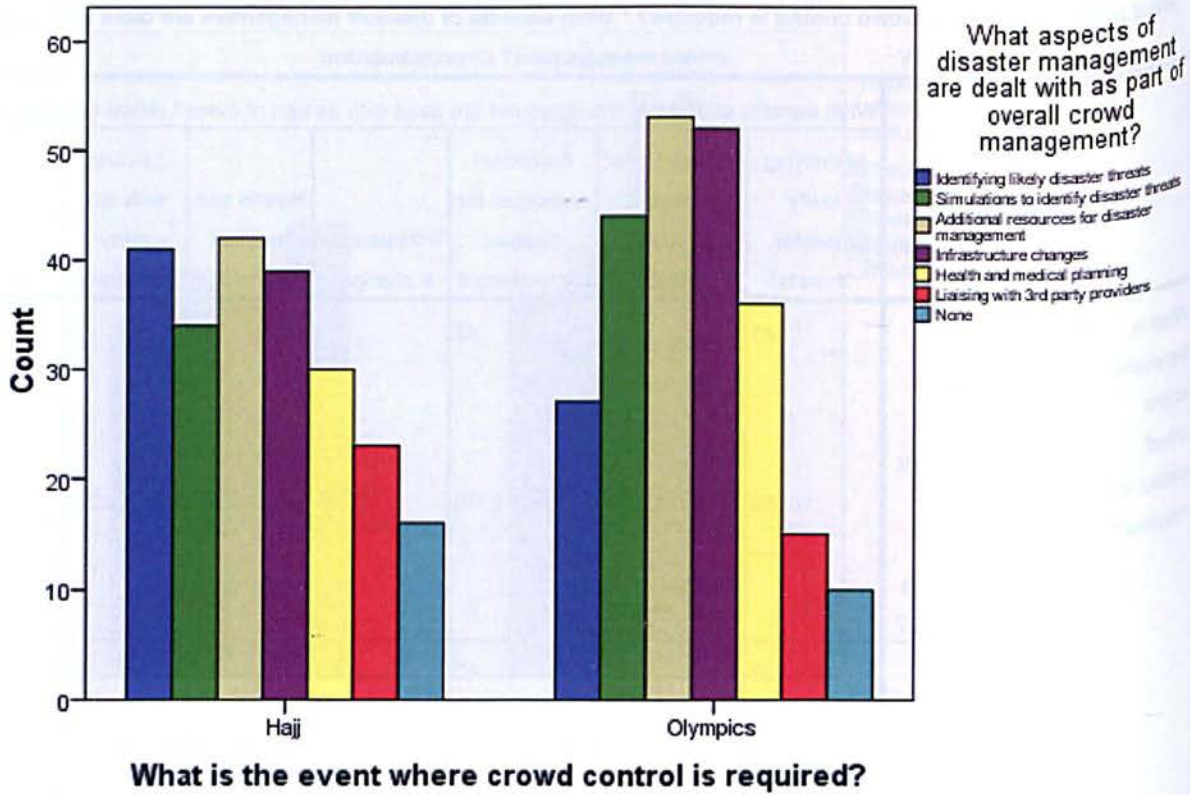


Figure 6.97- comparison of aspects of disaster management important for crowd management

Interpretation

'Disaster Management' was the last section in the questionnaire, in which the question was about the aspects of disaster management that are dealt with as part of overall crowd management. According to the responses of the survey, in the case of both Hajj and Olympics respondents, 'additional resources for disaster management' was selected by the most respondents. Apart from the option of 'none' the 'liaising with the 3rd party providers' was voted the least for both the Hajj and Olympics respondents. Looking at the Table and Figure 6-97 above .

CHAPTER 7: DISCUSSIONS AND FINDINGS

7.1 Introduction

This chapter of the report focuses on the discussions of the results and findings that were generated in the earlier chapters through data qualitative and quantitative data collection and case study analysis. The discussion is done in the light of and in comparison to the previous studies that were reviewed in the literature review section of this report. The previous chapters looked at the modeling of crowd behaviour and management, from both a theoretical background point of view and also from the perspective of using computerised simulation to achieve a more efficient understanding and also to create a framework that would be usable by a wide variety of authority figures, particularly when it comes to identifying potential problem areas within the crowd. In addition to this, case studies for Hajj and Olympics were also looked upon along with the analysis of six scenarios of the crowd behavior and management.

As part of this analysis, therefore, two specific events were looked at, both of which presents different challenges to the organizers. This will enable the author to consider a wide variety of frameworks that could potentially be used and the way in which they could be developed, through every phase of an event, to create a robust framework for future use. The problem, therefore, is to gain a suitable understanding of crowd management issues and frameworks, with reference to the case studies, as well as looking at literature reviewing this area and considering the wider issues, such as political factors and economic issues, as these will have a direct bearing on how crowd management takes place, before looking at establishing an appropriate framework that can be used, in a wide variety of circumstances, and can be adapted for future use. The collection of primary data involved the administration of a quantitative questionnaire and conducting the semi-structured qualitative interviews. The analysis of data collected from these methods result in the presentation of the framework for crowd management. Hence, all of this will then be drawn together, in order to gain a complete picture of the use of a modelling framework for crowd management (Smith, 1995).

This research aimed to establish a framework that would be useful, in a wide variety of circumstances, and one which enables all of the different aspects of crowd management to come together, for it to be an overall success. However, there are likely to be some factors which will require further research, or aspects that may need to be adapted, depending on how society evolves, in the future. For example, there has been a dramatic increase in the use of information technology, in recent years; this has naturally changed the way in which crowd management can take place, as well as changing the availability of travel for those wishing to participate in events, all of which will change how crowd management operates and based on the future challenges which require the framework to be adaptable. Naturally, however, the main focus of crowd management is likely to be, initially, to achieve public safety and this is the primary activity that those involved in these events will be focused on, before beginning to look at the extra benefits that can be achieved through strong crowd management initiatives (Lin, et al., 2001). Although crowd management principles can be used in a wide range of situations, it is worth noting that the precise way in which the crowd is dealt with, will depend on a wide variety of factors.

The issues associated with crowd management fall in two very different categories and, when attempting to establish an overall model that allows for those involved in event management to look at how they should be dealing with the types of crowds that they are likely to experience (Le Bon, 1897), each of the factors need to be considered, although they will naturally be more important in some events than another. Firstly, the very essence of crowd behaviour needs to be understood, completely. In order to have an effective plan in place, those involved in creating the plan must be aware of the types of characteristics that the crowd is likely to display. In its most basic sense, information such as the size of the crowd and the likely emotional position of the crowd will be important to determine the chance of conflict.

The issue of crowd management is something that has been gaining increasing attention, over the years. Despite this attention, crowd gatherings and the difficulties associated with this type of crowd gathering are not in themselves new, with instances such as the event taking place during the Hajj providing examples of how major injuries can occur where crowds are not suitably managed. By looking at various different disasters which have emerged, over the years, relating to crowd management and

identifying ways in which computerised systems and networks could potentially assist with crowd management, the basis of this research has established through the assistance of two specific case studies which were used (Beene, 1992).

The research, here, has drawn on network and framework theory to identify how the different components associated with crowd management can work together, in order to establish a workable framework that a crowd management team can use, both before, during, and after the event. Two specific case studies are used as a means of identifying how these could be practically applied, including the Hajj to Mecca and the London Olympics 2012. These two cases both create substantial crowd issues; however, they were very different in nature and in the way in which the crowds are likely to behave. This research was broken down the factors that emerge when dealing with crowd management and identified which of these could not be directly impacted upon by the crowd management team, before going on to assess how certain external activities could, potentially, change the way in which the crowd operates. By undertaking a full analysis of the cause and effect associated with crowd movement, the external factors that could impact on the crowd and the means whereby the crowd management team could influence these changes, a detailed framework was established. With the assistance of computer simulation, information can be gathered quickly and disseminated quickly, thus allowing the crowd management team to react to changes, both predicted and non-predicted.

In summary, this research suggested that anyone involved in crowd management, first needs to identify all of the factors that may be relevant to the way in which the crowd behaves, whether this emanates from the crowd themselves, the physical infrastructure, or another external factor which may be completely beyond the control of the crowd management team, such as the weather.

The research, initially, aims to break down the theories associated with crowd management. However, whilst this involves drawing on examples from the two case studies, the fundamental aim was to look at establishing a framework that could potentially work across any crowd management situation. Therefore, the components that come together in a crowd based situation need to be identified, in a more generic way, before then going on to see how this could apply to the specific case studies and analysis, here. All of this information was then pulled together, in order to look at

whether it would work in the case of the two case studies identified in this research. This also enabled the researcher to identify how this approach would work, in the future, with other crowd management situations. In using this method, the researcher has been able to establish a generalised framework which can be applied by crowd management officials, as well as establishing a questionnaire that is based on the framework and which can be used by crowd management officials to gather the necessary data, in advance of laying out the way in which they are going to deal with a particular crowd situation. By having these types of generic frameworks and questionnaires in place, it is proposed by the researcher that this has been created which can be used in a broad range of crowd management situations and is sufficiently adaptable to changes which may take place, both internally and externally.

7.2 Discussion of results: Crowd Management Evaluation Components (CMEC) - PRACTICAL APPLIATION AT THE HAJJ

The Hajj to Mecca presents a real challenge to those involved in modelling crowd behaviour, most notably due to the sheer volume of people involved and the fact that they are all in pursuit of similar religious agendas which can result in irrational behaviours, particularly when faced with a potential crisis. By looking at the six objective points that have been identified as being central to the model, the way in which this model could apply to the Hajj can be evaluated, with a greater practical understanding.

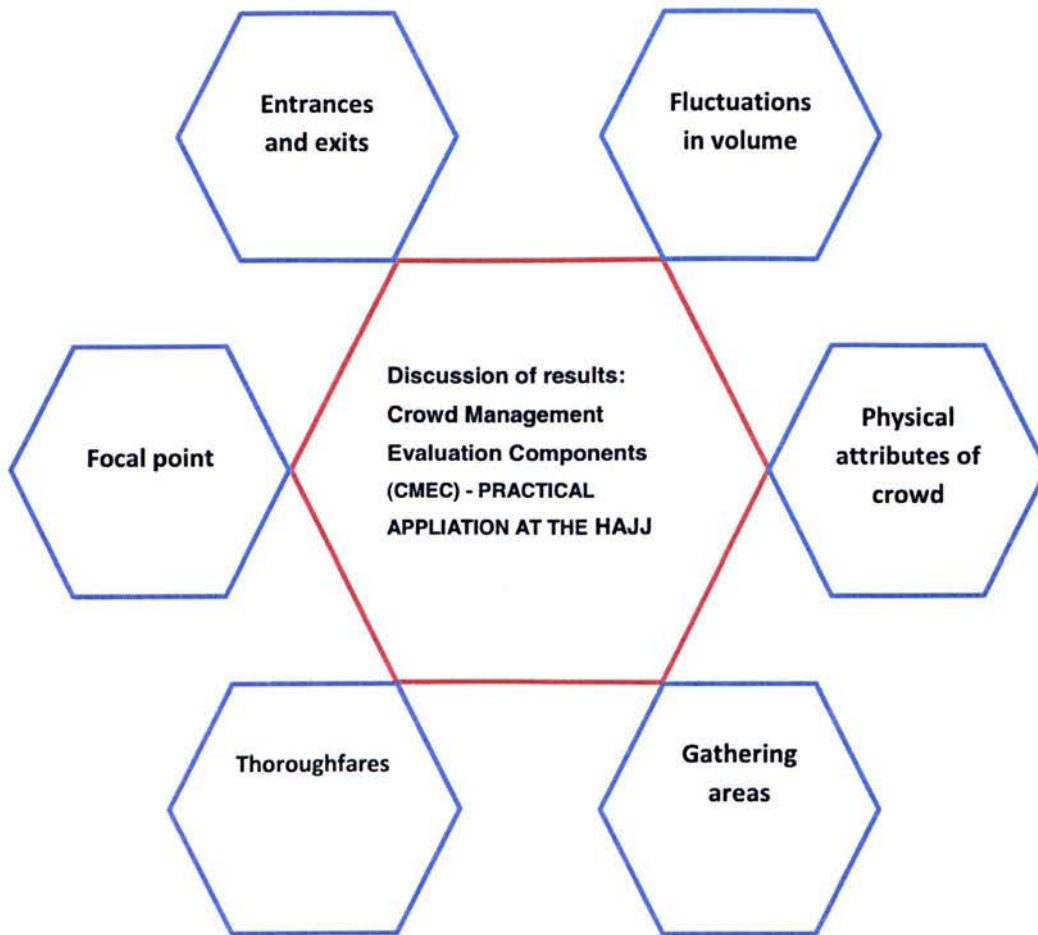


Figure 7.1 Crowd Management Evaluation Components (CMEC) - Practical application at the Hajj

Fluctuations in volume will take place throughout the pilgrimage and these can be ascertained, based on the general numbers that travel along the particular route throughout the period. Therefore, specific volumes can be mapped with reasonable accuracy. It is also likely that there are going to be specific periods of time that are likely to experience greater volumes of individual beginning the pilgrimage, particularly given

temperature fluctuations during the day and the desire of individuals to do the majority of the travelling during the early hours or the latter hours of the day.

The physical attributes of the crowd will be very varied and there will be some individuals who are physically very strong, but also a large percentage of the crowd will be old and frail, as well as families with small children. This means that, when a potential crash situation emerges, there are likely to be two distinct categories of people, those who are physically able to dominate the position and those who are not.

The entrances and exits available during the pilgrimage have, traditionally, been relatively restricted. Although increasingly, those responsible for ensuring health and safety, during the pilgrimage, have looked towards increasing the number of entrances available and widening the access routes so as to prevent congestion, on the whole, however, there are still choke points, particularly in some of the key areas of the pilgrimage.

Apart from the entrances and exits, there are also other potential problem areas for the crowd and anyone looking to manage the crowd in an efficient manner. For example, there are also specific focal points which are central to the pilgrimage, most notably Mina and this creates a slower moving, denser crowd, particularly at the central points by the pillar. Although this will take place over a period of several days there will be a concentrated effort at this particular focal point.

A similar analysis can be undertaken in relation to the fact that the pilgrimage takes place over a set route. However, whilst there may be slight differences in the way in which individuals travel, they are all, fundamentally, focusing on the same endpoint and this will, ultimately, impact on the thoroughfares available, particularly as the crowd begins to converge at Mina.

