Disaster Risk Reduction Strategies in Preparedness:

A case study of Jomo Kenyatta International Airport (JKIA) Nairobi Kenya

By

Richard Elvis Omwenga Obwaya
#2004148199

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Study Leader: Andries J. Jordaan

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DECLARATION OF ORIGINALITY

I, Richard Elvis Omwenga Obwaya, hereby present for consideration by the Disaster Risk Management Training and Education Centre for Africa (DIMTEC) within the Faculty of Natural and Agricultural Science at the University of the Free State (UFS) my dissertation in partial fulfilment of the requirements for the degree of Master's in Disaster Management.

I sincerely declare that this dissertation is the product of my own efforts and that no other person has published a similar study from which I might have copied and at no stage will this work be published without my consent and that of the Disaster Risk Management Training Education Centre for Africa (DIMTEC)

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EXCUTIVE SUMMARY

This study examines how well the Jomo Kenyatta International Airport (JKIA) in Nairobi, Kenya, is prepared to handle an airport disaster in the event that one occurs. In particular the study analyzed the relationship that exists between past disaster preparedness experiences, increasing disaster management complexity at airports and the increasing diversity of new disaster threats. The researcher examined the airport's disaster management policy, its disaster preparedness plans and its existing capacity and emergency response partnership arrangements. The study found that tragedies such as the terrorist attacks that occurred in the United States on September 11, 2001, have elevated the need for organizations to prepare for the unexpected through elaborate disaster management plans. Such plans enable organizations to mitigate risk and minimize the loss of life and property during disasters.

The findings of the study illuminate the current disaster preparedness capabilities of JKIA and could contribute to the enhancement of existing mitigation framework strategies at JKIA and other airports in Kenya and beyond. The study established that the JKIA plans, facilities and personnel cannot handle a large-scale disaster. A rapidly increasing traffic of travellers has put a strain on existing capacity at JKIA. Consequently, new hazards have emerged and existing hazards have become difficult to contain. Forecasts of growth have heightened the need for enhanced safety measures and better disaster management plans at JKIA.

Through a questionnaire, key informants were interviewed; cross-tabulation was done to show the relationship between variables such as the level of education of airport staff and their involvement in disaster response activities, among others. Data was coded using a codebook that enabled the conversion of measurements and attributes of variables into numerical form. Once coded, the data was entered into a computer and analyzed using Microsoft Excel and Statistical Package for the Social Sciences (SPSS).

The study's recommendations are based on an exhaustive analysis of various aspects of the airport establishment. The airport urgently needs to formulate a comprehensive disaster risk reduction framework with particular emphasis on boosting its safety and security facilities and equipment and addressing capacity building in disaster preparedness and management among its staff.

ACKNOWLEDGEMENT

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DEDICATION

To my wife Hellen Kerubo Omwenga

and

my children, also my best friends, Immanuel Obwaya and Abigail Moraa for being patient and understanding while I worked away from home and undertook this study.

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ACRONYMS AND ABBREVIATIONS

ASN	Aviation Safety Networks
CBDM	Community Based Disaster Management
CHE	Commission for Higher Education
EU	European Union
FAA	Federal Aviation Authority
FEMA	Federal Emergency Management Agency
FOD	Foreign object damage
GoK	Government of Kenya
MOHEST	Ministry of Higher Education Science and Technology
ICAO	International Civil Aviation Organization
ILS	Instruments Landing Systems
ISDR	International Strategy for Disaster Reduction
JKIA	Jomo Kenyatta International airport
KAA	Kenya Airports Authority
KCAA	Kenya Civil Aviation Authority
KNBS	Kenya National Bureau of Statistics
NTSB	National Transport Safety Board United States of America
UN	United Nations

CHAPTER 1: INTRODUCTION

1.1 Background information

The air transport industry has played an increasingly important role during the last quarter of the 21st century as a facilitator of overall economic activity and a critical element in certain economic sectors. Notwithstanding the importance of passengers carried, air transport has become a necessity to ensure the efficient and cost effective movement of goods and services. Even though flying is one of the safest forms of transportation, headline-grabbing disasters still occur at frequent intervals and Africa has been labelled as one of the most aviation disaster prone regions in the world (Kwiatkowski, 2001).

On another level, there is also an increasing interest in aircraft manufacturer, carriers, and other actors in the aviation industry for large size airplanes and the number of flights in many airports is on the increase. According to Ayres (2009), this makes airports to be extremely busy and even congested with increasingly large number of people being at the airport at any one time, yet there is no meaningful expansion and modernization of facilities.

The potential impact on airport related disasters involving these large numbers of people continue to increase. In the event of a disaster, the impact is often phenomenal. These disasters may arise from many causes ranging from mechanical problems to even human related factors such as terrorism with the later having the greatest frequency. Not only do disasters occur frequently around the world, but it would seem that their incidence and intensity have been increasing in recent years (UN/ISDR, 2008).

Disasters cause the loss of many lives, directly and indirectly (primarily or secondarily), affect large segments of the population, and cause significant damage to the environment and large-scale economic and social harm (Suda, 2000). Airports all over the world are therefore increasingly preparing for such disaster eventualities and this study is interested in understanding this kind of preparedness at the Jomo Kenyatta International Airport (JKIA), Kenya's largest and most internationally known airport in Kenya.

In the case of industrialized countries, disasters causes huge damage to the large stock of accumulated capital, whereas losses of human life are limited, thanks to among other factors, the

availability of effective early warning and evacuation systems as well as better urban planning and the application of more strict building codes and standards. In the developing countries, on the other hand, the number of deaths is usually high because of greater vulnerability brought about by the lack or inadequacy of forecast and evacuation programmes; and although losses of capital might be smaller in absolute terms when compared to those in developed countries, their relative weight and overall impact tend to be very significant, even affecting sustainability (Suda, 2000).

Risk is inevitable in human existence, this is not a debatable question, however, risk has been and will always remain part and parcel of human existence whether by our own liking or not. Risk has often resulted in disaster or disastrous events around the world, even in the face of advanced science and technology. The body is in some sense perennially at risk, even in the most familiar surroundings (Garatwa & Bollin, 2002). This in essence points to the inseparability of danger and humankind and by extension the inevitability of disasters. Despite advances in science and technology, humans are seemingly powerless in the face of disasters. It would seem that as technology advances, so is human vulnerability to danger and disastrous events (UN/ISDR, 2008).

Human made disasters was largely the focus of this study, as they are the result of human activities that may or may not be well intended. These are disasters or emergency situations of which the principal, direct causes are identifiable human actions, deliberate or otherwise. Apart from "technological disasters" this mainly involves situations in which civilian populations suffer casualties, losses of property, basic services and means of livelihood as a result of war, civil strife or other conflicts, or policy implementation (Kapoor, 2009).

In many cases, people are forced to leave their homes, giving rise to congregations of refugees or externally and/or internally displaced persons as a result of civil strife, an airplane crash, a major fire, oil spill, epidemic, terrorism, etc. These range from deforestation to quarrying and cultivation of hill slopes. For example, deforestation in one part of a country, motivated by the need to grow food crops and minimize malnutrition and starvation, can have disastrous consequences in another part of the country (Suda, 2000).

The most common man-made disasters are fires, explosions, and oil spills. To a growing degree, some human actions cause or aggravate the action of natural phenomena by improperly using natural resources or by not complying with codes and standards for the design and construction of development works. In other words, human intervention may increase the vulnerability of human settlements, production activities, infrastructure and services (Mulugeta etal. 2007).

In addition, records dating from 1974 show that there have been more than twenty five air crashes in Kenya (see annex 3), some of which have been very devastating. In this regard, the 1974 Lufthansa-operated Boeing 747-130 crash at Jomo Kenyatta International Airport on take-off was one of the devastating events (see Figure 1.1 below). In this disaster, 59 people died out of the 157 on-board (The East African Standard, 2004).