These static issues will always be central to how the crowd moves, during the pilgrimage, and there will always be a need to look at all these focal points, regardless of how the crowd itself is managed, in terms of achieving this end agenda. Based on this, therefore, crowd modelling in relation to the Hajj needs to look at how the crowd can be influenced, while still allowing the pilgrims access to the key focal points which they hold in high regard, as part of the activity. Throughout the pilgrimage, issues relating to personal space will naturally arise and, to a certain extent, it is accepted by

those involved in the pilgrimage that there will be an element of density, which will immediately encourage the crowd to move at a slower pace. The ultimate aim of the pedestrians involved in the pilgrimage is to reach the central place of Mina, and willingness to travel slower in order to achieve this is likely to be present, provided they ultimately get to their end destination.

By looking at the other factors that are external to crowd management and how they interact with these static issues, several distinct factors become clear, when it comes to dealing with the Hajj.

For example, when looking at the infrastructure surrounding the Hajj, those responsible for the management of the crowd could potentially look towards establishing different infrastructure routes that will encourage the individual to follow different routes and thus to relieve pressure around key focal points as the results of the qualitative and quantitative data collection also revealed. The computer simulation process could be used to ascertain what would happen, in the event that new infrastructure options were offered to individuals as part of the pilgrimage. In particular, the impact of this type of infrastructure could be looked at, from the point of view of relieving certain points that are prone to crush behaviour. It is likely that, if new infrastructure were to be put in place, this would offer the officials greater control over the movement of individuals, particularly if they were offering public transport for groups and individuals to travel along the pilgrimage route. Not only would this ease the thoroughfares, but it would also allow the officials to ensure that there is a constant flow of individuals through the crush points and to restrict transport availability where it looks likely that a crush is on the verge of happening.

Another area on which the officials involved in crowd management could potentially impact is that of third party support; simulations could be made in order to determine the impact of having increased intelligence in place to identify potential problem areas, before they emerge, as well as having a greater prevalence of emergency services and security staff at certain key locations. Gathering intelligence is, in fact, an aspect of managing the crowd, in this particular situation. Moreover, having looked at the issues that are deemed to be static, such as the end destination points, intelligence can then be gathered surrounding how the crowd behaved leading up to this point, something which has already been done, to a limited extent, already. For example, those involved

in improving the level of health and safety associated with the pilgrimage have already gathered intelligence, which will allow them to predict areas of difficulty, before there is a direct threat to human life.

Using the theories associated with computerised simulation and applying them to the likely crowd scenarios, during the pilgrimage, it is suggested that several different simulations are run, but with only one or two variables, such as having new access routes made available, as well as identifying what would happen, in the event that alternative transport arrangements were made available to those taking part in the pilgrimage and whether this would allow those involved in managing the crowd sufficient control over the flow of people, during these specific points of concern, most notably in Mina.

Another simulation that could be run could involve anything that would potentially slow the crowd down, in a similar way that traffic calming measures work, when dealing with vehicular crowd management. Essentially, the crucial factor is the final destination and the number of individuals involved who will remain present, and the simulation will need to look at a variety of different factors which could be changed by those involved in crowd management, in order to see how effective these measures would be.

A secondary strand of crowd management which needs to be taken into account, when dealing with this pilgrimage is the fact that it has been the cause of many deaths, over the years. Therefore, a large amount of attention needs to be paid to dealing with a crisis situation, once it emerges, and looking at various different simulations on how these crisis situations can not only be avoided, but can potentially be dealt with, if they do arise.

By examining the various different factors which are considered to be potential inputs to the crowd modelling framework, it can be seen that there are, in fact, several different reasons why a crisis situation might emerge as part of the pilgrimage. Firstly, the aims and objectives of the crowd are very much result driven and, as the pilgrimage is closely linked to religious principles, there are a large number of individuals who believe that their own personal safety should come second to achieving the aim of the pilgrimage, thus making it difficult to ensure that the individuals themselves behave in a way that may potentially maintain their own safety. Where the individuals within the crowd have

little or no regard for their own personal safety, additional challenges are faced by those involved in crowd management. In particular, it is noted that the behaviours of individuals, when faced with a crisis, are likely to be very different from those in other crowd situations. It is generally assumed that, where a crush takes place in a crowd, it typically involves the individuals trying to get to the nearest exit, in the shortest space of time; whereas, in the case of the pilgrimage, it is more likely that many of the individuals involved will stay within the region and will continue to pursue the result they are after, rather than necessarily travelling towards the nearest exit. With this in mind, it is unlikely that establishing a new exit would impact on how the crowd deals with the crisis; therefore other ways of lessening the pressure at particular points need to be considered. The risk acceptance of the individuals involved in the pilgrimage is, therefore, deemed to be particularly high. Therefore, simulation could be run to look at how the crowd would react, in the event that the density of the crowd in Mina became too great, yet no individual was prepared to leave by an exit without first visiting the pillar. This type of simulation would allow the crowd management officials to look at ways of channelling the pilgrims around the pillar, in a more organised fashion, recognising that individuals would be more prepared to leave the area, once they had achieved their end result.

It is suggested, therefore, that when an actual crisis emerges, as part of the pilgrimage, it is going to be extremely difficult for security staff and emergency services to encourage the crowd to behave in such a way that will alleviate the dangers to the individual crowd members (Moulin, et al., 2001).

Bearing in mind that reaching the end location is deemed to be central to all members of the pilgrimage, this needs to be a central part for the crowd management, with external factors being drawn upon to control and manage this process, rather than change it. Anything that will potentially control the flow of people towards the key focal point, while also allowing each individual to meet with their own agenda, will ultimately control the crowd, effectively.

Having used this modelling framework which has been established in the earlier section of this chapter, it has been possible to identify the stationary factors that are simply not going to change; this offers the authorities a much greater chance of being able to control the crowd in a way that supports them in achieving their end aim and will,

therefore, be much more readily accepted. In the case of the pilgrimage, this would involve using external control factors to support the crowd in reaching Mina, but doing so in a way that allows for a consistent flow of individuals, without having the lulls which have been identified as being a precursor for a particularly busy period, within a few minutes, which can create a danger to health and safety.

In this case, it has been suggested that simulations are run in relation to creating an infrastructure that would control the flow of people, as well as creating thoroughfares that would encourage movement of all individuals, at a consistent pace, with exits being made readily available to those who have already achieved their objective of visiting the pillar. As a secondary layer of crowd management, the simulation will also allow health and safety officials to identify signals of danger and to take action, prior to a crush situation emerging. Examples include slowing down the flow of individuals to the region, by either reducing the amount of transport available or by creating gateways along the path, so that all pilgrims cannot make it to the danger location, at the same time. This will all need to be done with reference to the static factors such as the end destination point and the volume of individuals trying to get to that endpoint, which is simply not flexible and not under the control of the crowd management officials.

7.3 Discussion of results: PRACTICAL APPLICATION AT THE 2012 OLYMPICS

Using the same framework with the 2012 Olympics, a similar analysis can be undertaken. However, the reality is that the crowd management issues in the case of the London Olympics are going to be considerably wider than those discussed in relation to the Hajj.

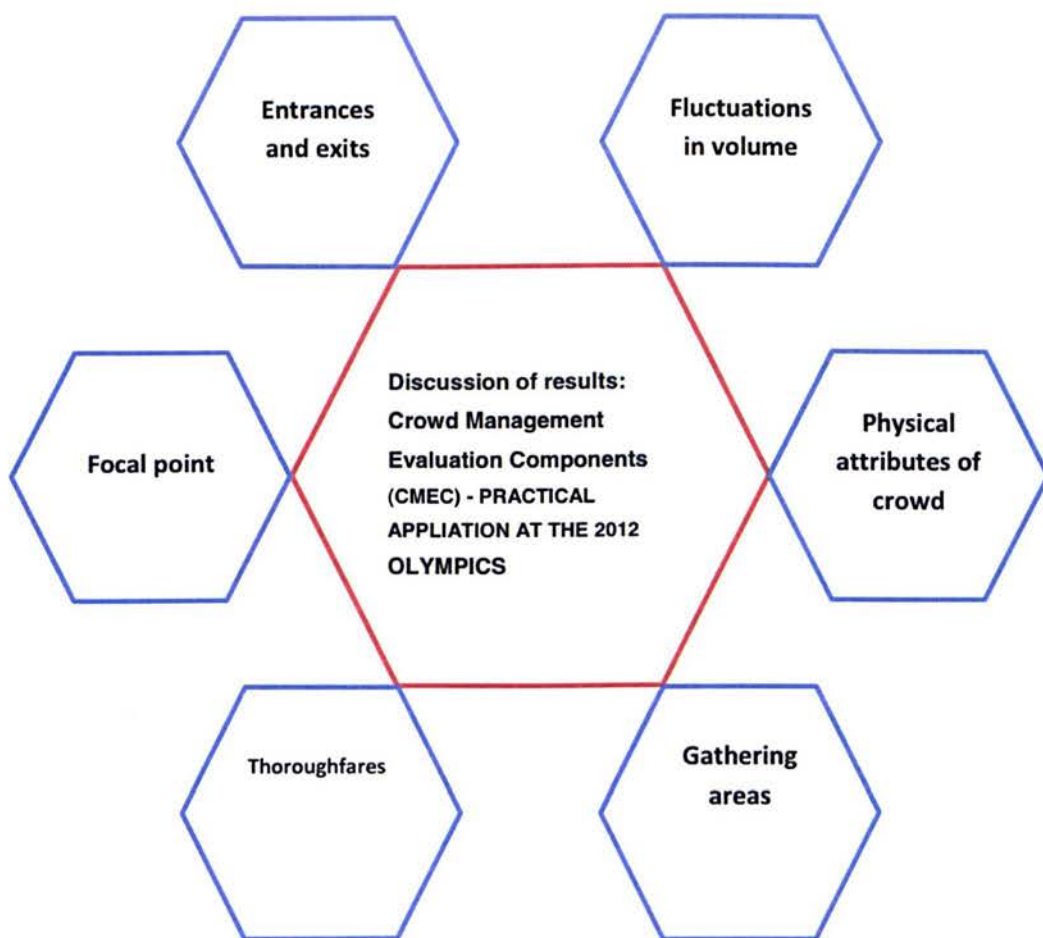


Figure 7.2 Crowd Management Evaluation Components (CMEC) - Practical application at the 2012 Olympics

Fluctuations in volume will happen consistently, across London, during the Olympics In 2012, with a variety of different events taking place, at different venues, all of which have specific tickets which have been sold to those looking to enter the venues. This means that, to a certain extent, the actual volumes of individuals entering each of the venues, on any given day, can be reasonably easily mapped, in a rudimentary form, by looking at the number of tickets that have been sold for each event and venue.

Similarly, the entrances and exits available to each of the venues will also be easily identifiable, including thoroughfares that will take individuals to the transport points to each relevant venue. All of these factors will remain relatively static and, as such, the gathering areas that are likely to form, such as in the stadia or the relevant venues will

be relatively consistent. The physical attributes of the crowd will be particularly varied, with a large number of families and older individuals also travelling to watch specific events. The demographic of people who have bought tickets can be matched, to a certain extent; however, on the whole, the crowd demographic will be relatively mixed, with a degree of competition being seen amongst the crowd, particularly where there are several countries being supported. However, on the whole, the crowd is likely to be peaceful and family orientated.

The real challenge that exists for crowd management within the London Olympics is associated with the large number of unknown factors that could, potentially, impact on how the crowd moves. There are relatively few static issues and, whilst there are strong controls in place, it can be used by the authorities to move the crowd around and to deal with an emergency situation, there is also a much greater number of unknown factors which could emerge throughout the games. When using computer simulation and breaking it down to specific times and individual venues, it can be seen that a substantial number of simulations will need to be undertaken, to map the various different stages and different events. Certain events will naturally be more popular and therefore the density of the crowd surrounding venues for these events will need to be increased for the purposes of running a simulation.

One particular area which is very much within the control of the authorities associated with crowd management at the London Olympics is that of the infrastructure and transport availability offered to those looking to reach the venues. Due to the nature of the London region, it is suggested that the crowd will be managed primarily through the use of public transport, as there will be very little in the way of private transport being allowed into the area. Given the strong area of control which is available to the ground management team, it is suggested that the simulations focus on this area and look at the impact and reaction that will be had when more transport is offered to a particular venue, at a particular time or, indeed, less. Consider, for example, a situation where approximately 200 individuals can travel on a particular route, which arrives at a venue, every 5 minutes. This will then offer information to those looking to manage entrance into the venue; as if they are unable to deal with 200 people, every 5 minutes, there will inevitably be a checkpoint at the entrance and this will require either new entrances to

be opened, the entrance to be made more efficient, or the infrastructure to slow down to prevent such a choke.

Based on the analysis undertaken in relation to the London Olympics, as well as the detailed understanding which has now been achieved in relation to crowd management and the modelling of crowd behaviour and simulation, it is suggested that the primary focus should be on controlling the infrastructure, as a means of controlling the flow of crowds. Unlike the position in relation to the Hajj, the personality of individuals involved in the crowds of the London Olympics will typically be somewhat more objective, as there is not a religious drive to ensure that they gain access to particular events. It was noted with the Hajj, that many of individuals were so desperate to gain access to the pillar, that they were prepared to risk their own health and safety, and this created a real difficulty for those looking to alleviate any pressure on particular points surrounding the pillar. This is not such a great issue with the London Olympics and, whilst individuals are likely to be very keen to gain access to events for which they have purchased tickets, this is not likely to be at the expense of physical safety, in the majority of cases. This would mean that individuals are more likely to be behaving in a risk averse manner, particularly given the family based demographic.

When looking at the other aspects that can have an influence on crowd behaviour, other inputs such as the threat of terrorist activity could create an unknown situation that will then need to be looked at, in the context of the fixed attributes, such as the venues, the number of individuals within the venues and the available entrances and exits. Given the magnitude of the London Olympics, several different external risks have already been identified as potentially detrimental to the safety of the crowd. It has already been established that the crowd itself is likely to be risk averse and will attempt to travel to the nearest exit, in the quickest possible time, where there is an external threat, such as a terrorist attack or some form of serious crime or disorder. This assumption that the crowd in its entirety will aim to go through the nearest exit point, in the quickest possible time, is an important part of the modelling framework that has emerged for the London Olympics 2012.