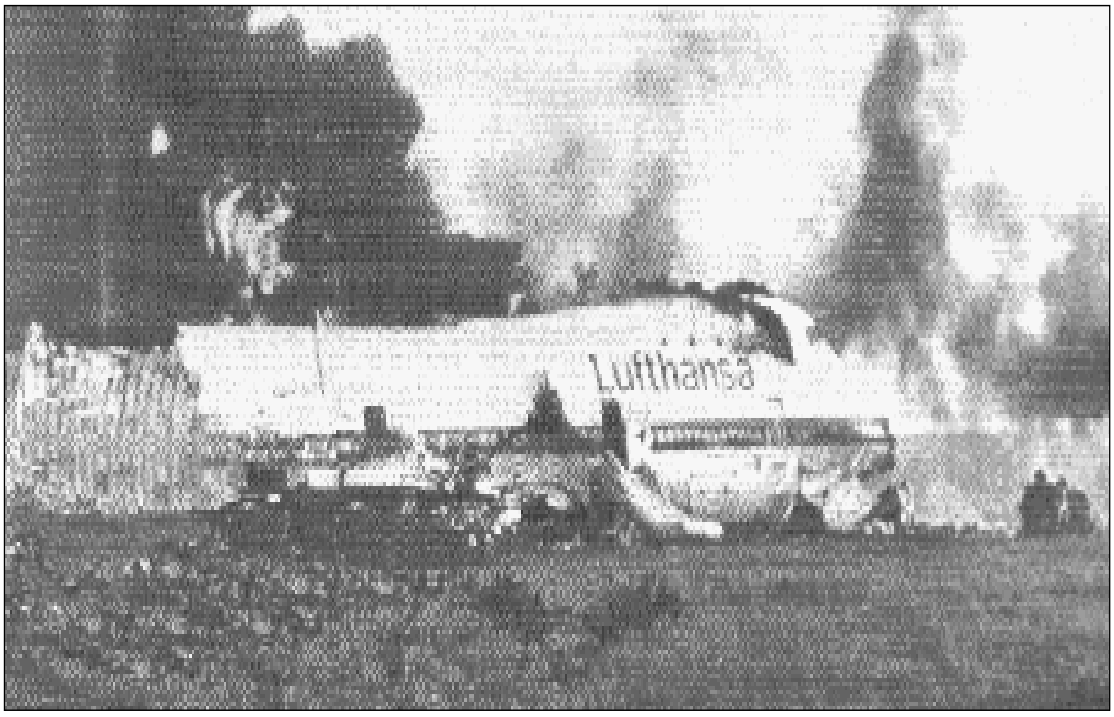

Photo 1: The Lufthansa aircraft that crashed at JKIA in 1974, Source (Lisk, 1997)

1.2. Problem statement

In many ways, airports are like small cities or towns. Though there are few permanent residences at airports, many have hotels. Inside the terminal are restaurants, shops, and financial services. Airports have their own fire stations, security force, and operations that handle utilities and engineering services. They provide trash collection, emergency medical services, and communications. Airports also are multimodal transportation centres where taxis, planes, cars, buses, trucks, and sometimes underground or surface rail combine to move people and goods to various locations on site and away from the airport.

All of this infrastructure and the constituents at an airport-employees, contractors, tenants, and the general public-are vulnerable to a host of hazards and potential disasters that can and do occur (Stambaugh et.al, 2009). The constant increase in the number of flights in airports and the

increasing growth in passenger numbers in airports and in the surrounding areas is posing new challenges to airports management and operations.

Consequently at the airports there is shifting interest in focus to the understanding of airports related disasters and the potential impacts of such disasters to various stakeholders involved with the day to day activities as part of management of airports. There is also an increasing observation that most of airports related disasters are caused to a large extent by human factors which puts issues of disasters preparedness in airports of key importance (Ayres, 2009).

Today, disaster preparedness is more far-reaching and inclusive of all hazards: extreme weather, hazardous materials accidents, natural disaster events, and acts of terrorism. According to Stambaugh et.al, (2009) the public and private sectors have invested heavily in improving threat assessments, plans, training, resource sharing, communications, and stockpiles of critical supplies. The lessons learned from the major events of the last decade have triggered new laws and regulations that expand prevention strategies and augment response capabilities.

The same disaster preparedness and response planning standards that govern cities, counties, states, and federal agencies are now being viewed for their applicability to airports. And as planning moved beyond a focus on surviving a nuclear weapon attack to comprehensive disaster planning, so, too, are airport managers expanding contingency plans from those based primarily on aircraft crashes to all potential emergencies (Stambaugh et.al, 2009).

Virtually no airport has sufficient resources to respond to every emergency situation independently. Each airport must depend to some degree on the resources from its surrounding communities. According to Ayres (2009) it is essential to prepare for emergencies that face an airport in order to be able to respond quickly, efficiently and effectively. While every contingency cannot be anticipated and prepared for, a strong emergency preparedness programme can assist in limiting the negative impact of these events, including liability and other post-emergency issues.

Lack of disaster preparedness has remained one of Kenya’s enduring development challenges for decades. Most of the disaster response initiatives in Kenya tend to be ad hoc, uncoordinated and short term measures, mainly in the form of emergency relief services to the worst affected areas. There is lack of recognition of the interrelationship between disaster preparedness, unsustainable production and consumption patterns (GOK, 2009a).

Despite the availability of personnel in Kenyan airports to deal with air crashes/disasters, it would seem that their preparedness in all these airports, including JKIA, is grossly wanting. For example, in

a simulation of disaster preparedness at the JKIA airport in June 2002, it took 37 minutes for ambulances and fire engines from without the airport to arrive (Mirichu, 2004). The first reaction that came out was panic, a situation in which proper planning was ruled out (The East African, 2004).

This study was interested in examining how well Jomo Kenyatta International airport (JKIA) is prepared to handle an airport disaster in the event that one occurs. The study was particularly interested in analyzing the relationship that exists between past disaster preparedness experiences, the increasing disaster management complexity at airports and the increasing diversity of new disaster threats. Equally important for the study was how well JKIA was meeting international safety standards based on the level of enforcement of the standards at the airports.

1.3. Research questions

The main focus of this study was to determine the common hazards and disasters JKIA was exposed to and how well the airport was prepared in handling such hazards and disasters. The study sought answers to the following two questions:

a) What disaster preparedness policies and strategies are in place to prepare JKIA in the event of a disaster?
b) How well equipped (training and facilities) is the airport to handle airport disasters?

In answering the above questions, the researcher explored the airport disaster policy, the disaster preparedness plans, the existing capacity and the emergency response partnership arrangements at JKIA.

1.4. Research objective

The main objective of this study was to determine the disaster preparedness level and strategies amidst increasing new threats to disasters like terrorism at the Jomo Kenyatta International Airport. The specific objectives of the study were:

a) To investigate the capacity of JKIA to handle any airport disaster that may occur at the airport.
b) To establish mitigation and preparedness measures that have been put in place to minimize the potential effects of air/plane disaster/crash.
c) Suggest measures to improve the general airport disasters management practices.

1.5. Research statement

Jomo Kenyatta International Airport has no capacity to handle any major disaster if it occurs and there are no mitigation and preparedness measures in place to minimize the potential effects of any air disaster occurrence.

1.6. Delineation and limitations

There are few key limitations to the study:

1. The study was limited to a single case study design, as such; the study presents generalization of the results, which is based on specific focus on capabilities of a certain aspect of the study, thus, while it represents the whole idea.
2. There was limited and strict access to airport incident and security related reports, data and information and facilities, this greatly contributed to quality and quantity of data and information released for the purpose of this study. Information that was shared by the management was limited to what was viewed to be unclassified; such kind of selective data could not provide informative data of the real situation of Jomo Kenyatta Airport which was the target area of study.
3. It is not possible to entirely exclude biases of the airport community and other stakeholders while collecting information about major hazards and their potential impacts, different opinions were collected as the study attempted to use several methods to triangulate the information.

1.7. Definitions of terms

(Definitions are from the International Strategy for Disaster Reduction unless otherwise noted Farnado, 2003).

Aircraft Accident

The Convention on International Civil Aviation Annex 13 defines aviation accident as any occurrence associated with the operation of an aircraft that takes place between the time a person boards the aircraft with the intention of flight and the time such person has disembarked, in which a person suffers death or serious injury as a result of the occurrence or in which the aircraft receives substantial damage (Kenya Civil aviation Authority-KCAA, 2007).

Aircraft Incident

> *Any occurrence associated with the operation of an aircraft that is not considered an aircraft accident (KCAA, 2007).*

*Community based disaster management (CBDM**)***

An approach that involves direct participation of the people most likely to be exposed to hazards, in planning decision making, and operational activities at all levels of disaster management responsibility *(for the purpose of this study this could mean the staff and other occupants of the Jomo Kenya International Airport).*

Disaster

A disaster is a serious disruption of the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of the affected society (or community) to cope using only its own resources. Disasters are often classified according to their speed of onset (slow or sudden), or according to their cause (natural, man-made or complex). The severity of the effects of a disaster may vary according to the degree to which man has created an environment susceptible to damage, that is, an environment in which life and property are at risk.

Disaster risk management

This is a systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies, and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.

Disaster risk reduction

The conceptual frameworks of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development.

Mitigation

Structural and Non-structural measures taken to limit the adverse impact of natural and technological hazards. Mitigation embraces measures taken to reduce both the effect of the

hazard and the vulnerable conditions to it in order to reduce the scale of a future disaster. In addition to these physical measures, mitigation should also aim at reducing the economic and social vulnerabilities of potential disasters

Preparedness

Activities and measures taken in advance to ensure effective response to the impacts of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations. That is, to predict and where-possible-prevent them, mitigate their impact on vulnerable populations, and respond to and effectively cope with their consequences.

Risk

The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions. Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be created or exit within social systems. It is conventionally expressed by the equation:

RISK = HAZARD x VULNERABILITY

Vulnerability

Vulnerability is the degree to which an individual, household, a community or an area may be adversely affected by a disaster, the conditions determined by physical, social, economic, and environmental factors or processes that increase the susceptibility of a community to the impact of hazards (Mulugeta et.al. 2007). The term vulnerability stems from the fact that certain communities or groups have settled in areas susceptible to losses resulting from the impact of a particular phenomenon or hazard.

1.8. Assumptions

The study was informed by the following assumptions:

a) Disasters create unusual circumstances for JKIA that require unusual response.
b) International and national standards are essential to ensure smooth operations.
c) National incident management system/incident command systems implementation is the most suitable articulation structure for multi-agency disaster operation at JKIA.

1.9. Significance of the study (Rationale)

The study of disaster preparedness at JKIA is of great importance not only to those working in the field of disaster management, but also to the people served by the airport. This study determines the

strengths and weaknesses of the current disaster preparedness capabilities of JKIA and explores the opportunities for improving the effectiveness of organizations that work in areas that are prone to disasters.

Research of this nature contributes to the field of disaster management at all levels of government, but in particular value to the executive level by providing an independent and impartial analysis of the current level of disaster preparedness capabilities at JKIA as well as recommended enhancements. The anticipated outcome of this endeavour is the development of a more proactive and consistent approach to disaster preparedness within JKIA that can be emulated by other airports.

By conducting this study deep understanding of the preparedness capacity will be realized and the study may be used to enhance or to advance the existing mitigation framework strategies at JKIA and other airports within the country, and if such strategies are applied could minimize the potential effects of aircraft and airport disasters. Since the disaster management policies and framework are still at the infant stages in Kenya, it is expected that this study will contribute to the disaster management academia in the country especially in airport related incidents and accidents, further contributing to the disaster information databases for further references and study.

1.10. Chapters overview

Chapter one has provided information on the background to the study, the problem statement, objectives of the study, limitations and the significance of the study and a brief definition of key terms. Chapter two focuses on relevant literature. It first gives the country's background, providing a clear picture of the Kenyan airports and specifically JKIA. Aviation disasters are emphasized in this chapter with the main causes of aircraft disasters. Chapter two also reviews airport hazards and looks at airport disasters globally, in Africa and specifically in Kenya. Air disaster preparedness and recovery with emphasis on disaster phases are further discussed.

Chapter three discusses the research methodology, the design, target population, sampling techniques and procedures, data collection procedures and ethical issues that might arise from the study. In chapter four the results of the study are analyzed and presented in tables, pie charts and graphs and thereafter a discussion of the results follows. Based on the study findings and the discussions, chapter five presents the conclusion and recommendation in line with the study objectives.

2.0. Introduction

This chapter presents a review of literature on disaster preparedness with a focus on Jomo Kenyatta international Airport in Kenya. It examines the various issues raised by the existing literature on aviation disasters and their management as a theoretical framework of the study.

2.1 Country background

2.1.1 Area

The Republic of Kenya is situated on the coast of East Africa, lies astride the equator and stretches longitudinally from 4° S and 4° N at latitude 34°E and 42°E. The total area, including 11 230 sq km (4 336 sq mi) of water, is 582 650 sq km (224 962 sq mi), with a maximum length of 1 131 km (703 mi) SSE – NNW and a maximum width of 1 025 km (637 mi) ENE – WSW (Encyclopaedia of the Nations, 2010).

Kenya is bound on the North by Sudan and Ethiopia, on the East by Somalia, on the South East by the Indian Ocean, on the South by Tanzania, and on the West by Lake Victoria and Uganda, with a total land boundary length of 3 477 km (2 161 mi) and a coastline of 536 km (333 mi) as shown on Map 2.1 below. The capital city, Nairobi, is located in the south central part of the country and sits on approximately 58 300 sq. km. (224 960 sq mi.); slightly smaller than Texas. With an estimated national population of 38 610,097 people, Nairobi is estimated to be home to over three million people (Government of Kenya, 2010).

Map 1: Map of the Republic of Kenya showing Kenyan airports, Source (AEO, 2006)

2.1.2. Terrain

Kenya's geography is diverse and varied. The coast is a low-lying area and extremely fertile. It has a coral reef supported by a dry coastal plain that is covered by thorny bushes and savannah. The terrain of the country gradually changes from the low-lying coastal plains to the Kenyan highlands. The highest point of the country lies in Mount Kenya, which is 5 199m high. The Great Rift Valley is located in the central and western part of the country and basically dissects the Kenyan highlands

into east and west. The highlands have a cool climate and are known for their fertile soil, forming one of the major agricultural regions of the country.

According to Kenya travel safari (2010) about 80% of the land area is arid and semi arid. A large number of swamps are in the Loraine Plain, situated in the north-eastern part of the country. There are also a number of lakes and rivers; most of the lakes are located in the Rift Valley. On the northern part of the country is Lake Turkana. On the western part of the country is Lake Victoria. Other major Rift Valley lakes include Lake Naivasha and Lake Nakuru. A few remnants of rainforests are found in the east of the country, including the Kakamega forest and the Mau forest.

2.1.3. Climate

Kenya is generally a dry country with over 75% of its area classified as arid or semi-arid with only around 20% being viable for agriculture. Inland, rainfall and temperatures are closely related to altitude changes, with variations induced by local topography. Kenya's climate varies from tropical along the coast to arid in the interior, especially in the north and northeast. Intermittent droughts affect most of the country. Less than 15 per cent of the country receives somewhat reliable rainfall of 760 millimetres or more per year, mainly the south-western highlands near Lake Victoria and the coastal area, which is tempered by monsoon winds. Most of the country experiences two wet and two dry seasons (Climatetemp, 2010). The driest month is August, with 24 millimetres average rainfall, and the wettest is April, the period of "long rains," with 266 millimetres (see Figure 2.1).

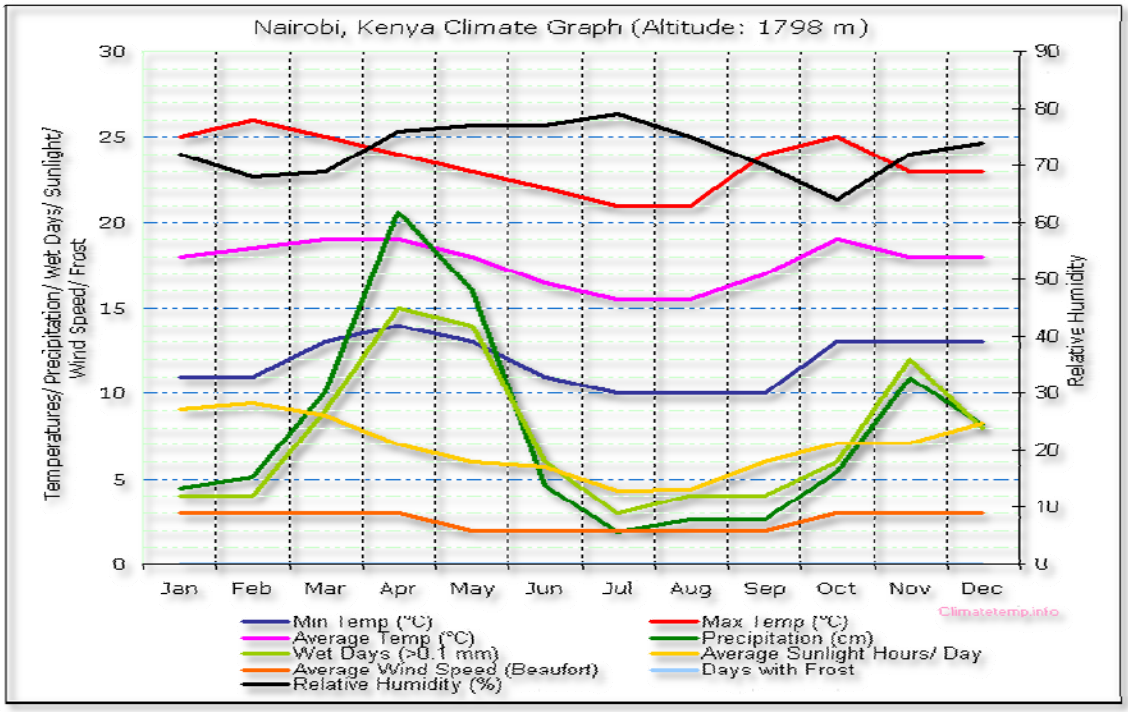

Figure 1: The climate of Nairobi, Kenya (Source: Climatetemp, 2010)

Except for the coast and Lake Victoria region, altitude is the main determinant of precipitation. The high-attitude areas (over c. 1 500m) in the central Kenya highlands usually have substantial rainfall, reaching over 2 000mm per year in parts of the Mau Escarpment. However, topography also has a major influence, with strong rain-shadow effects east of Mt Kenya and the Aberdare mountains. Here, even areas higher than 1 800m may be relatively dry. In the arid lowlands the peaks of isolated mountains attract cloud and mist, and may support very different vegetation to that of the surrounding plains (Climatetemp, 2010).

Differences in temperature vary predictably with altitude. Frost occurs regularly at 3 000m and occasionally down to at least 2 400m, and there is permanent snow and ice on top of Mt Kenya at 5 200m. The hottest areas are in the arid northeast, and west of Lake Turkana, where mean maximum temperatures average over 34^{o}C (Kenya Travel Safari, 2010).