Where this type of emergency situation arises, there are several different stages which need to take place, within the ground management approach. Firstly, the authorities need to have certain triggers that will alert them to a potential difficulty, in a particular

venue. A large amount of intelligence will need to be collected, in order to achieve this level of knowledge, such as identifying the number of individuals who can pass through a particular point, in any given period of time, and a maximum capacity of the various different gathering points. When individuals are travelling during the normal course of the event, crowd management principles will allow the authorities to slowly alter the flow of individuals, through the use of public transport, as noted above, so as to maintain a reasonable flow of people through these potential problem areas. This can also be assisted by the use of security staff and the emergency services, where appropriate (Kaminka & Fridman, 2006). This ability to smooth the flow of people over a prolonged period of time will not be as readily available, in the event of an external influence that creates a sharp change in the way that the crowd behaves; this is, therefore, a secondary element of crowd management which needs to be dealt with, separately. Essentially, therefore, the framework here has alerted those involved in crowd management and the London Olympics 2012; however, there are, in fact, two distinct areas of operation. Firstly, there is the day-to-day management of the crowds, to increase efficiency and to ensure a regular flow of people, so that no one is held up for a prolonged period of time and that safety is maintained; and secondly, there is the disaster management element, where there is a dramatic external influence (Taylor, 1990).

When looking at this formal element of crowd management and the day-to-day movements of the crowd around very different venues, there is also a secondary element beyond merely ensuring health and safety, but also ensuring that the London Olympics is held in high regard, on an international basis, and that the event is commercially viable. The London Olympics 2012 is an extremely important event for the UK and has cost a considerable amount of money, as well as putting London into the public eye. With this in mind, simply ensuring that the crowd presents no danger to human life is a very basic requirement for crowd management and, in reality, the aims and objectives should go much further. This is in contrast with the position in relation to the Hajj, where there is little or no commercial aim behind the gathering and the focus remains on ensuring the health and safety of those involved.

In this respect, the framework needs to be somewhat more sophisticated, in the case of the London Olympics. The movement of the crowd not only needs to ensure the safety

of the crowd, but it must also allow them to have a positive experience and to enable the crowds to be encouraged travel past certain commercial outlets. Simulation can be used to offer information to these commercial outlets, in terms of the volume of people who are likely to be travelling past their specific outlet, at any given point in time, based on the starting time of particular events and the number of tickets that have been sold. This type of information will allow these commercial outlets to ensure that a suitable number of staff is present and that crowds do not build up at these key gathering points (Reicher, 2003).

Disaster planning is also going to be fundamentally important to the crowd management team for the London Olympics 2012. The processes followed from a modelling point of view, in this regard, can be very similar to those already discussed in relation to the pilgrimage. Where there is an external event which causes a dramatic change in how the crowd behaves, this is likely to happen in a relatively short space of time; therefore, the intelligence that the central management team has, in terms of where everyone is located, at any given point, will be crucial to managing the position in the most effective manner. Automation of information gathering will be one of the main ways of gathering intelligence that will allow for a quick reaction, in the event of an external factor emerging, suddenly. Simulations will need to be run in advance of the London Olympics 2012, in order to ascertain the impact of opening another exit, or having specific security staff present, at particular points, to direct the crowd, in the event of an emergency, and with a view to creating more efficient flows of people where density increases and the volume attempting to get through a small space suddenly increases. These similar principles can then be used, in the event that there is some form of public unrest.

It is seen therefore, that by using these stationary factors as the central point for the modelling framework, the London Olympics can also use these crowd management techniques to its advantage, in the same way that the pilgrimage can. However with the Olympics, a much higher relevance is given to external factors that may suddenly change the direction and volume of the crowd, at any given point.

Surprisingly, when applying the modelling framework to the two case studies in this research, it can be seen that, on the whole, they operate in a very similar way, despite the fact that both events are very different, in nature.

The central starting point for any modelling framework that is to be used for crowd management is to identify the static features of the particular crowd, including identifying the underlying aims and objectives, as well as looking at issues that are unlikely to change, such as where there is a specific volume of individuals that will travel through a given point, at a particular point in time. In the case of the Hajj, the focus is on the gathering at the pillar in Mina. However, although this gathering point is not flexible, the number of individuals who pass by the pillar, at any given point in time, could potentially be changed, slightly, through the use of crowd management. Another stationary factor which was deemed to be relevant, in the case of the Hajj, is the fact that individuals may not necessarily have their own health and safety uppermost in mind, and gaining access to the pillar may be seen as more important than ensuring their safety, something which needs to be borne in mind, when managing crowds, during an emergency situation (Sanders & McCormick, 1993).

The starting point was the same for the modelling framework for the London Olympics. Once the various different static elements of the framework were identified, including the various different venues and infrastructure that is available, in order to transport individuals around the different events and venues. The number of tickets sold reflects the capacity and it is this element that will therefore be used as the central factor when it comes to identifying how changes will impact on crowd behaviour.

The characteristics of the crowd are somewhat more predictable for the London Olympics, and it is likely that, in the event of an emergency, all individuals will attempt to gain the quickest route out of the particular venue or area, with personal safety being put to the forefront. Therefore, the simulations that are run, in relation to the London Olympics will follow this basic assumption. The various different factors which can be used to control this movement, such as the availability of additional exits and the opening of new thoroughfares can be looked at with a degree of certainty, provided the appropriate intelligence, in terms of where precisely the individuals are, at any given point, is maintained (Johnson & Hogg, 1996).

Gathering intelligence so that the crowd can be monitored, on an ongoing basis, was seen as being important, in all of the crowd management situations that were considered in relation to the two separate case studies. In the case of the Hajj, specific intelligence relating to the flow of pilgrims identified that specific actions, such as a

reduction in the flow of people which is a precursor to a potentially dangerous situation; by having a strong intelligence system in place, those managing the crowd could identify these early warning signs and change the way in which the crowd is likely to move, in order to prevent the crush happening, in the first place. Given the stationary elements of the crowd associated with the Hajj, the opportunities available to those responsible for crowd management are somewhat limited, as the individuals will continue to want to travel towards a specific focal point, notwithstanding the physical danger that they may face. Therefore, physical boundaries need to be put up along the pilgrimage route, in order to reduce the pressure, slowly, at the central point (DCMS, 1997).

Using exactly the same principle in relation to the London Olympics, those responsible for crowd management have slightly more opportunities available to them, not least because the event itself is spread out over a wide variety of different focal points. This offers the crowd management team an opportunity to divert individuals along different routes through the use of public transport, so that no unnecessary pressure builds, up at any given point. This requires a much greater understanding of the network, in its entirety, as all individuals may be travelling in different directions. However, it does also offer greater flexibility when dealing with an emergency situation or an impending difficulty. It is also anticipated that the crowd will behave considerably more rationally, in the case of the London Olympics and therefore using simulation will be more successful as a means of identifying the best way to deal with a particular situation.

By practically applying the modelling framework which has been identified in the previous chapter, in two very different case studies, it is evident that the framework has universal application, although the precise way in which it works and the focus of the framework will naturally vary, depending on the nature of the crowd and the event in question. Identifying the factors which are immovable within the crowd management environment, such as the resulting focal point for the crowd, then acts as the central element of the crowd management framework and the various different external factors that may change can then be used to undertake simulation and planning. In particular, it became apparent that the use of simulation had to be relatively restricted to looking at the impact of one or two factors, rather than attempting to use simulation for a broad brush view of the general movement of the crowd. By limiting the analysis to direct

cause and effect, a much more efficient framework can be established and the various different agendas associated the crowd, including, where appropriate, mapping, the likely commercial benefit that can be obtained at any point by a retail outlet based on crowd movement, becomes achievable.

7.4. THE IMPORTANCE OF TECHNOLOGY

When analysing the components, it became apparent that the use of technology in order to gather information, centrally, and to ensure that it is disseminated to the relevant individuals in the quickest possible way was crucial. One of the difficulties that had emerged in the previous controlling and managing of the Hajj was the fact that when a problem arose, the authorities were particularly slow in identifying the problem area; even once the problem area had been identified, those in charge of the pilgrimage were not in a position where they could react quickly and mobilise the required resources, either to mitigate the problem, or to deal with the aftermath, wherever it had emerged. This is particularly evident by the high numbers of casualties which have occurred, in previous years. Technology, therefore, should be viewed as the central component into which all other components should link. For example, where there is information being presented in terms of the infrastructure or any difficulties that are taking place within the infrastructure, such as an increased density of people passing a certain point, this information needs to pass through to the relevant components, directly. Without the use of technology, this would involve information passing along the infrastructure trail, potentially simply through word of mouth and pilgrims informing each other that there is a difficulty at some other point along the route. With this type of linear movement of information, it is not possible for the other components to be alerted to the difficulties, in enough time to be able to react, so as to mitigate the issues (Figiel, 1998). In the case of an impending problem due to a crush in the infrastructure or due an increased density in the crowds, the information relating to this problem can travel, not only along the infrastructure route itself, but also to the different components, immediately from the location of the problem. Consider the situation where the technology is available at every potential choke point that analyses the density of the crowd, at every potential problem point along the route. Where a problem emerges, it is then possible for the technology to alert the other components, immediately, when certain triggers happen. This would enable the authorities to react, immediately, and for disaster management to begin. Furthermore, as this information is made available, it is

then possible for other aspects of the crowd management to be made aware of the issues, so that they themselves can be in a stronger position to adapt their own behaviours, where appropriate.

Taking the example of a crush occurring at one point along the route, the immediate reactions can be established, but the framework as stated also allows for changes to take place, on an ongoing basis, and to be absorbed into the various different components. Where there has been a particular crash or difficulty at one point during the Hajj, it is likely that this will impact on the culture and general attitudes of the rest of the crowds; therefore, whilst there is clearly merit in the information being immediately available to those involved in disaster management, it also provides important information to the other parts of the pilgrimage, so that they themselves can adapt and ensure that any knock-on effects are mitigated. This may be particularly relevant when it comes to changing cultures and behaviours, as well as changing the underlying health position of the group, in its entirety.

As well as utilising this suggested framework to deal with situations, as they arise during the pilgrimage, it is argued by the researcher that the framework will offer valuable information that can be used during the planning phase, in order to determine how disasters should best be managed by the authorities involved.

Collecting information, at the outset, in terms of the cultures of the individuals involved, as well as looking at any known health issues which may emerge and identifying the likely patterns of behaviour, based on the infrastructure that is available will offer those involved in the management of the crowd an opportunity to identify the starting point for many of the other components. For example, there are likely to be certain locations which can be easily identified as relevant when positioning officials trying to gather information in relation to the movement of the crowd, or in order to potentially divert the crowds, or change the movement of the crowd, in the event of an emergency, either at that point or some other location (Edwards & Morris, 1994).

Regardless of the types of scenarios which are looked at, when considering crowd management, and the factors and components that arise, the underlying theme remains the ability of those involved in crowd management to gather data and to adapt, quickly, to any changes that may be forced upon them, from an external source or from the crowd itself. Information will have to be gathered, initially, before the event starts or the crowd gathers, as this will then allow for alterations, as information emerges, in order to

allow for an amendment to be put in place when the crowd changes. Fundamentally, however, the main issue that has emerged during the establishment of the framework, and by looking in more detail at the various different components which make up the framework in the case of the Hajj, is the ability for the components to interact with each other in a way that is reflective of the external factors. To be able to react quickly with the appropriate resources is a key aim to maintaining the health and safety of a crowd situation, whether it is in relation to a religious pilgrimage, or if it is with reference to a wider sporting event such as the London Olympics.

At the centre of this framework is the appropriate technology and the ability of the crowd management team to collect data, analyse data and to present the data to the relevant parties, where necessary. In the case of the Hajj, the use of technology has already begun to emerge, with information being collected where the density of the crowd reduces to such an extent that it is thought that this would then trigger an influx of pilgrims, through a narrow entrance point that could potentially create a crush. This only looks at a very small part of the pilgrimage's progress and the proposed framework, here, takes this basic principle several steps further, to create an overall framework that is suitably adaptive to the changing circumstances, whether they are predictable or not.

CHAPTER 8: CONCLUSIONS AND CONTRIBUTIONS FOR FURTHER RESEARCH

8.1 Conclusions

This is the final chapter of the thesis and presents the conclusion of the study by combining the results of the data collected in the form a framework model for crowd management. It is concluded, based on the literature review and analysis of the data collected, looking at how crowd behaviours vary and how the risk is managed, and also drawing upon the two case studies and looking at the way in which these theories can be used, from a practical point of view, that establishing a modelling framework for crowd management is absolutely essential, if crowd management is to be undertaken with any degree of success (Payne, et al., 2008). Although there are multiple theories in place, in order to assess how crowds behave, a certain amount of protection can be undertaken, as well as a large amount of control, in terms of ensuring that specific groups of individuals are kept apart, and that certain types of behaviours are identified and prevented from taking place, fundamentally, how individuals behave and, in particular, how individuals react to the stress situations, can never be fully controlled; the role of the crowd management team, therefore, needs to be able to deal with these reactions, in a timely and efficient manner, rather than necessarily preventing these reactions, in the first place.

By putting a modelling framework in place, similar to that seen in organizations' that are looking to achieve greater efficiency of their operations, it is possible for the various different elements of the crowd and the different behavioural aspects to be identified, with particular reference to how they interact with each other. For example, if a rumour emerges that there is likely to be a terrorist action, in a particular location, the ability of the central team to model what this will do to the crowd behaviour will allow those involved in providing safety and security to see how crowd movement is likely to change. The team can, therefore, put in place mechanisms to alleviate these problems, such as potentially opening up new exits or ensuring that there is a greater security presence, in certain locations. Therefore, for this modelling process, it is crucial to run simulations, which will be important during the training aspect, but will also be very useful for identifying how the crowd is likely to behave, should any of the risks which had previously been identified, occur. It is that this reason that the focus of this research

now develops an appropriate crowd modelling framework that can be used in a wide variety situations, to offer a more efficient overall process of crowd management and crowd safety. It is expected that this framework will also offer information to those looking to enhance commercial benefits from the crowd who are travelling to an event; as, by modelling crowd behaviours, this will also assist traders in identifying where they are most likely to find the largest number of customers. For example, from a very basic point of view, it could be established that, if the bus service would terminate, when bringing individuals to a specific event, then a particular entrance is less likely to be used and more people are going to travel from a different entrance; this will require the crowd management team to open up further ticket stands around this entrance, but will also offer great opportunity for those selling programmes to move their manpower to this other entrance, in order to maximise sales, showing that crowd management has several different aspects to it or which will be explored through the establishment of a modelling framework.

8.2 Theoretical and Practical Implications

By looking at how the framework can be applied to several different scenarios that have emerged from the two separate case studies and primary data collection, a real evaluation of the framework can be undertaken, and suggestions for the future, made.

Regardless of the nature of the case study and the type of crowd that is emerging, the actual process of crowd management remains the same, from a fundamental point of view. This involves ascertaining the immovable factors and the known factors and using these as the central means for controlling the crowd. It also entails identifying how certain changes will impact on the crowd, which will typically react to immovable factors, but will do so with reference to the immovable points, such as the end destination or the exits and entrances that are available.