2.1.4. People

Kenya has a very diverse population that includes three of Africa's major sociolinguistic groups: Bantu (67%), Nilotic (30%), and Cushitic (3%). According to the Kenya National Bureau of Statistics-KNBS (2010), in the 2009 national population and housing census, the top ethnic communities by numbers are Kikuyu at 6.62 million, Luhya at 5.33 million, the Kalenjin at 4.96 million, and Luo at 4.04 million. Others are Kamba (3.89 million), Kenyan Somali (2.38 million), Kisii (2.21 million), Mijikenda (1.96 million), Meru (1.65 million), Turkana (0.99 million), Maasai (0.84 million), Teso (0.33 million) and Embu (0.32 million) among others.

Kenyans are deeply religious. The 2009 census results indicated that Protestant churches enjoy the biggest following in the country, with 18.3 million followers (47 %). They were followed by the Catholic Church with 9 010 684 followers (23%) while other Christian churches accounted for 4 559 584 followers (12%). The Muslim population in the country stood at 4 304 798 (11%) while that of Hindus, Indigenous beliefs, Bahá'í Faith, Buddhism, and others accounted for 7% (Kenya National Bureau of Statistics, 2010).

Most city residents retain links with their rural, extended families and leave the city periodically to help work on the family farm. About 75% of the work force is engaged in agriculture, mainly as subsistence farmers. The national motto of Kenya is Harambee, meaning "pull together." In that spirit, volunteers in hundreds of communities build schools, clinics and other facilities each year, and collect funds to send students abroad. The 1999 showed the number of Kenyans at 28.7 million and

in 2009 Kenyans were approximately 38.6 million, representing a growth of ten million people within a decade (Mutahi, 2010).

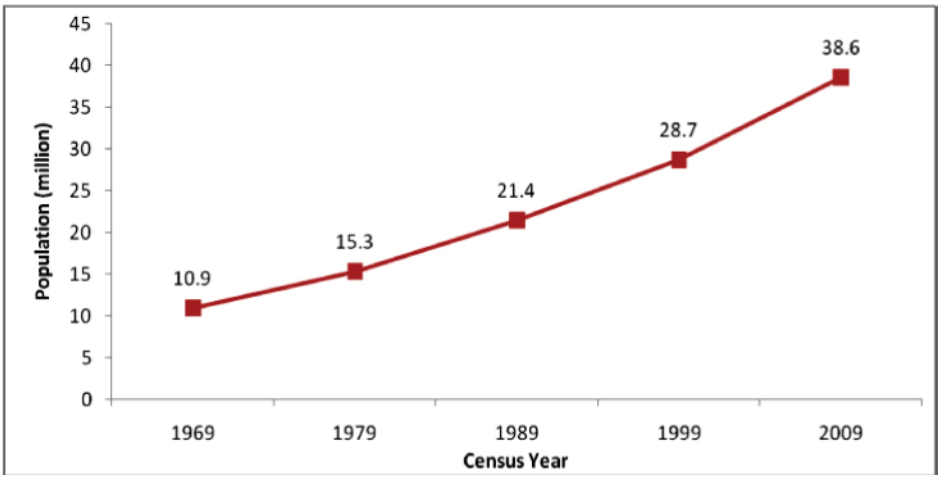

Figure 2: Population of Kenya 1969-2009. Source (KNBS, 2010)

2.1.5. Education

According to the Ministry of Higher Education Science and Technology (MOHEST), Kenya has seven accredited full-pledged public universities namely the University of Nairobi (UoN), Kenyatta University (KU), Jomo Kenyatta University of Agriculture and Technology (JKUAT), Egerton University, Moi University, Maseno University, Masinde Muliro University of Science and Technology (MMUST), most of which also have constituent colleges and 18 private universities (chartered private universities and private universities with letters of interim authority), including United States International University (MOHEST, 2009).

Public and private universities have a total enrolment of approximately 50 000 students with about 80% of these being enrolled in public universities (representing 25% of students who qualify for university admission). In addition more than 60 000 students enrol in middle-level colleges, where they study career courses leading to certificate, diploma and higher diploma awards. International universities and colleges have also established campuses in Kenya where students enrol for distance learning and other flexible programmes. Other Kenyan students pursue their university education outside the country (Commission for Higher Education, 2010).

2.1.6 Economy

After independence, Kenya promoted rapid economic growth through public investment, encouragement of smallholder agricultural production and incentives for private (often foreign) industrial investment. Gross domestic product (GDP) grew at an annual average of 6.6% from 1963 to 1973. Agricultural production grew by 4.7% annually during the same period, stimulated by redistributing estates, diffusing new crop strains, and opening new areas to cultivation. After experiencing moderately high growth rates during the 1960s and 1970s, Kenya's economic performance during the 1980s and 1990s was far below its potential (Library of Congress, 2007).

The economy grew by an annual average of only 1.5% between 1997 and 2002, which was below the population growth estimated at 2.5% per annum, leading to a decline in per capita incomes. The decline in economic performance was largely due to inappropriate agricultural, land, and industrial policies compounded by poor international terms of trade. Increased government intrusion into the private sector and import substitution policies made manufacturing sector uncompetitive. The policy environment along with tight import controls, and foreign exchange controls made the domestic environment for investment unattractive for both foreign and domestic investors (GOK, 2009b).

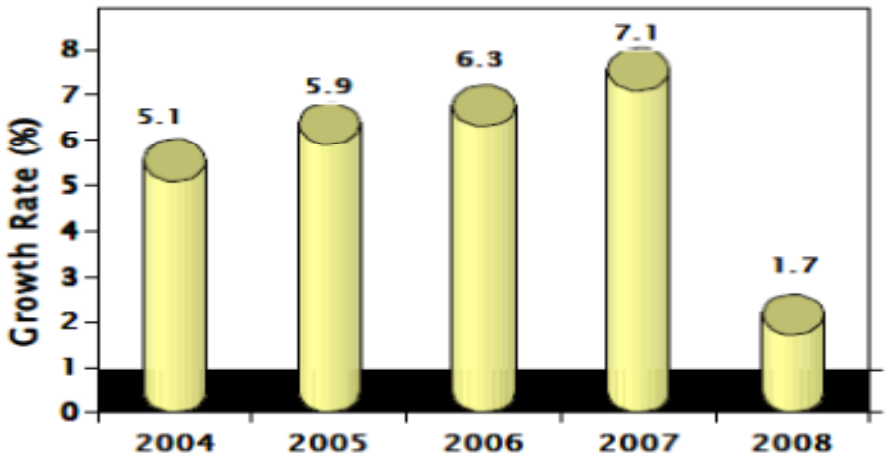

Figure 3 Kenya economic growth, Source: GOK, 2009b.

The country experienced remarkable sustained economic growth for the period 2003-2007 with a GDP growth rate reaching 7.1% in 2007, the highest growth rate over the period. However, 2008 was affected by internal shocks like the post election disruptions, unfavourable weather, high cost of food and fuel prices and external shocks like the global financial crisis. Internationally the global economy expanded by 2.7% in 2008 compared to 3.7% growth in 2008 (Government of Kenya, 2010).

Although Kenya's economic performance has exceeded that of most other African nations, the benefits of this growth have been seriously diluted by a variety of factors. Poor governance and corruption, increasing economic inequality, and environmental deterioration partly caused by high surging population, and erratic weather patterns have negatively affected the country's economic performance (Kenya National Bureau of Statistics, 2010).

2.1.7. Air transport in Kenya

Air transport has become increasingly important to the economy of Kenya. The aviation sector in Kenya has had significant growth in the recent past, both in tourism and cargo transport. Kenya Airways, the national carrier, is among the airlines (in the region) with extensive route network in

sub-Saharan Africa, ensuring their dominant position in providing essential regional air transport services. JKIA is the sixth busiest airport in Africa, and is an important regional hub, currently serving 32 destinations in the African continent (ASN, 2010).

However, the current airport was originally designed for an annual capacity of 2.5 million passengers and presently handles almost double that volume. The JKIA Extension Project aims at increasing the design capacity to 9.3 million annual passengers and providing improved security in order to comply with International Civil Aviation Authority standards (European Union, 2009). Jomo Kenyatta International airport is the hub and stop-over for all regional and international flights into and out of Kenya. The air passenger transport market in Kenya currently amounts to about two million air journeys (domestic plus international) from the airports in Nairobi and Mombasa (Government of Kenya, 2009a).

Tourists travel to Kenya to see its abundant and diverse wildlife, to experience the natural beauty of the land, and to enjoy Kenya's colourful, multifaceted culture (see Figure 2.4 below). The number of visitors who travelled out through JKIA increased by 22% from 90,777 persons in May 2009 to 110,707 persons in June 2009 while number of persons who landed increased by 12.5% from 113,712 persons to 127,926 persons over the same period (KNBS, 2010). Among all African countries in 1993, Kenya ranked in the top five for both international tourist arrivals and tourism revenue. Over the past decade, Africa recorded growth in tourist visits of 8.2%, the second highest growth rate among world regions and significantly higher than the world average of 5.5% (Kenya Airports Authority, 2008). The commercial passenger air traffic dropped from 7.0 million in 2007 to 6.4 million in 2008 (KNBS, 2010).