On the whole, this approach was seen as an excellent starting point for dealing with real life scenarios and looking at the way in which a crowd is likely to behave, when specific scenarios play out. For example, when looking at the Hajj, there are certain factors that are unlikely to change, such as the desire to gain access to the pillar, at the expense of one's own personal safety, if necessary. By maintaining this central immovable presumption, crowd management techniques can be looked at, in more detail, and a

much better understanding of how these client management approaches will be received can also be had.

By undertaking this type of enterprise framework modelling and understanding how the various different factors associated with crowd behaviour and client management interact with each other, much better control of a crowd situation can be achieved. The aim is not necessary to remove all uncontrollable factors, because this is simply impractical, as demonstrated by the scenarios relating to natural disasters and terrorist threats, but rather to ascertain how these are likely to play out, from a practical point of view and the changes that can be made to the factors that can be altered (Olsson and Regan, 2001).

It appears that the modelling framework was more useful when dealing with crowd situations in the Hajj, primarily due to the fact that the crowd's behaviour is somewhat more predictable, given the fact that they are relatively single-minded in their determination to gain access to the pillar and this can be used as a central means of determining how the crowd is likely to behave when faced with an external input such as poor weather. The position became slightly more challenging, when it came to dealing with external factors in relation to the London Olympics. This is largely because the entire event was more complex and the agendas being followed by the various different crowd members are also likely to be distinctive, with different groups looking to gain access to different events and venues, at different times. Despite this added complication, when looking at the London Olympics 2012, the use of computer simulation became more prevalent and the ability of those involved in crowd management to control a potentially difficult situation was increased. A large amount of different infrastructure was drawn upon, in order to establish crowd movement in relation to the London Olympics. However, although this offers greater possibilities for problems to arise, it also allows the security services an opportunity to divert part of the crowd, or to present travellers with different options to get to different locations.

When there is an increased variety of potential crowd reactions, or where the crowd is dissipated over a broader range of areas, the issues associated with crowd management can become considerably harder to handle. Therefore, it becomes even more important that the points, in terms of identifying relevant infrastructure issues and the number of individuals are likely to be travelling along these routes.

Fundamentally, however, it can be seen that, despite the differences that exist between the way in which the proposed framework applies to the Hajj and how it applies to the London Olympics 2012, the basic presumptions laid out by the framework operate extremely well and offer a real understanding for those involved in crowd management as to how they can potentially mitigate difficult situations, in an efficient manner, that takes into account the static factors which simply cannot change.

Difficulties in crowd management emerge, where those involved in the actual decisions relating to the changes that need to take place where external factors change, do not have the relevant information available to them, or have a poor understanding of how their decisions could impact on the general crowd movement. For example, when looking at the Hajj, it has already been identified that one of the static issues is the fact that all individuals will ultimately push towards the pillar and that any attempts to put in diversions that will prevent an individual from getting to the pillar are unlikely to be successful. With this in mind, interventions need to allow the individual to continue to travel towards the pillar, albeit in a more controlled and safer environment. Provided this type of approach is maintained, the level of success achieved by those involved in crowd management will be considerably higher.

By having strong links between the cause and effect of the various different factors within the crowd management arrangement, it is possible not necessarily to control every single factor, but rather to identify how the effect of these factors can be mitigated, by changing one or more of the other factors that are within the control of the crowd management authorities. Overall, by looking at the findings of the study, it can be seen that the proposed model framework does, in fact, offer valuable information to the crowd management team that can be relied on in order to offer computerised crowd management systems, without any form of human input and decision-making. The framework merely offers the information that would allow humans to make the most relevant decision; however, it will not make the decisions for the crowd management team. Provided this is borne in mind, the model framework is deemed to be particularly useful for dealing with these types of crowd management scenarios.

The focus of this research has been to look at two specific case studies that have very different client situations associated with them. By using these two case studies, a particular framework has been established which could arguably be used in a wide

variety of different crowd situations and would allow crowd management officials the opportunity to manage crowd situations and also to deal with disaster situations, when they arise. In the previous sections, the application of the established framework was looked at, through the use of various different scenarios and the primary data collected. However, the evaluation process has also resulted in several new points coming to the forefront. Consideration now needs to be given to how the evaluation of the framework and the various different scenarios has added to our knowledge of crowd management, not only from the point of view of using a modelling framework, but also for directing crowd management officials in the way that they undertake the activities involved in the planning of events and in dealing with the unexpected eventualities that take place during the course of the crowd gathering.

Once a framework has been established and a model produced, for a particular situation, such as is likely to be the case for the London Olympics 2012, this is not the end of the modelling process. Next, the authorities need to spend time looking at the model that they have established, as well as considering how they could potentially alter this model, or how it might need to be altered, during the course of the event. By running a wide variety of different scenarios, any weaknesses within the model or any alterations that may need to take place will be identified. In practice, and where it involves a complex event such as the London Olympics, the model is unlikely to remain completely static, with certain elements needing to be adjusted, in order to deal with external factors that are outside the control of the officials; or, there may be several different models that can be drawn upon, in order to gain a greater understanding of how the crowd is likely to act, in a variety of different situations. Take, for example, the London Olympics 2012, and its heavy reliance on public transport as a means of travel for individuals, from one location to the next. In this respect, the infrastructure available and, in particular, the use of the underground services and use of bus services could be viewed as its own independent model, whilst certain other external factors might influence how this model works, for example, if there were a dramatic change in the way that the crowd is likely to move, in the event of a terrorist attack. This may influence the infrastructure model and by having an independent model which looks at how the infrastructure operates, this will immediately put the crowd management team in a stronger position, when it comes to ascertaining how it could potentially influence crowd movement (Stanton and Wanless, 1995).

The suggestion in the application of the model framework is that one complete framework will be established to deal with a particular crowd situation; however, in reality, it is likely to be made up of several smaller models which would then interact with each other, in order to create the overall larger model. It is the ability to see how the interactions work that is the real benefit of using an enterprise modelling framework. Furthermore, the purpose of using modelling frameworks to identify how the input will ultimately convert to outcome and the processes used, when it comes to crowd management, albeit that the input may be a wide variety of external factors and the output is, ultimately, the end goal of the event gathering.

In practice, therefore, the application of this evaluation process is to identify how the various different scenarios are likely to operate within the framework and, critically, to identify any weaknesses that might arise, as well as identifying any aspect of the crowd management that needs looking at, in more detail, and established into the framework, such as the infrastructure system within the London Olympics.

A similar application can be seen with the framework used by those managing the Hajj. In this context, whilst the crowd management officials are actually likely to focus on the difficulties that emerge in the main area of Mina, in reality, there are multiple other different smaller systems and actions that can take place outside of Mina, as part of pilgrimage, which will ultimately result in the system, as a whole, operating more effectively. By undertaking these evaluations and the use of scenarios, the modelling framework becomes more real and becomes more applicable in a real-life situation; however, it is noted that this type of evaluation would need to be raised, whenever a new system is established and the one-size fits all would simply not work for crowd management.

Having completed a detailed analysis of the two potential case studies and behaviours and how modelling could be used to offer a greater practical understanding of how crowd management theories are likely to unfold in reality, suggestions can be made for the future use of frameworks. Although having a degree of computerized automation and using particle theory which has been central in crowd management literature over the years is still part of the current modelling framework, relying entirely on this type of approach will no longer reflect the different ways in which individuals act. When a crowd of people comes together, even for the same purpose, they are also likely to behave in

a slightly different manner, and identifying these factors that will influence the behaviour of the crowd has not been given sufficient importance, in previous literature.

8.3 Limitations

In this research, several limitations have been identified which could, potentially, have an impact on the usability of the research when undertaking crowd management activities. By identifying these limitations, recommendations for future research have been established, as well as allowing those responsible for crowd management to understand where there may be limitations to their research, to such an extent that it will be necessary to alter their approach and will lead to them managing their own crowd situation slightly differently from the framework presented, here.

Firstly, it has been identified that one of the real difficulties with attempting to manage a crowd based situation is that, while there are a large number of factors that can be controlled, there will always be certain uncontrollable elements that will depend on the changing situation. These situations can change, on a minute by minute basis, making it very difficult to establish a framework that will always apply across all situations. Whilst the analysis, here, has looked at two different case studies and has established a broad framework, there is a limitation, which means that it is simply impossible to consider every single crowd based situation. Technologies are also improving, on a regular basis; therefore, the types of computerised simulation that may be available will also be changing, regularly, such that the research needs to be reviewed, on a regular basis, to take into account changing factors, in particular technology which is likely to be constantly improving the way in which crowd management operates.

8.4 Recommendations and Directions for Future research

The framework that was established in the previous chapters, as well as case studies, that have been used in order to explore the potential usefulness of these frameworks, allowing for the detailed analysis of the use of the framework to be undertaken, as well as offering the opportunity to determine the recommendations that should be put forward to anyone looking to use the framework for their crowd management approach, in the future.

More specifically, using several different real-life scenarios has offered additional strength to the research, not only in identifying the positive aspects of the modelling

framework, but also in identifying the ways in which crowd management officials will need to adapt the framework for their own purposes, on an ongoing basis. This aspect of the research has resulted in several key findings. However, whilst it remains central to the argument, here, that the modelling framework is the most appropriate way to progress crowd management theories and to create an efficient crowd management approach that is suitable for a wide variety of different situations, there are specific amendments and alterations that will need to be taken into account. Furthermore, it has become apparent through the use of the scenarios, and by using two very different case studies, that crowd management cannot be a one-size fits all. In addition, whilst the process associated with crowd management can be uniform, the way in which it operates in each individual situation will vary.

Bearing in mind the limitations that have been noted in the previous section of this chapter, it is suggested that future research in this area needs to be undertaken, regularly, and with reference to any substantial changes that have taken place in the area of crowd management. Furthermore, it is anticipated that this research will focus, to a large extent, on technology and the way in which technological advances allow for those responsible for crowd management to spend a larger period of time using infrastructure to automate proceedings. Following are some of the recommendations and directions for future researches.

- The research could also be undertaken on a wide range of case studies and, in particular, would be helpful for different types of crowds and situations where groups of people may come together for specific purposes, in order to identify any subtle changes that may take place in how the crowd can be managed, depending on the nature of the activity in question.
- Essentially, therefore, crowd management approaches needs to be reviewed, on a regular basis, and case studies used in order to look at any situations where crowd management was particularly effective (or particularly ineffective), to look at ways in which the framework could be improved, in the long-term.
- By undertaking these regular reviews, it will be possible for the crowd management framework to evolve and develop, constantly, to suit the changing needs and changing resources available.

- This evaluation and primary analysis section has allowed the researcher to take the proposed framework to another level. By applying it in a practical sense, it has become possible to look at the various different aspects of the framework which will need to be adapted, depending on the crowd situation being experienced at a specific event, as well as any incidents which may take place, either unexpectedly or during the course of the event, that will require adjustment. Therefore, those involved in crowd management will need to be adaptable and it has become very clear, during this section, that there is a need for those individuals involved in crowd management to manipulate the information that they gain; utilising the framework which has been established will be almost as important as the framework itself. Ultimately, the abilities of those involved in crowd management within any organisation will be almost as important as the crowd management framework itself.
- By using the underlying theories associated with particle movement and the way in which they physically interact, it can be seen that there are several similarities between this analysis and crowd management theories. Understanding the physical reactions and movements of a particular crowd will put the crowd management team in a stronger position to deal with the myriad of issues that may arise. For example, in the case of the London Olympics, once the number of people who are able to enter a specific venue is known and the space available through the entrances and exits established, it will be possible to use particle analysis, in order to map the way in which the crowd is likely to move and impact on each other, from a physical point of view. This analysis should not be overlooked, as the physical activity is important in determining the likely movement of the crowd and the likely level of panic that might ensue. Where the particles are particularly close together, (i.e. the crowd is particularly dense), the level of panic is likely to be higher, regardless of the risk profile of the crowd. This is clearly not the end of the analysis; however, by establishing a new modelling framework, it is not the case that the more traditional analyses should be ignored.
- External factors such as the risk profile of the crowd, the change of thoroughfares, as well as external risks such as terrorist activity will clearly, then, have an impact on how the particles interact. Once one particular movement has begun, particle analysis remains a vitally important part of the analysis and

should not to be overlooked, simply because the framework plan is more advanced and takes on board a wider variety of factors.

- It is recommended, therefore, that anyone looking to use these types of frameworks should look to extend their understanding of the crowd situation with which they are dealing. Whilst the framework will act as a central backbone for the analysis, the more traditional forms of analyses, such as particle movement, should not be overlooked, as these will feed into the framework, in order to ascertain how specific aspects of the framework will alter the way in which the particles move.
- Recommendations for experts looking to apply this framework approach in the future, therefore, involve drawing upon the traditional particle-based analysis, in greater detail, than perhaps the research had initially thought necessary. The research also suggests that the static factors should be maintained as the pivotal centre for the model. Whereas, there may be circumstances in which these central points change and need to be altered and its real strength lies in the ability to adapt to situations that may be constantly changing. It is this that the framework model aims to achieve and, necessarily, there needs to be a starting point from which to work and identifying the static points is clearly a good starting point; therefore, recommendations are made to those looking to apply this to maintain a degree of flexibility, particularly where the event in question takes place over a prolonged period of time.
- The primary recommendation that comes from this section of the analysis is that, although the framework has been established as a strong starting point, this research has shown that there needs to be a degree of adaptability and the real strength of the framework lies in the ability to change a variety of different factors and to fully understand the impact this will have on the crowd, from an emotional and physical point of view.
- Bearing in mind the above point, there are considerably greater uses which can be made of computerised simulation, notably in the modern context where computer programs are certainly more advanced than may have been previously thought, as part of crowd management activity. During the research that has been undertaken, here, the process of developing static points within which the framework operates and then adapting and dealing with external changes

suggests that computer simulation would not always be appropriate. This is because many of the external factors will not be black-and-white and will not be controllable. Despite this constriction, the potential use of computerised software is becoming increasingly apparent, when it comes to crowd management. To a large extent, this is linked to particle movement analysis, as it is this type of approach that can be taken by crowd management officials when looking at the various different influences that can be had on how the crowd behaves and how this will then play out over the course of time. For example, the program could be used to determine the movement of the individual and to gather intelligence relating to crowd movement. Consider the situation in relation to the London Olympics 2012; computerised systems can be used not only for crowd control but also for information gathering at the gates. With the use of computerised systems, it will be possible for information to be collected on the number of people travelling to each entrance, as well as identifying the location of ticket holders, based on information being collected from these tickets, as people move from venue to venue. It may even be able to use the computerised system to identify how individuals are moving around the public transport system, thus offering even more information, in terms of where people are, how they are moving and the density of the crowd, at any particular point. This approach has already been taken with the Hajj to Mecca, where computer monitoring is used to mark the density of the crowd, at any point. Whilst all this does is give the crowd management officials a strong idea of where the crowd is becoming excessively dense and may potentially be a danger area, it is not necessarily the use of the framework approach that will achieve this, as it does not show how different actions from the crowd management officials could potentially impact on the density or dissipate the density from the perceived danger areas (BSI, 1999).

- One of the main factors identified as being particularly important, where crowd management and crowd control are concerned, is that of intelligence gathering. Having a strong knowledge of where precisely the crowd is approaching is likely to be relevant, as well as the way in which the crowd is flowing through particular choke points, such as the entrance gate. Computer simulation can be very effective in this regard and, by having computer programs especially developed in order to map out the movement of the crowd and a particle-based analysis,

crowd management techniques can become much more sophisticated and much quicker to react to unexpected changes.

- Not only do computerised systems offer greater information gathering abilities and greater scenario planning opportunities for those involved in crowd management, in situations such as the London Olympics 2012, using the system is arguably vitally important, as it would simply be impossible for communications to happen across such a broad range of different venues and events, that would allow the crowd to be managed in such a way that is congruent to the whole event. From a well thought out computerised system, the event manager will be able to see how one activity in one particular event can have a knock-on effect across the entire games, rather than necessary just looking at one part of the London Olympics, or looking at one venue, in particular (Proulx, 1994). By using a computerized system it is argued, in the context, that not only will a computerized system be beneficial to crowd management, but will, in fact, be essential and the framework as suggested in the previous sections of the research will operate considerably more effectively. If this is done through the use of computerized simulation allows for much more instantaneous analysis, once the external factors are determined and the cause and effect of these factors is already know and therefore can be programmed into the computer simulation, effectively.

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Appendix 1: MECCA Framework Mega Event Command and Control Architecture

MECCA Framework Mega Event Command and Control Architecture

	Security	Safety	People	Technology	Location	Management	Infrastructure	Legal
	Security/ Surveillance/	Identify Risks and Hazards / Contingency	Team Leadership	Project Management System	Main Headquarters	Time/Cost/ Control/ Monitoring Project Management	Security and S urveillance monitoring	Insurance / Licence and Permission
	Security/ Surveillance/	Structural Safety / Hazard Associated with Barriers / Providing a Safe Venue / Food Safety / Fire Safety	Event Advertising / Marketing	Event Management System	Event Control / Facilities Management	Pre-Event Planning / Preparing for Unexpected / Available Funds and Resources / Event Management Strategy	Temporary Structures	Insurance / Licence and Permission
	Transport and communication security	Transport safety	Communication	Communication networks: landline and wireless /Vehicles /	Venues /	Infrastructur e and Transport Management	Buildings / parking / air land / sea traffic network / Utilities / gas/electricity /water /pedestrian facilities / road networks	Transport and communication regulations
	Health awareness	Accidents / Trauma / injuries /death / illness and disease	Paramedics / medical staff / Nurses /doctors // treatment	Ambulance / Medicine / Health Management System	Facilities	National & Private health Service	Hospitals / Clinics	Medical insurance
	Crime Rates	Health/nutrition	Language/ Dress codes /Behaviour/ Different culture/ poverty social exclusion/	Communication	Venues/ Main Headquarters	Event Management Strategy	Support network for disabilities	Insurance / Licence and Permission
	Security/ Surveillance/	Structural Safety / Hazard Associated with Barriers / Providing a Safe Venue / Food Safety / Fire Safety	Team authorities	Contact with relevant bodies and agencies	Event	Police system	Stewards	Licences and permission
	Appraisal of crowd safety management / Prevent crime	Prediction/ Stampedes/fire /Building collapse and injured	Team staff disaster management	Sensor /Technology/ Communication	Venues/ Main Headquarters	Efficient crowd management	Monitored /Analysed by video cameras/Capacity of emergency doors/Create database comprehensive emergency data/Evacuation Capacity of door openings in panic situation	Licences and permission/ Insurance
	Security/ Surveillance/	Pollution/Weather/F ood risk/noise	Team staff environmental	Communication	Venues/ Main Headquarters	Event Management Strategy	Food quality/transport network/water quality/air quality	Licences and permission/ Insurance
	Security/ Surveillance/	Structural Safety / Hazard Associated with Barriers / Providing a Safe Venue / Food Safety / Fire Safety	Communication team	Satellite/GPS/ wireless/ Internet /telephone/	Venues/ Main Headquarters	Event Management Strategy	Cell tower /wired communication network /wired communication network	Licences and permission/ Insurance
	Security/ Surveillance/	Accidents/stampede s in congested places	People density/crowd behaviour/potenti ally aggressive abusive	Planning /coordinating emergency /management available spaces	Event or venue density	Physically Managing	Administering coordinating/clear passage	Licences and permission/ Insurance
	Security/ Surveillance/	Monitoring	Public relation	Contact with relevant bodies and agencies	Venues leases	Compliance management	Decision management	Instruction/Local authority/Licences and permission/ Insurance
	Deal with emergency /Security/ Surveillance/	Fire safety checklist	Team of training/advance planning	Improve skills	Deal with kinds crow /people	Deal with large event	Deal with any threat	Deal with terrorism/Licences and permission/ Insurance
	Security/ Surveillance/	Accommodation occupancy rate	Public transport	Communication networks: landline and wireless /Vehicles	Main Headquarters	Team of Budget management/ evaluate	Accommodation Infrastructure /Exchanging/Bank/	Licences and permission/ Insurance

Appendix 2: Questionnaire

Primary Research Data Gathering

1. What is your role within your organisation?

Director	
Higher Management	
Team Leader	
Security	
Crowd control	

2. What type of organisation do you work for?

Event management	
Security management	
Sporting events	
Health and safety	
Fire-fighters	
Traffic	
The Ministry of Health	
Ministry of Hajj	
Ministry of the Interior	
Immigration	
Affairs of the Two Holy Mosques	

Part 1 :SAFETY

3. What sort of crowd management approaches does your organisation use?

Ticket control	
Security staff	
Barriers	
Cameras	
Traffic calming	
Changing timing of event	
Using infrastructure controls	

4. What is the main crowd management approach used?

Ticket control	
Security staff	
Barriers	
Cameras	
Traffic calming	
Changing timing of event	
Using infrastructure controls	

Part 2 : CROWD CONTROL

5. On a scale of 1 - 10 (1 being none and 10 being total), how much control

Do you have over the following issues with the crowd you manage?

Size of the crowd	
Demographic of the crowd	
Movement of the crowd	

Use of infrastructure to move crowd	
Timing of the crowd at key focal points	
Thoroughfares	
Amount of staff present	
Terrorist threats	

6. What is the most likely cause of a disaster in a crowd based situation?

Too many people being let in to the area	
Too few security staff	
External shock such as fire	
Misbehaviour of the crowd	
Technology failure	
Focal point being inaccessible	

Part 3 : TECHNOLOGY

7. On a scale of 1 to 10 (1 being least and 10 being most) Which of the following technologies would be beneficial for crowd control

Ticket control	
Automatic holding barriers	
CCTV	
Crowd density analysis	
Automatic infrastructure changes	
Alarms when density increases	

8. On a scale of 1 to 10 (1 being least and 10 being most) which of these do you see as within your role?

Planning the event	
Determining crowd movement	
Disaster management	
Customer services	
First aid	
Security	
Maximising profits	
Advertising	
Sales	

Part 4 : SECURITY

9. Which of the following security personnel do you use during crowd management?

Private police	
Private undercover police	
Specialist crowd control teams	
Emergency services only	
No specialist security personnel	

10. How do you decide on the number of security personnel to be employed?

Size of the crowd	
Nature of the event	
Cost of security personnel	
Legal requirements	
Spread of the crowd (geographic)	

Part 5 : PEOPLE

11. Which of the following are involved in your crowd management process?

Project managers	
IT technicians	
Medical professionals	
Security professionals	
Disaster management professionals	
Administration staff	
Politicians	
Military	

12. Which are the most influential people for the safe management of crowds?

Project managers	
IT technicians	
Medical professionals	
Security professionals	
Disaster management professionals	
Administration staff	
Politicians	
Military	

Part 6 : ENVIRONMENTAL ISSUES

13. How relevant are environmental issues to crowd management and planning?

Vitally important	
Very important	

Moderately important	
A little important	
Of very little importance	
Not at all important	

14. Which of the following environmental issues are relevant to your crowd management?

Human waste	
Noise pollution	
Water pollution	
Air pollution	
Whatever the law requires	
Refuse generated	

Part 7 : PROJECT AND RISK MANAGEMENT

15. Which of the following processes are integral to crowd management?

Risk assessments	
Project planning	
Emergency planning	
Risk simulations	
Budgeting	

16. Whose responsibility is project and risk management?

Overall management team	
Specific project management professionals	
Private police	
Security professionals	
Depends on the area of risk	

Part 8 : EVENT MANAGEMENT

17. What is the main aim of event management?

To maintain crowd safety	
To make sure overall efficiency of the event	
To make a profit	
To achieve a large crowd	

18. How important is event management to crowd safety?

Vitally important	
Very important	
Moderately important	
A little important	
Of very little importance	
Not at all important	

Part 9 : COMMUNICATION AND COLLABORATION

19. Who is responsible for maintaining communication throughout the event?

Overall management team	
Project management professionals	
Private police	
Security professionals	
All professionals responsible for own area	

20. What are the major threats to communication and collaboration?

Breakdown of IT	
Too many managers	
Conflict between the teams	
Lack of systems	
Too much bureaucracy	

Part 10 : AUTHORITIES

21. Which authorities are involved in crowd management?

Government regulators	
Police authorities	
Health and safety authorities	
None	

22. Which authorities are most influential to crowd management?

Government regulators	
Police authorities	
Health and safety authorities	
None	

Part 11 : SOCIETY AND CULTURE

23. When undertaking crowd planning how important is society and culture?

Vitally important	
-------------------	--

Very important	
Moderately important	
A little important	
Of very little importance	
Not at all important	

24. Which aspect of event and crowd management is influenced by society and culture?

The crowd demographic	
The willingness to follow instructions	
The level of calm during an emergency	
The use of infrastructure	
Medical requirements	
None	

Part 12 : INFRASTRUCTURE AND TRANSPORT

25. Which forms of infrastructure need to be managed as part of the crowd management?

Public transport such as trains and buses	
Car routes to the area	
Car parking in the area	
Transport around the event	
Walkways within the area	
International and long distance travel	
None	

26. Why is infrastructure and transport seen to be important for crowd management?

It provides exit routes in a disaster	
Ensures lack of crowding at pressure points	
Encourages people to visit the event	
Allows people to be tracked and followed	
Opportunity for greater revenue	
None	

Part 13 : HEALTH

27. How Important is managing the health of the crowd as part of wider event management?

Vitally important	
Very important	
Moderately important	
A little important	
Of very little importance	
Not at all important	

28. What health issues are seen as particularly relevant to crowd management?

Injuries through crushes	
Illness and injury whilst attending event	
Contamination across attendees	
External threats such as terrorism	
Natural threats such as flooding	
None	

Part 14 : LEGAL AND REGULATORY

29. How Important is legal regulation when planning an event?

Vitally important	
Very important	
Moderately important	
A little important	
Of very little importance	
Not at all important	

30. Do you feel that regulatory requirements are beneficial to crowd safety?

Yes – incredibly	
Yes – slightly	
Moderately	
Rarely	
Never	

Part 15 : TRAINING AND REHERSAL

31. Do you undertake any advance training and rehearsal for an event?

Yes, several times	
Yes once	
Yes parts of the operation	
Not usually	
Never	

32. What types of training and rehearsal are seen as being most important for crowd management?

Simulation	
Disaster management practices	
Training to use specific technology	
Overall event rehearsal	
None	

Part 16 : FINANCIAL

33. How important are the financial targets for the crowd management process?

Vitally important	
Very important	
Moderately important	
A little important	
Of very little importance	
Not at all important	

34. Which financial measures are deemed important for the crowd management process?

Return on investment	
Income for every attendee	
Overall income	
Overall expenses	
None	

Part 17 : DISASTER MANAGEMENT

35. How Important is disaster management for overall crowd management?

Vitally important	
Very important	
Moderately important	
A little important	
Of very little importance	
Not at all important	

36. What aspects of disaster management are dealt with as part of overall crowd management?

Identifying likely disaster threats	
Simulations to identify disaster threats	
Additional resources for disaster management	
Infrastructure changes	
Health and medical planning	
Liaising with 3rd party providers	
None	

Appendix 3: SEMI-STRUCTURED QUESTIONS FOR INTERVIEWS.

1. What is the name / title of the event or activity?

2. What is your role within your organisation?

3. What type of organisation do you work for?
4. What sort of crowd management approaches does your organisation use?
5. What is the most likely cause of a disaster in a crowd based situation?
6. How do you decide on the number of security personnel to be employed?
7. How relevant are environmental issues to crowd management and planning?
8. Whose responsibility is project and risk management?
9. What is the main aim of event management?
10. How important is event management to crowd safety?
11. Who is responsible for maintaining communication throughout the event?
12. What are the major threats to communication and collaboration?
13. Which authorities are involved in crowd management?
14. When undertaking crowd planning how important is society and culture?
15. Which aspect of event and crowd management is influenced by society and culture?
16. Which forms of infrastructure need to be managed as part of the crowd management?
17. Why is infrastructure and transport seen to be important for crowd management?
18. How important is managing the health of the crowd as part of wider event management?
19. What health issues are seen as particularly relevant to crowd management?
20. How important is legal regulation when planning an event?
21. Do you feel that regulatory requirements are beneficial to crowd safety?
22. Do you undertake any advance training and rehearsal for an event?
23. *What types of training and rehearsal are seen as being most important for crowd management?*
24. *How important are the financial targets for the crowd management process?*
25. *Which financial measures are deemed important for the crowd management process?*
26. How important is disaster management for overall crowd management?
31. What aspects of disaster management are dealt with as part of overall crowd management?

These questions are indicative of the key framework components identified in the previous chapter and aim to give the management team an overall view of the issues that are likely to be relevant to the crowd management process. By breaking it down and answering specific questions for each of the component the crowd management team can ensure that they have all of the relevant information is gathered. In certain situations it may be the case that an initial question will raise other factors that are event specific. These questions aim to be a platform for discussion rather than necessarily an inclusive list.