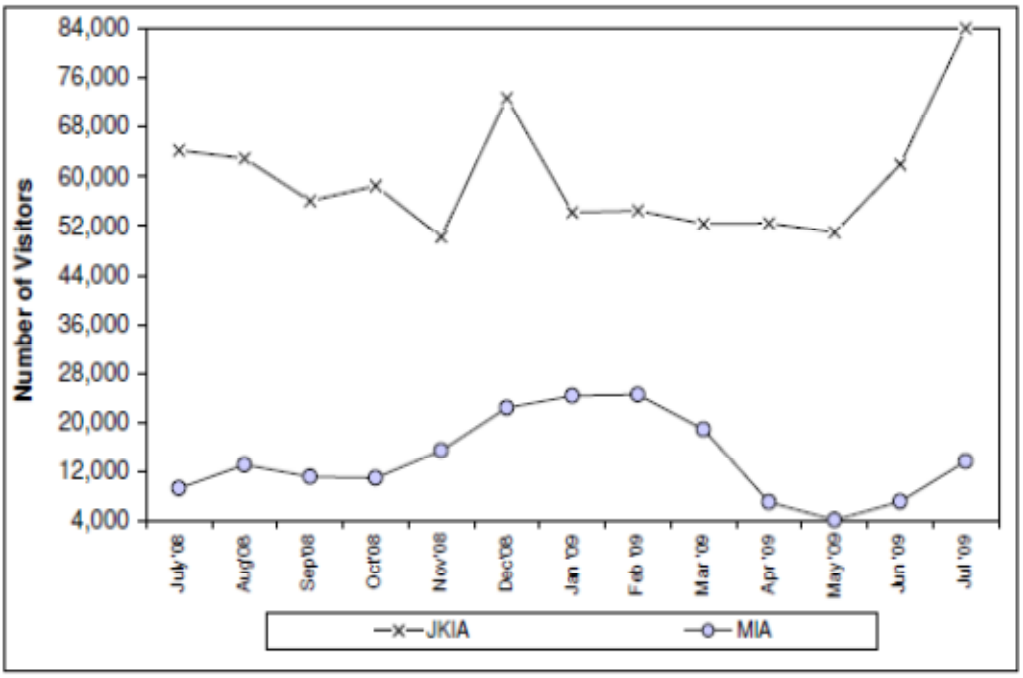

Figure 4 Visitors arriving in Kenya between July 2008-July 2009 (GOK, 2009b).

The air freight market is currently about 90 000 tons of cargo and mail. Most international visitors are European tourists, 50% of which arrive on chartered flights. Traffic on the Middle East/Asian routes consist mainly of foreign expatriates based in the Middle East and travelling to Kenya for vacation, Kenyans who work in the Gulf region, and family visitors and business travellers between Kenya and India. The majority of travellers on sub-Saharan routes consist of business travellers (Trading Economics, 2010).

2.2. Kenya airports

Kenya has more than 200 airports and airfields, 15 of which have paved runways, including four with runways longer than 3 000 meters. About 35 airfields can be considered commercial. Four airports handle international flights, Nairobi's Jomo Kenyatta International Airport (JKIA), Mombasa's Moi International Airport (MIA), and Eldoret International Airport and Wajir International Airport (KAA, 2010). Other facilities include Wilson Airport in Nairobi; airports at Malindi, Kakuma and Kisumu; and numerous airstrips throughout the country.

The Northern Corridor Transport Improvement (NCTI) project approved in mid-2004 includes US$41 million for aviation. The funds are earmarked to enhance facilities and safety at JKIA and MIA, including perimeter fencing, new navigation, security and baggage-handling equipment (EU, 2009).

The runway extension at JKIA is expected to raise capacity from 2.5 to 5.5 million passengers per year. A key objective of the airport upgrade is to achieve approval of "category one" status from the United States of America (U.S.A) Federal Aviation Administration to allow for direct flights between JKIA and U.S. airports. Direct flights would boost tourism and trade and secure JKIA's status as a regional hub. Kenya Airport Authority (KAA) operates all airports and runways in Kenya and authorizes airlines to use airport facilities and compiles traffic data (Kenya Airports Authority, 2010).

2.2.1 Jomo Kenyatta International Airport

Jomo Kenyatta International Airport, formerly called Embakasi Airport and Nairobi International Airport, is Kenya's largest aviation facility, and the busiest airport in Eastern Africa. It is the sixth busiest airport in Africa. The airport is located in Embakasi, a suburb to the south-east of Nairobi situated 15 kilometres (9.3 mi) from Nairobi's Central Business District (see annex 7, Map 2.3), at the edge of the city's built up area at Longitude 36°55.35'E and Latitude 01°19.07S, 5,375 feet above sea level (KAA, 2010). The Mombasa Highway runs adjacent to the airport (see Map 2.2 below), and is the main route of access between Nairobi and the airport.

The airport is the main hub of Kenya Airways. Jomo Kenyatta airport is served by Runway 06/24. Runway 06 is Instrument Landing System (ILS) equipped, 4 117m long by 45 m wide and is used for take-offs and landings. The airport is served by one terminal building constructed in the 1970s. Jomo Kenyatta International Airport's terminal has three units that cater for both arrivals and departures. Units 1 and 2 are mainly used for international flights whereas unit 3 is mainly used for domestic flights (Kenya Advisor, 2010).

Departing passengers check-in through units 1 and 2 depending on their destinations. Both units have airline check-in counters that operate on a Common Use Terminal Equipment (CUTE) system and immigration desks at the ground floor where passengers are cleared before they proceed to the departure lounge in the first floor via escalators or lifts. There are 30 checks in desks, 13 departure gates and eight air bridges and four baggage claims used to board aircraft. Arriving international passengers enter via the same gates into a concourse which leads to immigration counters at the first floor before coming to the baggage hall situated in the ground floor. The baggage hall is well served with baggage conveyor belts (Exploring Kenya, 2010).

Map 2: Jomo Kenyatta International Airport, Nairobi (Kenya Advisor, 2010).

Banking facilities, taxis, car hire, tour operators and hotel booking offices are conveniently situated at the arrival areas. A scheduled bus service to and from the town centre is available at unit 1 and 2 bus stops (Kenya Airports Authority, 2010).

2.3 Aviation hazards

Humankind has been able with thoughtful success to create disasters for itself, and more so with the inventions of science and technology (Kiema-Ngunnzi, 2002). Aviation travel is one such invention, which is unique among other transportation models because aviation accidents, even relatively minor ones, can result in mass fatalities due to the unique nature of the aviation environment. According to Krasner (2009), when automobiles collide, trains derail or ships sink, passengers may face the triple threat of blunt trauma, fire and smoke. However, these accidents do not happen at a lightning pace as often the case when an aircraft crashes at an airport at approximately 150mph (Devine, 2009).

Essentially, a commercial plane is like a crowded office building, occupied by as many as 600 people, but unlike the spacious high ceiling suites of a skyscraper, passengers are crowded into a tightly confined cabin. Thus even a small fire in one end of the cabins will produce blinding, toxic smoke that will engulf every passenger almost instantly. According to Ayres (2009) and Swabrick (2009), in the ensuing panic, passengers must then try to navigate the tight confines of a narrow aisle and reach one of the few emergency exits available.

The potential for disaster has increased significantly in recent years because more planes are carrying larger numbers of passengers, often flying to and from airport facilities not equipped or staffed to handle this increased traffic. More specifically, these airports are ill-equipped to respond to aviation accidents because they are operating under not much upgraded facilities designed to handle fewer travellers flying in smaller aircraft and landing at airports handling far less traffic than is the case today (Cleary & Dickey, 2010).

The commonly held belief that any aircraft mishap spells certain doom for its occupants is unsupported by many agencies like the Federal Aviation Agency (FAA) who assert that airports with well thought-out disaster plans and adequate rescue capacities have always averted disasters. A survey of airport emergency services conducted by International Association of Fire-fighters in 1998, found that existing FAA regulations are often ignored when it comes to passenger safety. For example, FAA requires airports to suspend air operations when fire protection falls below minimum levels, in extinguishing agents, staffing levels and medical emergency staff. Only two airports were found to comply with these regulations worldwide, namely Manchester airport and JFK airport, New York (ICAO, 2004).

According to Swabrick (2009), except in a catastrophic incident when a plane explodes or slams into the earth, most accidents are survivable because the vast majority occurs at or near airports during take-offs and landings. Although take-off, initial climb, approach and landings account for 18% of flight time; they account for 79.9% of all aircraft accidents. The National Transport Safety Board (NTSB) has classified fatalities in three categories, during the impact, post impact, and at undeterminable times. Excluding the latter, 78% of fatalities occur after the impact during climb or descent resulting from smoke inhalation and burns (Owen, 2003). Thus, a focus on airport disaster preparedness zeroes in on the most crucial zone of aviation safety.

Take-offs and landings place passengers and crew in circumstances most vulnerable to accidents. Kenya's Wilson airport is reputed to be the busiest in Africa with approximately 500 local flights per day (Mirichu, 2004). The airport is geared more towards cargo than human transport, as it transports only 1 000 passengers daily; while Jomo Kenyatta International Airport handles 20 international

flights per day transporting 10 000 passengers daily. JKIA is reported to have handled 3.2 million passengers in the year 2003 (Mirichu, 2004). As such, a major airplane crash will exact a heavy emotional and monetary toll on society. The human cost to victims and survivors and their families is immeasurable. The direct cost of just one fatal commercial air crash can total hundreds of millions of dollars.