استبيان الاولمبياد

إطار نمذجة إدارة السيطرة على الحشود في إدارة المشاريع وتنسيقها في الأحداث الضخمة

أعزائي المشاركون،،،

أنا باحث درجة دكتوراه في إدارة الحشود بجامعة كنغستون / لندن. أقوم حالياً وكجزء من بحثي بإجراء دراسته استقصائية للطرق التي يتم بها إدارة السيطرة على الحشود وإدارة المشاريع وتنسيقها في الأحداث الضخمة في مكة المكرمة - أحداث الحج ، والالمبياد لندن 2012 . وسأكون ممتناً ومقدر لكم مشاركتكم الكريمة في هذا البحث والاجابه على اسئلة هذا الاستبيان. ويهدف هذا الاستبيان لجمع المعلومات الخاصه لتحديد العوامل التي تؤدي إلى تحسين فعالية وكفاءة السيطرة على الحشود واستراتيجيات الإدارة والأداء في الأحداث الضخمة . إجاباتك ضرورية للغاية في دقة هذا البحث. أرجو الملاحظة بأن جميع الإجابات سيتعامل معها بسرية تامة ، ولن تستخدم لأي غرض آخر خلاف البحث العلمي. أخلاقياً ، لك الحق في الانسحاب من هذه المشاركة في أي وقت تريد. نشكركم مقدماً على مساعدتكم القيمة.

الباحث / خطاب السبيعي

قسم نظم المعلومات

كلية العلوم الهندسية والحاسوبية

مدرسة نظم المعلومات الحاسوبية

لندن - كنغستون

الاستبيان:

جمع بيانات البحوث الأولية

1. ما هو دورك داخل المؤسسة؟

	المدير
	الإدارة العليا
	قائد فريق
	الأمن
	السيطرة على الحشود

2. ما هو نوع المؤسسة التي تعمل لديها؟

	إدارة الأحداث
	إدارة الأمن
	الأحداث الرياضية
	الصحة والسلامة
	الدفاع المدني
	المرور
	وزارة الصحة

الجزء 1: السلامة

3. أي نوع من طرق إدارة الحشود تتبعه المؤسسة الخاصة بك؟

	التحكم بالتذاكر
	رجال الأمن
	الحواجز
	كاميرات المراقبة
	تهنئة حركة المرور
	تغيير توقيت الحدث
	استخدام عناصر تحكم البنية التحتية

4. ما هي طريقة إدارة الحشود الرئيسية المستخدمة؟

	التحكم بالتذاكر
	رجال الأمن
	الحواجز
	كاميرات المراقبة
	تهنئة حركة المرور
	تغيير توقيت الحدث
	استخدام عناصر تحكم البنية التحتية

الجزء 2: السيطرة على الحشود

5. قم بإعطاء درجة من 1 إلى 10 (حيث 1 يعني لا شيء و10 تعني الحد الأقصى)

كم تمتلك من السيطرة على المسائل التالية مع الحشد الذي تديره؟

	حجم الحشد
--	-----------

	ديموغرافية الحشد
	حركة الحشد
	استخدام البنية التحتية لتحريك الحشد
	توقيت الحشد في نقاط الاتصال الرئيسية
	الشوارع العمومية
	كمية الموظفين الحاضرين
	التهديدات الإرهابية

6. ما هو السبب الأكثر احتمالاً لوقوع كارثة في حالة مواقف الحشود؟

	السماح لعدد كبير من الناس بالدخول إلى المنطقة
	وجود عدد قليل من رجال الأمن
	الصدمات الخارجية مثل الحريق
	سوء السلوك من الحشد
	فشل التكنولوجيا
	عدم إمكانية الوصول إلى نقاط الاتصال

الجزء 3: التكنولوجيا (التقنية)

7. قم بإعطاء درجة من 1 إلى 10 (حيث 1 يعني لا شيء و 10 تعني الحد الأقصى) أي من التقنيات التالية قد يكون مفيداً في السيطرة على الحشود؟

	التحكم بالتذاكر
	الحواجز المانعة الأوتوماتيكية
	كاميرات المراقبة
	تحليل كثافة الحشد
	تغييرات البنية التحتية التلقائية
	أجهزة الإنذار عند زيادة الكثافة

8. قم بإعطاء درجة من 1 إلى 10 (حيث 1 يعني لا شيء و 10 تعني الحد الأقصى) أي من الأدوار التالية تراه الدور المناسب لك؟

	تخطيط للحدث
	تحديد حركة الحشد
	إدارة الكوارث
	خدمة العملاء
	الإسعافات الأولية
	الأمن
	تعظيم الأرباح
	الإعلان
	المبيعات

الجزء 4: الأمن

9. أي من طواقم الأمن التالية يمكنك استخدامها أثناء إدارة الحشود؟

	الشرطة الخاصة
--	---------------

	الشرطة الخاصة السرية
	الفرق المتخصصة للتحكم في الحشود
	خدمات الطوارئ فقط
	أفراد الأمن غير المتخصصين

10. كيف يمكنك أن تقرر عدد أفراد الأمن المطلوب توظيفهم؟

	حجم الحشد
	طبيعة الحدث
	تكلفة أفراد الأمن
	المقتضيات القانونية
	انتشار الحشد (الجغرافي)

الجزء 5: الناس

11. أي الأفراد التالية بعد مسئولاً أثناء عملية إدارتك للحشد؟

	مديري المشروع
	فنيي تكنولوجيا المعلومات
	المهنيين الطبيين
	رجال الأمن
	رجال إدارة الكوارث
	موظفي الإدارة
	السياسيون
	الجيش

12. أي من الأفراد التالية هم الأكثر تأثيراً في عملية الإدارة الآمنة للحشود؟

	مديري المشروع
	فنيي تكنولوجيا المعلومات
	المهنيين الطبيين
	رجال الأمن
	رجال إدارة الكوارث
	موظفي الإدارة
	السياسيون
	الجيش

الجزء 6: المسائل البيئية

13. ما مدى أهمية المسائل البيئية بالنسبة لتخطيط وإدارة الحشود؟

	ذات أهمية حيوية
	مهمة جداً
	مهمة بشكل متوسط
	أهمية صغيرة
	أهمية صغيرة جداً
	ليست مهمة على الإطلاق

14. أي من المسائل البيئية التالية تتعلق بعملية إدارة الحشود؟

	النفائات البشرية
	التلوث الضوضائي
	التلوث المائي
	التلوث الهوائي
	أي شيء يتطلبه القانون
	تولد الرفض

الجزء 7: إدارة المشاريع والمخاطر

15. أي من العمليات التالية يعد جزء لا يتجزأ من إدارة الحشود؟

	تقييمات المخاطر
	تخطيط المشروع
	تخطيط الطوارئ
	محاكاة المخاطر
	وضع الميزانية

16. من الذي تكون مسؤوليته إدارة المشروع والمخاطر؟

	فريق الإدارة ككل
	الموظفين المحددين لإدارة المشروع
	الشرطة الخاصة
	رجال الأمن
	يتوقف ذلك على منطقة الخطر

الجزء 8: إدارة الحدث

17. ما هو الهدف الرئيسي من إدارة الحدث؟

	الحفاظ على سلامة الحشد
	ضمان الكفاءة الكلية لهذا الحدث
	الحصول على الأرباح
	تحقيق حشد كبير

18. ما هي أهمية إدارة الحدث بالنسبة للسيطرة على الحشد؟

	ذات أهمية حيوية
	مهمة جداً
	مهمة بشكل متوسط
	أهمية صغيرة
	أهمية صغيرة جداً
	ليست مهمة على الإطلاق

الجزء 9: الاتصال والتعاون

19. من هو المسئول عن الحفاظ على الاتصال خلال فترة الحدث؟

	فريق الإدارة ككل
--	------------------

	موظفين إدارة المشروع
	الشرطة الخاصة
	رجال الأمن
	كل الموظفين المسؤولين عن منطقة معينة

20. ما هي التهديدات الرئيسية للاتصال والتعاون؟

	تعطل قسم تكنولوجيا المعلومات
	تعدد المديرين
	التعارض بين فرق العمل
	قلة الأنظمة
	الكثير من البيروقراطية

الجزء 10: السلطات

21. ما هي السلطات المسنولة عن إدارة الحشود؟

	الهيئات التنظيمية الحكومية
	هيئات الشرطة التنظيمية
	هيئات الصحة والسلامة
	لا يوجد جهات مسنولة

22. ما هي أكثر الجهات المؤثرة في إدارة الحشود؟

	الهيئات التنظيمية الحكومية
	هيئات الشرطة التنظيمية
	هيئات الصحة والسلامة
	لا يوجد جهات مسنولة

الجزء 11: المجتمع والثقافة

23. عند النظر إلى إدارة الحشود، ما هي أهمية المجتمع والثقافة؟

	ذات أهمية حيوية
	مهمة جداً
	مهمة بشكل متوسط
	أهمية صغيرة
	أهمية صغيرة جداً
	ليست مهمة على الإطلاق

24. ما هي جوانب الحدث وإدارة الحشود التي تتأثر بالمجتمع والثقافة؟

	ديموغرافية الحشد
	الرغبة في اتباع التعليمات
	مستوى الهدوء في حالة الطوارئ
	استخدام البنية التحتية
	المتطلبات الطبية
	لا يوجد جوانب تتأثر

الجزء 12: البنية التحتية والنقل

25. ما هي أشكال البنية التحتية التي يجب إدارتها كجزء من إدارة الحشد؟

	النقل العام مثل القطارات والأوتوبيسات
	طرق السيارات للمنطقة
	مواقف السيارات في المنطقة
	النقل حول الحدث
	طرق المشاة داخل المنطقة
	طرق السفر الدولي ولمسافات طويلة
	لا يوجد

26. لماذا يبدو أن البنية التحتية والنقل من الأهمية بمكان في إدارة الحشود؟

	توفر طرق للخروج في حالة الكوارث
	تضمن عدم حدوث تكديس في نقاط الضغط
	تشجع الناس على زيارة الحدث
	تتيح إمكانية تتبع وتعقب الناس
	فرصة لزيادة الإيرادات
	لا يوجد سبب

الجزء 13: الصحة

27. ما هي أهمية إدارة صحة الحشد كجزء من إدارة الحدث بشكل كامل؟

	ذات أهمية حيوية
	مهمة جداً
	مهمة بشكل متوسط
	أهمية صغيرة
	أهمية صغيرة جداً
	ليست مهمة على الإطلاق

28. ما هي المسائل الصحية التي ترى دائماً على أنها متعلقة بإدارة الحشود؟

	الإصابات الناتجة عن الاصطدامات
	المرض والإصابات أثناء حضور الحدث
	التلوث عبر الحضور
	التحديات الخارجية مثل الإرهاب
	التحديات الطبيعية مثل الفيضانات
	لا يوجد

الجزء 14: القانون والتنظيم

29. ما هي أهمية التنظيم القانوني عند التخطيط للحدث؟

	نو أهمية حيوية
	مهم جداً
	مهم بشكل متوسط
	أهمية صغيرة
	أهمية صغيرة جداً
	ليس مهم على الإطلاق

30. هل تشعر بأن المتطلبات التنظيمية تعود بالفائدة على سلامة الحشد؟

نعم - للغاية	
نعم - قليلاً	
بشكل متوسط	
نادرًا	
أبداً	

الجزء 15: التدريب والتمرين

31. هل تقوم بإجراء أي تدريب أو بروفة مسبقة للحدث؟

نعم، عدة مرات	
نعم، مرة واحدة	
نعم، لبعض أجزاء العملية	
ليس عادة	
أبداً	

32. أي نوع من البروفات والتدريب يمكن اعتباره أنه الأهم في عملية إدارة الحشود؟

المحاكاة	
ممارسات إدارة الكوارث	
التدريب على استخدام تكنولوجيا محددة	
البروفة على الحدث بالكامل	
لا شيء	

الجزء 16: الجوانب المالية

33. ما هي أهمية الأهداف المالية بالنسبة لعملية إدارة الحشود؟

ذات أهمية حيوية	
مهمة جداً	
مهمة بشكل متوسط	
أهمية صغيرة	
أهمية صغيرة جداً	
ليست مهمة على الإطلاق	

34. أي من القياسات المالية يمكن اعتبارها مهمة لعملية إدارة الحشود؟

العائد على الاستثمار	
الدخل لكل فرد من الحضور	
الدخل ككل	
النفقات ككل	
لا يوجد	

الجزء 17: إدارة الكوارث

35. ما هي أهمية إدارة الكوارث بالنسبة لعملية إدارة الحشود؟

ذات أهمية حيوية	
مهمة جداً	
مهمة بشكل متوسط	

	أهمية صغيرة
	أهمية صغيرة جداً
	ليست مهمة على الإطلاق

36. ما هي جوانب إدارة الكوارث التي يتم التعامل معها على أنها جزء من عملية إدارة الحشد ككل؟

	تحديد تهديدات الكوارث المحتملة -
	المحاكاة لتحديد تهديدات الكوارث
	الموارد الإضافية لإدارة الكوارث
	تغييرات البنية التحتية
	التخطيط الصحي والطبي
	الاتصال والتنسيق مع مقدمي الخدمات من الطرف الثالث
	لا يوجد

الاستبيان: أسئلة المقابلة

1. ما هو مسمى / عنوان الحدث أو النشاط؟ مسمى الحدث موسم الحج
2. ما هو دورك داخل المؤسسة؟
3. ما هو نوع المؤسسة التي تعمل لديها؟
4. أي نوع من طرق إدارة الحشود تتبعه المؤسسة الخاصة بك؟
5. ما هي طريقة إدارة الحشود الرئيسية المستخدمة؟
7. ما هو السبب الأكثر احتمالاً لوقوع كارثة في حالة مواقف الحشود؟
8. كيف يمكنك أن تقرر عدد أفراد الأمن المطلوب توظيفهم؟
9. ما مدى أهمية المسائل البيئية بالنسبة لتخطيط وإدارة الحشود؟
10. من الذي تكون مسؤوليته إدارة المشروع والمخاطر؟
11. ما هو الهدف الرئيسي من إدارة الحدث؟
12. ما هي أهمية إدارة الحدث بالنسبة للسيطرة على الحشد؟
13. من هو المسؤول عن الحفاظ على الاتصال خلال فترة الحدث؟
14. ما هي التهديدات الرئيسية للاتصال والتعاون؟
15. ما هي السلطات المسنولة عن إدارة الحشود؟
16. ما هي أكثر الجهات المؤثرة في إدارة الحشود؟
17. عند النظر إلى إدارة الحشود، ما هي أهمية المجتمع والثقافة؟
18. ما هي جوانب الحدث وإدارة الحشود التي تتأثر بالمجتمع والثقافة؟
19. ما هي أشكال البنية التحتية التي يجب إدارتها كجزء من إدارة الحشد؟

20. لماذا يبدو أن البنية التحتية والنقل من الأهمية بمكان في إدارة الحشود؟
21. ما هي أهمية إدارة صحة الحشد كجزء من إدارة الحدث بشكل كامل؟
22. ما هي المسائل الصحية التي ترى دائماً على أنها متعلقة بإدارة الحشود؟
23. ما هي أهمية التنظيم القانوني عند التخطيط للحدث؟
24. هل تشعر بأن المتطلبات التنظيمية تعود بالفائدة على سلامة الحشد؟
25. هل تقوم بإجراء أي تدريب أو بروفة مسبقة للحدث؟
26. أي نوع من البروفات والتدريب يمكن اعتباره أنه الأهم في عملية إدارة الحشود؟
27. ما هي أهمية الأهداف المالية بالنسبة لعملية إدارة الحشود؟
28. أي من القياسات المالية يمكن اعتبارها مهمة لعملية إدارة الحشود؟
29. ما هي أهمية إدارة الكوارث بالنسبة لعملية إدارة الحشود؟
30. ما هي جوانب إدارة الكوارث التي يتم التعامل معها على أنها جزء من عملية إدارة الحشد ككل؟
31. أي جوانب أخرى في إدارة الحشد أو الحدث والتي تعد ذات صلة أو علاقة؟

Appendix 4: CROWD MANAGEMENT SIMULATION SCENARIOS

The six scenarios below are examples of the types of simulations that could be run using this crowd management framework, looking at how these different scenarios are likely to play out and the way in which this can use the modelling framework to offer answers to those involved in crowd management, on how they should deal with the scenarios, below.