When airplane crashes occur and the airport fire fighters can reach crash victims in the first few minutes after an airplane has crashed and fires ignite, the survival rate is 100%. Unfortunately, too many airports do not have the capacity to respond that quickly because they lack the necessary fire fighting personnel and equipment. This shortcoming places the lives of passengers, airport staff and fire fighters in jeopardy, and with more than 350 million people and crew flying in and out of world's airports each year, the potential for a disaster is greater than ever before (Ayres, 2009).

In cases where airlines have been associated with frequent air disasters, client exodus is expected and this leads to loss of revenue. Compensation claims for disaster victims could be quite high and their payment obviously leads to reduced profits, adding on to the loss incurred as a result of the damaged aircraft. In addition, loss of other property could be very high (Kiema-Ngunnzi, 2002).

Moreover, air disaster can disrupt communication so that telephone communication which is critical for coordinating emergency rescue operations are delayed, and the task of controlling curious crowds that normally gather in a disaster scene is hampered. There could as well be psychological and physical effects on the victims, friends, close relatives and even onlookers. Those of the 1998 Nairobi bomb blast have since lived with Post-Traumatic Stress Disorders. Some have partly lost their confidence and live with perpetual fear of another bomb blast (Kiema-Ngunnzi, 2002). Such are the kind of effects expected in case of a disaster like an air crash.

The Busia plane crash report (on one of the air crashes which occurred in Kenya in 2003) accuses the KAA, which regulates Kenyan airports, of many ills, including inefficiency, irregularities and unethical practices in its operations (The East African, 2004). The report further says that adequate security is required at Kenyan airports and their respective perimeter fences to reduce the risk of terrorist threats, smuggling and illegal immigration. Training was also cited as lacking in departments such as fire fighting, air traffic control and inspectorate. There is therefore the need to look more closely at the above weaknesses with reference to Kenya's premier airport, which was not the focus of the Busia report.

2.4 Causes of aircraft disasters

Travel by air is, by and large, perceived as a very safe mode of transport. Because of the nature of flying and the sheer volume of air travel today, though, there are a rising number of accidents. Aircraft disasters have a multiplicity of causes and by extension effects. Planes are flying at such high speeds and are so massive that any accident is almost sure to cause serious injury or death to the passengers. They also tend to fly over dangerous areas, like oceans or mountains, which make the chances of surviving an accident very slim. There are various causes of aircraft accidents, and unfortunately, some of them, including weather, cannot be controlled. However, many of them are a result of human error that can be avoided. According to Devine (2009), some of the causes of aircraft accidents include structural defects, tower error and bad weather as discussed below.

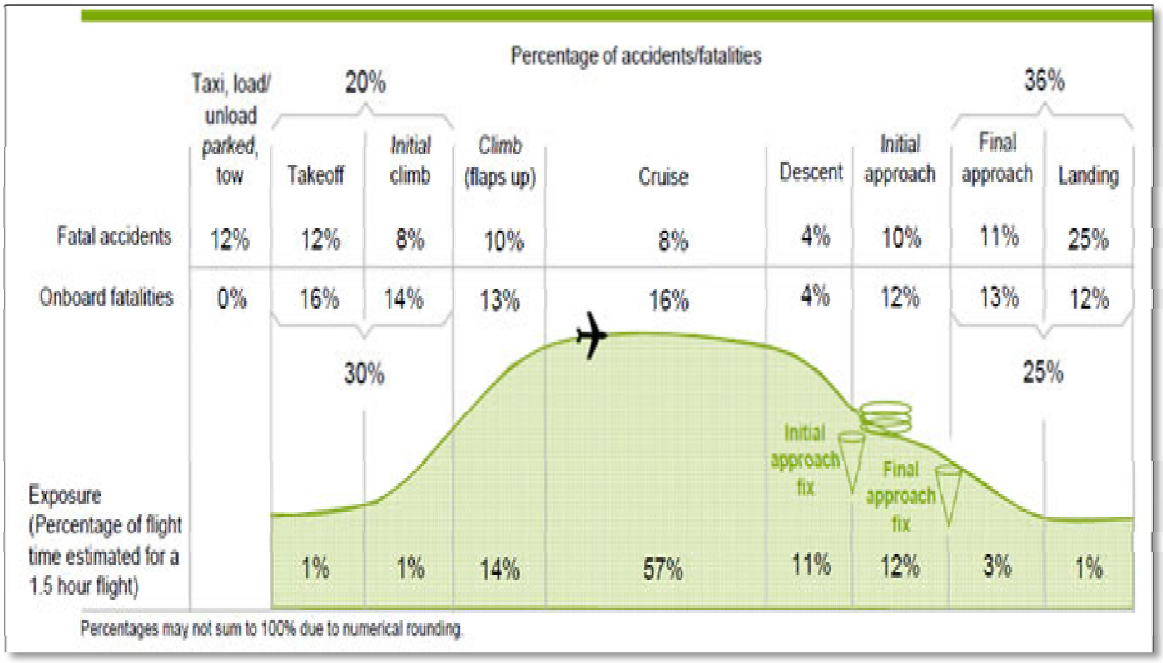

Figure 5: Statistical Summary of Commercial Jet Airplane Accidents, 1959 – 2008 Boeing. Source (PCI, 2010).

2.4.1 Pilot error

Approximately 80% of all aircraft accidents occur shortly before or during take-off and landing. These are usually said to have been caused by 'pilot error', although these days this is more often referred to as 'human error', to emphasize that pilots are simply human beings. Pilots are responsible for the well-being of the aircraft and of every passenger. Pilot error is certainly one of the easiest factors to consider when looking at causes of airplane crashes (Figure 5).

Humans, by their very nature, make mistakes; therefore, it should come as no surprise that human error has been implicated in a variety of occupational accidents, including 70% to 80% of those in civil and military aviation. While the number of accidents attributable solely to mechanical failure has decreased markedly over the past 40 years, those attributable to human error have declined at a very slow rate (Krasner, 2009).

Table 1: Causes of fatal accidents by decade %

Ause	1950s	1960s	1970s	1980s	1990s	2000s	All
Pilot Error	40	32	24	25	27	26	29
Pilot Error (weather related)	11	18	14	17	21	17	16
Pilot Error (mechanical related)	7	5	4	2	4	3	5
Total Pilot Error	58	57	42	44	53	46	50
Other Human Error	0	8	9	6	8	8	6
Weather	16	10	13	15	9	9	12
Mechanical Failure	21	20	23	21	21	28	22
Sabotage	5	5	11	13	10	9	9
Other Cause	0	2	2	1	0	1	1

(PCI, 2010)

(*The table is compiled from the PlaneCrashInfo.com accident database and represents 1,300 fatal accidents involving commercial aircraft, world-wide 1950-2009 for which a specific cause is known. Aircraft with 10 or less people aboard, military aircraft, private aircraft and helicopters are not included*).

Pilots are particularly susceptible to perceptual errors when their sensory input is degraded as is the case at night or in visually impoverished environments. Aircrew run the risk of misjudging distances, altitude and descent rates, as well as responding incorrectly to a variety of visual illusions (see Table 1). There are times when human errors, particularly by pilots and air traffic controllers, have led aircraft to miss runways, crashing into stationary objects like buildings and other planes. This has often resulted in fire outbreaks.

According to the United States of America National Transport Safety Board (2003), out of the 40 aircraft accidents at or near Hayward Airport since 1983, 17 were the result of human error. Human

error includes actions of inexperienced pilots (students), veering off the runway, failure to follow instruction from air traffic controllers, incidents due to the mental state of the pilots, misjudging of weather and loss of control of the aircraft by the pilots, although the latter is not always human error. Indeed, human error and especially inexperienced pilots have played a big role in aircraft accidents at or near Hayward Airport. This is against the fact that the airport having the most comprehensive air accident reporting and response as well as being listed as one of the ten most needed airports by the Federal Aviation for aviation accident data (National Transport Safety Board, 2003).

Human error is the underlying cause in the majority of aircraft accidents. The person at fault may be a pilot, maintenance engineer, ground crew member, manager or supervisor, designer or someone involved in the manufacture of an aircraft. Errors on the ground can include faulty aircraft construction or maintenance, incorrect instructions to air crew, mistakes in refuelling or securing the aircraft doors, overloading and excessive stress on staff. In the air, pilots may make navigation errors or choose to fly in cloudy conditions using visual cues such as landmarks instead of navigational instruments (Swabrick, 2009).

2.4.2 Structural defects

Structural defects can lead to dramatic and unpredictable aviation accidents. Defects can range from faulty or aging wires to corrosion and fuselage loss. In 1988, a Boeing 737 flown by Aloha Airlines experienced a ruptured fuselage, tearing part of the cabin apart and blowing a flight attendant off the plane and to her death. The accident was caused by problems with the adhesive bonding process, a problem Boeing was already aware of (Devine, 2009).

Structural problems in aircraft are usually related to corrosion, surface cracks, fatigue cracks and skin disbonds. Aging aircraft may experience structural defects from general use and lack of maintenance. When these problems go undetected, the lives of passengers and flight crew are endangered. This is especially important because of the very precise calculations that go into the physics of flying. It is a complicated science, and a bad design can be a huge problem. Equipment must be maintained and checked regularly to ensure the least possible chance of mechanical failure (Devine, 2009).

The International civil Aviation Organization has strict guidelines in place governing how often these checks have to be made. Engine failures have caused a number of accidents and the United States of America National Transport Safety Board (2003) records that out of the 40 air accidents at or near Hayward Airport since 1983, 12 were the result of internal aircraft problems including engine failure

and fuel leak. Other internal problems include power and gear failure, which have led to crash landings, resulting in loss of life and property.

Engine failure is a mechanical problem that can easily lead to aviation accidents. There are many reasons engine failure may occur, including an insufficient fuel supply and the breaking of engine parts. Pilots and crew are specially trained to manage engine failure as best they can by gliding the plane to a safe landing, but sometimes the aviation accidents resulting from this mechanical problem can be horrific (Devine, 2009).

2.4.3 Non-compliance with regulations

The International Civil Aviation Organisation (ICAO) and member states including Kenya under Kenya Civil Aviation Authority (KCAA) has very specific rules that cover almost all parts of air travel, from the equipment to ground personnel to passengers, luggage security, pilots and airports. They are designed for the utmost safety of everyone involved, and breaking these rules can create extremely dangerous situations (ICAO, 2004).

2.4.4 Tower error

Air traffic controllers have the large responsibility of making sure that the various planes and pilots are not going to endanger each other. Pilots are dependent on them to give timely, accurate information about everything from weather to landing patterns and runway positions. Collisions can occur if this information is not accurate and prompt (Kumar & Malik, 2003).

Recent reports of air traffic controllers acting dangerously only bring more attention to the potential consequences of their actions. In 2005 it was reported that by August, 200 human-related errors had been made by New York air traffic controllers, compared to 24 for all of 2004. Air traffic controllers have responsibilities just as pilots do. Mistakes and lapses in vigilance can result in aviation accidents and losses of life (Krasner, 2009).

2.4.5 Bad weather

Weather is the cause of almost a third of aircraft accidents. While it is blamed for causing most of air traffic delays, costing world airlines four billion dollars, and thunderstorms present some of the biggest hazards to aircraft in general. In fact, a single thunderstorm contains multiple threats to aircraft including heavy precipitation, hail, lightning, very severe turbulence, low level wind shear, microburst and icing conditions. Wind, mist and fog, particularly with regard to light aircraft, that impair visibility and air pressure have been noted to lead to air crashes. According to Baum (2010), failing to heed up-to-date weather forecasts is unwise especially where the elements are particularly

changeable and intense due to the mountainous terrain and the prevalence of strong winds and turbulence.

Severe weather can test the structural strength of aircraft designed for less rigorous conditions, and the skill of the pilots (Swabrick, 2009). Although poor weather conditions are beyond the control of pilots, airlines and flight crew, these people have a responsibility for the safety of their passengers. When the decision is made to go ahead with a flight despite weather advisories, the lives of others are put at risk.

2.5 Airport hazards

Hazard identification do consider every potential source of system failure, including equipment, the airport operating environment, and operational and maintenance procedures. According to Ayres (2009) organizational and human factors to consider include:

a) All persons having access to the workplace (e.g., airport workers, passengers, contractors, delivery personnel, as well as airport employees).
b) The hazards and risks arising from their activities, the required skills and training to perform a procedure, and their varying behaviour, medical conditions and physical limitations .
c) The hazards arising from the use of equipment or services supplied to the airport and its tenants as seen in Plate 1 annex 7.
d) The hazards arising from operational practices and procedures.
e) The work environment (visibility, lightning, temperature and precipitation conditions, strong winds).
f) Communications, including means, terminology and language.
g) Regulatory factors, including the applicability and enforceability of regulations; certification of equipment, personnel, and procedures and the adequacy of oversight.
h) Defences, including detection and warning systems, and the extent to which the equipment is resilient against errors and failures.
i) Organizational factors, such as airport policies for recruitment, training, remuneration and allocation of resources.

Beyond the obvious hazards that can contribute to an aviation accident, other causes exist. It is important for these possibilities to be taken into consideration so that the lives of passengers and other innocent people are not jeopardized. These factors often receive less attention than decent and landing accidents, taxi and takeoff accidents, mechanical failures, pilot errors, fuel mismanagement and inclement weather yet can have equally deadly results (Devine, 2009).

2.5.1 Terrorist attacks

These have been responsible for many air disasters, especially so during this 'era of terrorism'. For example, the September 11, 2001 terrorist attack on the New York Twin Towers and the Pentagon (US Defence Headquarters) by suspected *al Qaeda* terrorists could be the most remembered of all (Caffera, 2003). In this particular incident, civilian planes were crashed into the two scenes by suspected *al Qaeda* operatives, who had boarded the planes as normal passengers. People of various nationalities were killed and property worth millions of dollars destroyed. Suffice to mention that terrorists do not just use planes, but also surface-to-air missiles for attacks (Caffera, 2003).

A case in point is the failed downing of an Israeli jetliner during its take-off at Moi International Airport (Mombasa) in November 2002. Indeed, the first recorded surface-to-air missile attack was attempted in Rome in 1973 (Caffera, 2003). It should as well be pointed out that would-be terrorists could compromise airport officials to allow them to board an aircraft with the aim of hijacking it for a terrorist mission. Should the mission mature, the effects in terms of loss of life and property are devastating.

2.5.2 Bird hazards

Although many people (unfamiliar with the aviation sector) may not realize it, birds are a common threat to airline safety. A number of fatal accidents have been caused by bird strike. On 3 October 1960 in the USA, a Lockheed Electra turbo prop ingested European starlings into all 4 engines during takeoff from Boston Logon airport (MA) crushing into the Boston Harbour killing 62 passengers. Bird strikes are such a serious problem that the FAA estimates it costs United States aviation $480 million each year. Bird strike (also called BASH-bird aircraft strike hazard) occurs when there is a collision between a bird and an aircraft (see Figure 6).

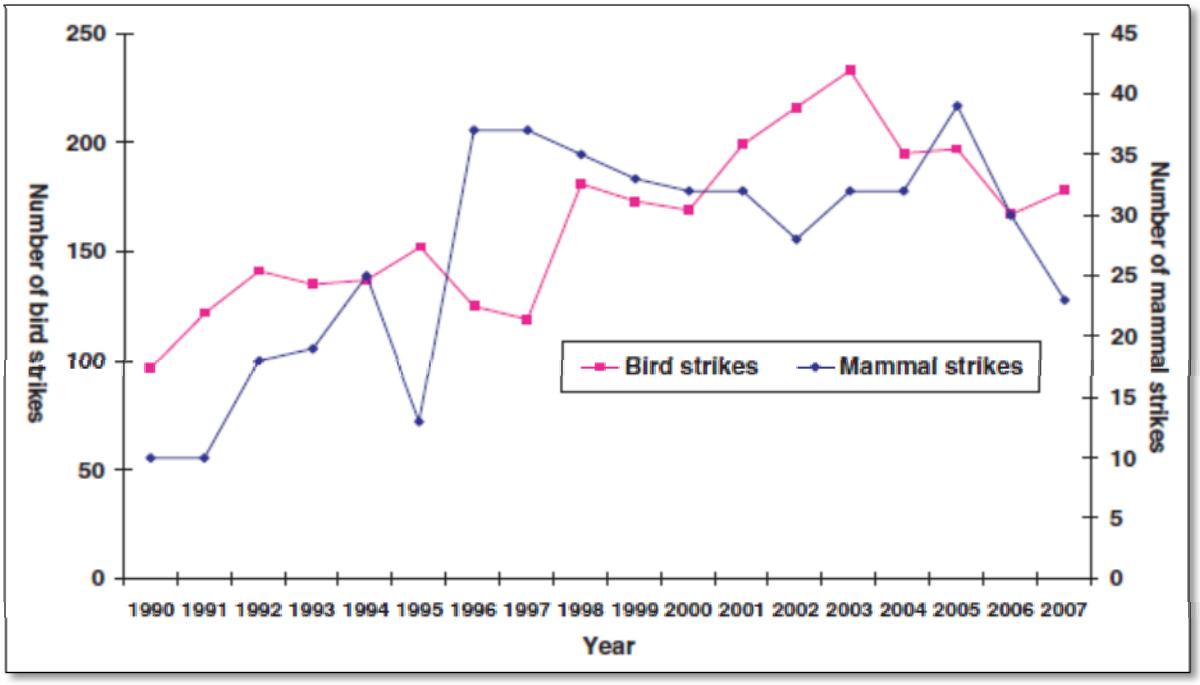

Figure 6: Wildlife aircraft strikes at general aviation airports, USA, 1990-2007
Source (Cleary & Dickey, 2010).

The speed of impact is such that even light objects like birds can cause destructive damage to a fast-moving vehicle. In most cases, birds impact the engine, and can thus cause a plane to completely lose its ability to fly (Cleary & Dickey, 2010). Because bird hazards have been such a significant problem throughout the history of aviation, pilots are trained to avoid bird collisions, and most airports have taken measures to make their runway areas inhospitable to winged animals. However, some people may act negligently in addressing bird strike (Devine, 2009).