Scenario 1

Within the Hajj, a large number of individuals decide to visit the pillar, as expected; however, they do not travel past the pillar at the same velocity as was expected. As such, the number of people entering the area exceeds the number of people leaving the area, so that the crowd slowly becomes denser around the pillar, to an extent that there are no concerns over public safety. By looking at the rest of the pilgrimage, it can be seen that there is no particular gap emerging and individuals are continuously arriving at the pillar, at a greater rate than they are leaving the pillar, with some of the crowd becoming entirely stationary. The crowd is made up of a mixed demographic, with some of the physically stronger individuals being those who are particularly keen to remain stationary.

Scenario 2

Scenario two incorporates an emergency situation which has already been initiated, again at the pressure point in Mina. In this case, several of the physically stronger members of the group have not been able to gain sufficient access to the pillar and have decided to physically push their way to the front, causing several of the weaker members of the crowd to fall over and a panic situation to ensue. Some of the crowd are attempting to leave the area, as they have fulfilled their objective, whereas others are using the crush as an opportunity to get closer to the pillar. Meanwhile, the pilgrimage is continuing and more people are entering the area. Family groups are being split up and the general level of panic amongst the groups is increasing although, on the whole,

focus remains on gaining access to the pillar, despite the fact that physical safety is becoming a real issue, particularly for the weaker and frailer members of the groups.

Scenario 3

Finally, a scenario based on natural difficulties will also be looked at. While visiting the pillar, all pilgrims are required to travel across bridges which have a limited capacity. An external factor such as particularly poor weather conditions could have a direct impact on how the crowd travels throughout the entire pilgrimage and, therefore, on the volume of individuals who attempt to cross the bridge and enter the area of Mina, at any given point. As the pilgrimage can take place over several different days, very poor weather conditions, on any given day, will ultimately have the impact of reducing the density of the crowd, on that particular day, but will then have a knock-on effect on the other days, where the density will increase. Mapping the impact of these external factors needs to be done, in order to mitigate the wider impacts of an external factor, such as the weather.

Scenario 4

The London Olympics are based on a wide variety of different events taking place at venues, across London. Individuals will be travelling between various different locations, in order to reach each venue, to see the events for which they have booked tickets, or simply to enjoy the atmosphere, in that particular area. Public transport will be central to the transportation of individuals and a breakdown on a particular route can create substantial changes to how the crowd will move. One particular scenario that will be looked at is the breakdown of vital transport links, and how this can impact on the way in which the crowd moves, as well as how it can be mitigated, in order to prevent failure, in terms of allowing individuals, ultimately, to arrive at the venue, in good time to view the relevant event.

Scenario 5

There are major concerns that there could be a threat of terrorist activity, or substantial public disorder, as part of the London Olympics. The London Olympics will be viewed from across the world and, therefore, anyone looking to achieve widespread disruption would potentially consider the London Olympics as a means of achieving this aim. A scenario will be looked at to identify how crowd management can be used to deal with an imminent terrorist threat, whether or not this threat emerges to be a reality or not, as crowd behaviour is likely to alter the moment a threat becomes probable. Although there are a wide variety of different venues involved, each of which will react slightly differently to a terrorist attack, the general scenario will be run, based on a typical venue. It may be appropriate to run this scenario, in several different venues, to ascertain whether there are specific areas which present a weakness, from a crowd management point of view and therefore need to be particularly alert to terrorist behaviour.

Scenario 6

Finally, a scenario will be run, in terms of looking at a situation where it is anticipated that large numbers of individuals will attend a venue. All the tickets have been sold for the event and this should give guidance on how much volume is expected to pass through the point, on any given day. There are also chances that groups of individuals will travel to a venue, simply to be close to the event, with the hope of obtaining access to the venue, without a ticket. Therefore, a scenario will be run looking at a substantial influx of individuals without tickets, in a particular area; this will enable the crowd management team to identify how this scenario can be dealt with, but in a way that does not detract from the experiences of those who hold tickets, while also ensuring that safety is maintained and that, overall, individuals have a positive experience of the Olympic Games.

Appendix 5: Interview Transcript

INTERVIEW 1: Olympics respondent 1

1. What is the name / title of the event or activity?

I have been working in the crowd control management team for the event of Olympics in the years 2004, 2008 and 2012. I have a 15 years experience in crowd management and i have helped prepare for the main event of Olympics thrice. Presently, my organization is working for the crowd management for various events that are one on a large scale in teh country and we will also be working in the crowd control management for the next Olympics to be held in 2016.

2. What is your role within your organisation?

The main department that I work for in my organization is the crowd control. I have specialized in this area and also have a 15 years experience working in various areas of crowd management. Presently, I am working as a senior manager for crowd control in my organization.

3. What type of organisation do you work for?

My organization mainly deals in Security management but since security management is one of the most important areas of crowd control and the crowd management can never be carried out without the dealings and management if security issues, especially in the modern times.

4. What sort of crowd management approaches does your organisation use?

My organization uses a number of approaches as it has some STATE of the art techniques also. The organization has had an experience to manage large events like OLYMPICS so we have to keep out techniques and approaches up to date and of full maintained standard. Hence my institution that I work with use s several ways for crowd management mainly including work barriers, surveillance cameras, where there are thousands of cameras and to monitor the crowd accurately, as well as the element of security men and who is one of the important elements and helping to manage the

crowd and control and final element is traffic calming, which helps a lot in crowd control management and is one of the most efficient techniques.

5. What is the most likely cause of a disaster in a crowd based situation?

There can be many number of reasons due to which there can be a disaster in a crowd based situation. Any small abnormal situation can lead to a general panic in the crowd, which itself could be a cause of a large disaster. This is why the crowd based situations are very difficult to handle. However, out of the many different possible reasons, allowing a large number of people to enter the area the crowd at one time considered one of the important reasons and most of disaster during the crowds gathered as well as the lack of support crowds forces crisis. It is important that there is an appropriate to the size of the crowd and of security men that is responsible for the crowd. The organizers as well as the non-cooperation of the public with security men to follow the instructions and directives of sound provided of regulators to manage the crowd can also be one of the reasons of the disaster in a crowd.

6. How do you decide on the number of security personnel to be employed?

The number of security personnel depends on the size of the crowd, along with the demographics of the group. In addition to this, the geographical nature of the crowd also determines the number of security personnel to be employed at the place of the crowd as people belonging from different culture and the type of gathering also determines the reactions of people towards various crowd situation and the place of the crowd.

7. How relevant are environmental issues to crowd management and planning?

The environmental issues for the planning and management of the crowds of vital importance, because sometimes the environmental issues also give rise to the crowd disasters and sometimes the planning also becomes difficult due to the problems arising in crowd management.

8. Whose responsibility is project and risk management?

The responsibility for project management and risk management is of all the authorities that are responsible in planning the event. Hence the overall team is responsible for the project management. We are responsible as a whole team. If even one unit of the organization fails to complete their duty, the whole crowd management plan can go astray due to which any disaster can arise. This is why all the units and the responsible people have to be vigilant and therefore unite in their joint efforts.

9. What is the main aim of event management?

The main aim of the event management is to manage the large crowd in a way that the event happens peacefully and in a secure manner. Hence the main aim can also be said in a one liner that achieving a large crowd and maintaining its integrity and ensure the overall efficiency of the crowd and get the expected profits from the crowd. The important thing to note here is that the managing a large event with a large crowd needs is a huge responsibility and needs a lot of planning and proper employment of available resources so that all goes well, especially if it is an international event like OLYMPICS being witnessed may thousands of people live and millions around the world. It takes months and months of planning to make security plans and other crowd management issues which need to be overlooked in every detail possible.

10. How important is event management to crowd safety?

As I already explained that managing a huge event is a very big responsibility. And in the present conditions of terrorism around the world and the threats, the crowd safety issues become increasingly important. Fool proof security plans are made and appropriate number security officials are employed to maximize security of those who attend the event.

11. Who is responsible for maintaining communication throughout the event?

The plans for security and the overall event management work when there is excellent communication and understanding level between the people involved in planning the event. The overall management team especially the officials that are responsible for communication are supposed to maintain the quorum for the level of communication. It is important that there is a right amount of communication at the right level, with proper understanding because the lack of communication or even a small communication gap

could lead to missing some instructions which could ultimately cause an accident or even a major disaster. Hence, not only the individuals responsible for communication, but also any technology being used is double checked that is properly working and all instructions have been delivered well.

12. What are the major threats to communication and collaboration?

There can be a number of reasons why communication and collaboration could possibly fail. For example when it comes to the fail of communication and collaboration on the scene, one reason could be the failure of technology or the equipment being used. Another threat could be on another level which is bureaucracy and conflict between work teams, or the disruption of the IT department during the event.

13. Which authorities are involved in crowd management?

Depending on the type of event and the scale on which it is being held, the authorities responsible for it can be different. For example, in a small scale event, the authorities involved in crowd management could be the company heads or the people of the company for which the event is being held. On the other hand, for larger events like Olympics all government regulatory bodies could be involved in the crowd management. In addition to this, all security and safety authorities, health, financials, environmental and others also an active role and are required in the crowd management so that the overall event is planned and issued well.

14. When undertaking crowd planning how important is society and culture?

The event that this being carried out is for the people whose presence would make the event possible. And every culture and society have norms that might be different from other cultures and societies. This is why it is of paramount importance because the crowd gathered and crystallized consists of community. For example, an event being managed in a Muslim country would could have the separate crowd of males and females, whereas no such requirement is important for a non-Muslim country where could be a mix gathering of the males and females. Hence, while undertaking the crowd planning it is very important to understand the society and culture in which the event is to be arranged and managed.

15. Which aspect of event and crowd management is influenced by society and culture?

As I told you in an answer to the previous question that the society and culture is of significance important when it comes to managing and planning the crowd for an event. The demographics and the level of calm that arises in an emergency situation to follow the instructions that are issued by the department of the crowd management are the important aspects of the event and crowd management is influenced by society and culture.

16. Which forms of Infrastructure need to be managed as part of the crowd management?

Again this depends on the type of event and on the scale it is being arranged. In a large event like Olympics, the infrastructure for roads, travelling through public transport like buses, trains, taxis, metros and other transport mode should be managed so people don't have any problem when they need to travel from one place to another. There should be roads connected to the event as well, and there should be ample parking space outside the arena where the event is being held. In addition to this sidewalks and pedestrian areas should be properly highlighted because people from all over the world would come to witness an international event like Olympics and there should be a universal understanding of what various signs mean.

17. Why is Infrastructure and transport seen to be Important for crowd management?

Yes, the Infrastructure and Transport facilities are significantly important because that encourages people to visit the event and provide ways out during disasters. The presence of proper infrastructure with proper road signs and roads, and other facilities ensures that the congestion in the pressure points is decreased and because of all the excellent arrangements and proper facilities, there is an opportunity to increase the revenue collected from the event.

18. How Important is managing the health of the crowd as part of wider event management?

One of the most important areas in the arrangement of an event and the important aspect of crowd management alongside security is the health of the crowd. Unhealthy conditions and unclean environment can give rise to epidemics and that could be a major setback to the event. Also in emergency disaster situations the importance of health and management cannot be denied. The preparation of the event should include the tentative organization and set up in hospitals if any emergency disaster happens, so that everything can be controlled, first aid can be given on time and people can be saved from major problems.

19. What health issues are seen as particularly relevant to crowd management?

There are many important issues associated with running the crowds such as external threats such as terrorism and natural threats such as floods and fires as well as disease and injuries resulting from collisions during the attendance of events. All these things have to be thought of before and there should be an arrangement such that if any ill happenings occur at the event, they can be taken care of accordingly without any delay.

20. How Important Is legal regulation when planning an event?

The legal regulation regarding event and crowd management is in coordination with the event being planned. All the activities and the planning of those activities is carried out based on the law of that country. For example, all the international travelers coming to witness the event must carry their passports at all times. This is in coordination with the law of any country where the event is being held. This will not only cover the law part, but will also help to keep security checks, therefore, it could be said that the legal regulation when planning for the event is of great importance too.

21. Do you feel that regulatory requirements are beneficial to crowd safety?

The regulatory requirements are very beneficial to the safety of the crowd. It has always been said that there is a reason of making rules and laws, and the reason is that it is for the benefit and good for the people. If people don't abide by the rules and laws, there can be problems, which can obviously lead to restlessness, lawlessness, crimes and other problems leading to major disasters in the event being held. This is why there are rules for example, in case of OLYMPICS, there is a rule, that if the game starts at 10

am, people need to come to the arena certain hours before so that security can be checked, there is no hassle and people can be settled before the game event starts.

22. Do you undertake any advance training and rehearsal for an event?

Our organization is specialized in the field and services of event and crowd management and it covers all the sub areas that exist in it and need to be managed accordingly. At our organization we regularly give training to our employees regarding the event and crowd management. In addition to this we conduct exercises as well as rehearsal prior to the event. These exercises are very intense and cover emergency situations to make sure that all departments are ready to manage the crowd in time. These simulation exercises help to visualize and have an understanding of what the employees might actually face in the real times situations. These exercises make them expert to handle any kind of situations that might occur during the main event. In addition to this for contingency situations, our employees have basic understanding and training to take hold of such situations where they don't have any record of previous handlings in such situations.

23. What types of training and rehearsal are seen as being most important for crowd management?

Rehearsal on the entire event is considered important but certain things like security and other similar plans become extremely important. One of the reasons of rehearsals and exercises being important in any process to manage the crowds as well as the work of testing of the plans that have been working to make sure that they are ready to handle readiness in case of an emergency or any disaster situation.

24. How important are the financial targets for the crowd management process?

Money is one of the most important things in any situation. Nothing can be arranged without finances. Hence, the financial targets for crowd management process is crucial to that based on the development of financial goals are developing plans to manage and the success of any crowd.

25. Which financial measures are deemed important for the crowd management process?

In order to calculate the total expenses incurred in the event and the total revenue calculated, the income and expenditure of the financial measurements are important to the process of managing the crowd as well. This will also help in calculating the return on the investment for the crowd as that is one of the main aims of the arrangement of any event.

26. How Important Is disaster management for overall crowd management?

I think that this question can possibly be the summary of the entire interview that I gave you. Disaster Management for the crowd management process is very important too as it takes into account all the steps with extra precaution to be held in the main event. Disaster management is very important because it takes into account how the responsible people will take action if any disaster situation arises. Training and rehearsal along with simulation exercise is given to the employees and because of this employees will understand how to take control and manage the crowd when such emergency situation arises.

27. What aspects of disaster management are dealt with as part of overall crowd management?

The most important aspect of disaster management that is dealt as a part of the overall crowd management is managing the potential threats like the security problems. In addition to this other things like the infrastructure changes as well as the health and medical planning is also an important part of the process of managing the crowd.

INTERVIEW 2: Hajj respondent

1. What is the name / title of the event or activity?

Crowd management is a very important area when it comes to managing a huge event. I have been working in this organization for the last ten years where they plan the crowd management for the annual Muslim pilgrimage that is Hajj. It is a large Muslim event which takes place in the Holy city of Mecca, Saudi Arabia each year in the holy Month of Zi-ul-Hajj. My company is one of the companies involved with the Government for the preparation of this holy pilgrimage each year. Our company takes care of the security of the people who come on this pilgrimage. In addition to this our things that our company takes care is the mobilization of the people to perform different MANASIK (steps) in the Hajj. This also involves the roads, transports and the infrastructure to be managed. For the last 5 years we have been handling the responsibilities given to us by the government in an excellent manner which is why we are given the responsibility this year too and at present working permanently to carry out these operations.

2. What is your role within your organisation?

The main area for which I work is security of the crowd. I have specialized in this area of crowd management and have trained a number of security professionals in the past 12 years. Presently, I am working as a senior manager for crowd control in the security department in my organization. As I explained earlier that my organization works under instructions given directly from the government and we specifically handle the security and infrastructure issues for the people coming for the sacred Hajj pilgrimage.

3. What type of organisation do you work for?

As I explained earlier that my organization works under instructions given directly from the government and we specifically handle the security and infrastructure issues for the people coming for the sacred Hajj pilgrimage. In general, my organization deals with managing small and large events that various companies, organizations or even the government hold around the country. We sign a contract with the organization that has to host the event and our work is contract based. For smaller events we manage the

whole event by ourselves, whereas in large events, especially the annual event of Hajj, we manage a part of it.

4. What sort of crowd management approaches does your organisation use?

My organization mainly plans whatever needs to be done. In addition to this the equipment that our company uses is up to date. my organization has had an experience to manage large events so we have to keep out techniques and approaches up to date and of full maintained standard. Hence my institution that I work with uses several ways for crowd management mainly including work barriers, surveillance cameras, where there are thousands of cameras and to monitor the crowd accurately, as well as the element of security men and who is one of the important elements and helping to manage the crowd and control and final element is traffic calming, which helps a lot in crowd control management and is one of the most efficient techniques. In times of Hajj, the main crowd management approach that we use is the monitoring of the crowd through various techniques like surveillance cameras, security professionals. The mobilization of people from one place to another is aided with public transport that is especially dedicated to this process.

5. What is the most likely cause of a disaster In a crowd based situation?

When there is a large crowd, any number of things can happen. Even something causing panic can itself lead to a large disaster. In many previous Hajj events almost about before ten years, things like fire in the camps because of the stoves, or trampling of people due to excess number of people in one area caused disasters which cost lives of people. But after these incidents, especially precautions were taken in the years to come. For example the stoves are not allowed inside the camps now. Similarly the mobilization of people is controlled, groups of people are made so that more than required people do not go at one place in a specific time, and this would avoid the incidents of trampling. These incidents could be avoided with a proper planning of the entire event so that all these precautions are pre-thought about.

6. How do you decide on the number of security personnel to be employed?

Our organization employs over five hundred security professionals, and since Hajj is a very large event, we outsource people as well and there are some temporary hiring as well. The number of security personnel depends on the size of the crowd, along with the demographics of the group. In addition to this, the geographical nature of the crowd also determines the number of security personnel to be employed at the place of the crowd as people belonging from different cultures and the type of gathering also determines the reactions of people towards various crowd situations and the place of the crowd.

7. How relevant are environmental issues to crowd management and planning?

The environmental issues for the planning and management of the crowds are of vital importance, because sometimes the environmental issues also give rise to the crowd disasters and sometimes the planning also becomes difficult due to the problems arising in crowd management. Especially at an event like Hajj, where people from all over the world are coming belonging from all kinds of cultures, there are environmental issues that need to be tackled and kept the environment clean so that no problems arise.

8. Whose responsibility is project and risk management?

The responsibility for project management and risk management is of all the authorities that are responsible in planning the event. Hence the overall team is responsible for the project management. We are responsible as a whole team. If even one unit of the organization fails to complete their duty, the whole crowd management plan can go astray due to which any disaster can arise. This is why all the units and the responsible people have to be vigilant and therefore unite in their joint efforts.

9. What is the main aim of event management?

The event management is not a small thing, depending on the scale of the event and the size of the crowd, the event management is carried out. I think that the main aim of the event management is to manage the large crowd in a way that the event happens peacefully and in a secure manner. Hence the main aim can be to achieve the success of the event by handling the large or small crowd and maintaining its integrity and ensure the overall efficiency of the crowd management and get the expected profits from the crowd. The important thing to note here is that the managing a large event with a large crowd needs a huge responsibility and needs a lot of planning and proper

employment of available resources so that all goes well. It takes months and months of planning to make security plans and other crowd management issues which need to be looked into in every detail possible so that everything goes well in the annual event of Hajj without any problems, issues, accidents or disasters.

10. *How important is event management to crowd safety?*

Managing a huge event that happens on annual basis is a very big responsibility. And in the present conditions of terrorism around the world and the threats, the crowd safety issues become increasingly important. Fool proof security plans are made and appropriate number security officials are employed to maximize security of those who come for the holy pilgrimage each year.

11. *Who is responsible for maintaining communication throughout the event?*

As explained earlier that the role of our organization is to look for security checks and the mobilization of the crowd and communication is an essential element in both these responsibilities to be handled properly. The plans for security and the overall event management work when there is excellent communication and understanding level between the people involved in planning the event. The overall management team especially the officials that are responsible for communication are supposed to maintain the quorum for the level of communication. It is important that there is a right amount of communication at the right level, with proper understanding because the lack of communication or even a small communication gap could lead to missing some instructions which could ultimately cause an accident or even a major disaster. Hence, not only the individuals responsible for communication, but also any technology being used is double checked that is properly working and all instructions have been delivered well.

12. *What are the major threats to communication and collaboration?*

There can be a number of reasons why communication and collaboration could possibly fail. For example when it comes to the fail of communication and collaboration on the scene, one reason could be the failure of technology or the equipment being used. Another threat could be on another level which is bureaucracy and conflict between work teams, or the disruption of the IT department during the event.

13. Which authorities are involved in crowd management?

Depending on the type of event and the scale on which it is being held, the authorities responsible for it can be different. For example, in a small scale event, the authorities involved in crowd management could be the company heads or the people of the company for which the event is being held. On the other hand, for larger events all government regulatory bodies could be involved in the crowd management. In addition to this, all security and safety authorities, health, financials, environmental and others also an active role and are required in the crowd management so that the overall event is planned and issued well.

14. When undertaking crowd planning how important is society and culture?

The pilgrimage of Hajj brings together millions of Muslims from all over the world. The event that this being carried out is for the people whose presence would make the event possible. And every culture and society have norms that might be different from other cultures and societies. This is why it is of prudent importance that the officers working on crowd management are aware of the norms and cultures from which the people belong. So that the crowd gathered and crystallized consists of similar communities so that they can be handled accordingly. Hence, while undertaking the crowd planning it is very important to understand the society and culture in which the event is to be arranged and managed.

15. Which aspect of event and crowd management is influenced by society and culture?

As I told you in an answer to the previous question that the society and culture is of significance important when it comes to managing and planning the crowd for an event. The demographics and the level of calm that arises in an emergency situation to follow the instructions that are issued by the department of the crowd management are the important aspects of the event and crowd management is influenced by society and culture. The pilgrims at Hajj might not be aware of the norms of the Kingdom of Saudi Arabia, which is why the officials introducing them to the various steps of Hajj will also introduce them to the norms that they need to know during their stay at KSA.

16. Which forms of Infrastructure need to be managed as part of the crowd management?

To complete various steps of Hajj, Muslims have to travel from one place to another in the city of Mecca which is why the travelling is a main part of the pilgrimage. As our organization is given the responsibility of the mobilization of people, so the travelling through public transport like buses, trains, taxis, metros and other transport mode is managed by us so people don't have any problem when they need to travel from one place to another. There is an already developed infrastructure by the government which is in excellent condition which connects the places to complete the steps in Hajj. In addition to this, there are excellent bus services given to the people so they have no problem during traveling the distance to successfully complete their pilgrimage. In addition to this sidewalks and pedestrian areas are also properly highlighted because people from all over the world would come to witness this annual pilgrimage and there should be a universal understanding of what various signs mean. Our organization looks into this in detail and covers all aspects of it before the pilgrimage of Hajj starts each year.

17. Why Is Infrastructure and transport seen to be Important for crowd management?

In the annual Muslim pilgrimage of Hajj the Infrastructure and Transport facilities are significantly important because that people have to travel from one place to another to complete their Hajj for almost 20-25 KMs. The presence of proper infrastructure with proper road signs and roads, and other facilities ensures that the congestion in the pressure points is decreased and because of all the excellent arrangements and proper facilities. This travelling through the developed infrastructure and given transport is developed well so that travelers or the pilgrims face no problem.

18. How Important Is managing the health of the crowd as part of wider event management?

The event of Hajj almost takes two days to complete so people need to have good health in order to complete the Hajj. One of the most important areas in the arrangement of an event and the important aspect of crowd management alongside security is the health of the crowd. Unhealthy conditions and unclean environment can

give rise to epidemics and that could be a major setback in the entire event. Also in emergency disaster situations the importance of health and management cannot be denied. The preparation of the event should include the tentative organization and set up in hospitals if any emergency disaster happens, so that everything can be controlled, first aid can be given on time and people can be saved from major problems. Medical teams are assigned to the groups of people for managing the overall health of the crowd.

19. What health issues are seen as particularly relevant to crowd management?

There are many important issues associated with running the crowds such as external threats such as terrorism and natural threats such as floods and fires as well as disease and injuries resulting from collisions during the attendance of events. Too much rush of people in one place can cause trampling incidents. All these things have to be thought of before and there should be an arrangement such that if any ill happenings occur at the event, they can be taken care of accordingly without any delay.

20. How important is legal regulation when planning an event?

Whenever it comes to travelling internationally to cover an event, there is a legal regulation involved both on the part of the hosts who plan the event and also the people who visit. All the activities and the planning of those activities are carried out based on the law of that country. For example, all the international travelers coming to perform the Hajj and witness the event must carry their passports at all times. This is in coordination with the law of any country where the event is being held. This will not only cover the law part, but will also help to keep security checks, therefore, it could be said that the legal regulation when planning for the event is of great importance too. Our security professionals are told that they could randomly check these things so that the security remains intact.

21. Do you feel that regulatory requirements are beneficial to crowd safety?

Yes, it is true that laws and rules are made for a reason and which is why the regulatory requirements are very beneficial to the safety of the crowd. If people don't abide by the rules and laws, there can be problems, which can obviously lead to restlessness,

lawlessness, crimes and other problems leading to major disasters in the event being held.

22. Do you undertake any advance training and rehearsal for an event?

Our organization is specialized in the field and services of event and crowd management and it covers all the sub areas that exist in it and need to be managed accordingly. At our organization we regularly give training to our employees regarding the event and crowd management. In addition to this we conduct exercises as well as rehearsal prior to the event. These exercises are very intense and cover emergency situations to make sure that all departments are ready to manage the crowd in time. These simulation exercises help to visualize and have an understanding of what the employees might actually face in the real times situations. These exercises make them expert to handle any kind of situations that might occur during the main event. In addition to this for contingency situations, our employees have basic understanding handlings in such situations.

23. What types of training and rehearsal are seen as being most important for crowd management?

Rehearsal on the entire event is considered important but certain things like security and other similar plans become extremely important. One of the reasons of rehearsals and exercises being important in any process to manage the crowds as well as the work of testing of the plans that have been working to make sure that they are ready to handle readiness in case of an emergency or any disaster situation.

24. How important are the financial targets for the crowd management process?

Money is one of the most important things in any situation. Nothing can be arranged without finances. Hence, the financial targets for crowd management process is crucial to that based on the development of financial goals are developing plans to manage and the success of any crowd. Hajj is not personal revenue collection for the government of Saudi Arabia which is why only the costs of the stay of the pilgrims is taken from them.

25. How important is disaster management for overall crowd management?

It is very important for the reputation of the country as well as the reputation of the organizers that the event carries out smoothly without any disruptions, problems or even the any small or large disasters. This is why the disaster management for the crowd management process is very important too as it takes into account all the steps with extra precaution to be held in the main event. Disaster management is very important because it takes into account how the responsible people will take action if any disaster situation arises. The disaster management when planned covers all kinds of training and rehearsals to the employees that would help them handle the situation of disaster. Hence, as per your question, I think that disaster management is a very important part of the overall crowd management.

27. What aspects of disaster management are dealt with as part of overall crowd management?

The most important aspect of disaster management that is dealt as a part of the overall crowd management is managing the potential threats like the security problems, disaster management, handling the infrastructure and transportation facilities, financial aspects, health management issues. In addition to this other this other things like the infrastructure changes as well as the health and medical planning is also an important part of the process of managing the crowd. Other things are taken care as they come, but are prepared before hand as well so that at the time of need everything is handled well and the entire event runs smoothly.