2.5.3 Mid-air collisions

Mid-flight disasters are rare, although not entirely unheard of. They have occasionally been caused by wrong altimeter settings, lack of proper two-way communication with the tower, bombs or other terrorist activity, such as the 1988 Lockerbie disaster. A mid-air collision is every pilot and passenger's worst nightmare and one of the most dramatic types of aviation accidents.

Mid-air collisions are almost always due to human error, and are entirely preventable. Pilots receive training to avoid potentially dangerous situations, but when this preparation is overlooked fatal consequences may occur. Most mid-air collisions occur during daylight hours under good visibility. Additionally, no pilot regardless of experience is immune to mid-air collisions, and most collisions occur during pleasure flights with no flight plan filed (Devine, 2009).

Other hazards include fuel and lubricants (see annex 7, plate 1), fire among others. Annex 6 presents several hazard categories present at airports. Each category is further broken down into specific components of the category. The third column provides some general consequences associated with the specific hazard category and its components. The list is not intended to be exhaustive, but to provide some helpful information that can be used to identify additional categories, components and potential consequences.

2.6 Airport Disaster

2.6.1 Global perspectives

Since 1998, there have been 61 air accidents across the globe, and a simple calculation reveals that there is an average of almost one air accident each month (Owen, 2003). In some of the cases, a number of planes crash in a single day. The four planes downed by suspected *al Qaeda* terrorists on September 11, 2001 in the USA could be a good example. It should be mentioned that most of the recorded accidents involved civilian aircrafts. The statistics do not include warplanes destroyed during the war in Afghanistan, Iraq and other places across the world. According to only four websites that are by no means exhaustive, since 1998, global air crashes are distributed as shown in Annex 2 and no single region has been spared.

2.6.2 Air related disasters in Africa

Table 2: Air accidents by continent

CONTINENT	ACCIDENTS	% of ACCIDENTS
North America	839	25%
Europe	753	22%
Asia	633	19%
South America	557	16%
Africa	318	9%
Central America	144	4%
Australasia	103	3%
International waters	68	2%

North and South Poles	5	0%
TOTAL	**3420**	**100%**

(Source: SouthAfrica.to, 2010)

Although only about four per cent of the world's air traffic passes over Africa**,** one in four plane crashes happens in Africa. It is certain that less than 1 in 10 plane crashes have occurred in Africa since 1945. Examining the period from 2001 to 20 May 2007, there were 349 fatal accidents in the world, of which 60 have occurred in Africa (see Table 2 & 3 and Annex 4). So, over this period 17% of fatal airplane accidents occurred in African skies or just less than 1 in 5 fatal plane crashes occurred in Africa (SouthAfrica.to, 2010).

Table 3: South African Airways accidents

Date	Flight No.	Location	Aircraft Type	Cause
8 Apr.1954	201	Mediterranean Sea	de Havilland Comet 1	Structural failure, metal fatigue
13 March 1967	406	East London, Eastern Cape	Vickers 818 Viscount	Not available
20 Apr. 1968	228	Windhoek	Boeing 707-344C	Not available
28 Nov. 1987	295 (Helderberg)	Indian Ocean	Boeing 747-244B Combi	In-flight fire

(Source: South Africa.to, 2010)

The Kenya Airways crash in Douala Cameroon on May 2007 was not a typical African accident in that Kenya Airways is regarded as one of the safest airlines in Africa. Established in 1977, Kenya Airways has had two fatal crashes (see Table 4).

Table 4: Kenya airways accidents

Date	Flight number	Location	Aircraft Type	Cause
10 July 1988	5Y BBS	Kisumu	Fokker F-27 Friendship	Landing Gear
11 July 1989	5Y BBK	Addis Ababa	Boeing 707-351B	Landing Gear
30 Jan 2000	431	Abidjan	Airbus A310-304	Pilot Error
5 May 2007	KQ 507	Cameroon	Boeing 737-800	Undetermined

(Source:SouthAfrica.to, 2010)

In the January 2000 crash there were ten survivors out of 179 - one of whom, a Frenchman, swam to shore. In the May 2007 crash, all lives (114) were lost. Kenya Airways had non-fatal accidents on 10

July 1988 in Kisumu and on 11 July 1989 in Addis Ababa Ethiopia, both cases involving the problems with the landing gear (SouthAfrica.to, 2010).

While opening the summit of African Union of ministers responsible for aviation in 2005 in South Africa, South African president Thabo Mbeki noted: “It is alarming that, although the continent accounts for about three per cent of world aircraft departures, Africa witnesses 27 per cent of all fatal accidents on its soil". This statement by president Mbeki captured the essence of aviation security in the entire continent of Africa. The same concern has been raised in many more analyses concerning the air safety issues (Phillips, 2002). These experiences have portrayed the continent as a dangerous place to fly and as the most vulnerable place in the world to air-related disasters. Other factors that have been blamed for the airport-related accidents in the continent are air safety, navigation, ground transportation, network immaturity, security, geography, governmental mismanagement most of which have often been presented as insurmountable (Kwiatkowski, 2001).

Most of the crashes and air disasters have been noted to be concentrated in certain countries like Democratic Republic of Congo, Angola, Sudan, Nigeria and Kenya whose totals account for 62 per cent of all air accidents in Africa thus giving credence to the perception that Africa is generally an unsafe place to fly. Continent wide, Nigeria has borne the biggest chunk of air disasters and since 2004, there have been nine plane crashes in the Nigerian Kano State alone. Since 1956 over 300 people have lost their lives and millions of dollars worth of property destroyed (SouthAfrica.to, 2010).

2.6.3 Air disasters in Kenya

Kenya is quite well known for transportation related disasters. The country has experienced quite a number of disasters spread across all forms of transportation like the ferry disaster at the coast, off rail train disasters, air disasters and numerous road accidents all claiming thousands of lives. All these have not resulted in a properly well thought out national disaster management policy, and so disasters of any form have been treated just like any other, but more often with lots of criticism that they are not properly managed or handled (Okungu, 2006).

In the case of air-related disasters, every time that one happens it leads to issues being raised on the country’s state of airports and airstrips in particular and disaster preparedness in general. At the level of disaster preparedness, issues have been raised on the efficacy of equipment as well as availability of effective facilities at the airports. Other aspects like appropriate training have also been raised (Okungu, 2006).

Air-related accidents and incidences in Kenya have therefore not been left out, and have been quite prominent. In addition to the common causes of air accidents found in other parts of the continent,

Kenya has also experienced other causes of air accidents, namely those caused by birds (Satheesan & Satheesan, 2000).

Table 5: Air accidents in Kenya

Date	*Type*	*Registration*	*Operator*	*Fatality*	*Location*
09-NOV-2009	Beechcraft 1900D	5Y-VVQ	Blue Bird Aviation	1	Nairobi-Wilson
29-SEP-2008	DHC-5D Buffalo	5Y-OPL	Trident Aviation	0	Lokichoggio ...
29-APR-2008	Fokker 50	5Y-VVF	Blue Bird Aviation	0	Wajir Airport
27-APR-2008	Airbus A340-313	G-VAIR	Virgin Atlantic	0	Nairobi-Jomo...
12-DEC-2007	DHC-5D Buffalo	5Y-MEG	Trident Aviation	0	Nairobi-Wilson
12-DEC-2007	Cessna 208B Grand Caravan	5Y-SLA	Safari Link	0	Nairobi-Wilson
08-JUL-2007	ATR-72-212	5H-PAR	Precision Air	0	Nairobi-Jomo...
06-JUL-2007	Beechcraft 1900C	5Y-BTT	Aero Kenya	0	Nairobi-Wilson
30-DEC-2006	DHC-5 Buffalo	5Y-SRK	Sky Relief Services, of. Red Cross	0	Near Nairobi-JKIA.

(Source: ASN, 2010)

In view of the foregoing, it is evident that 50% of the air accidents occurred during take-offs, 28.6% during landing and 21.4% during cruise (Table 5). Take-offs and landings accounted for 78.6% of the accidents (see Annex 3), and thus most air accidents occur during take-off and landing (ASN, 2010).

Most of these accidents happen within the precincts of the airport, which renders further justification for the study of disaster preparedness in Kenya's main airports. Indeed, the other recent security incident at the Jomo Kenyatta airport concerning the so called Armenian brothers brought a further focus of interest on airport security issues (ASN, 2010).

2.7 Airports and fire disaster vulnerability

During this 'era of terrorism', to assert that our airports are highly vulnerable to terrorist attacks cannot be in any way an understatement. Terrorists have been able to crash four American planes inside the USA at the same time, with one of the crashes being into the Pentagon (US Defence Headquarters) itself. In addition, the fact that the terrorists can plan and execute their plans *incognito* makes one feel unsafe, especially boarding an aircraft or even residing near an airport, among other public places (Caffera, 2003).

It should always be remembered that an aircraft is mechanically fabricated, and bearing in mind that human knowledge is limited to a certain degree, it is clear that air disasters are inevitable even with advancement in technology. All we can perhaps do is to put measures in place so as to minimize the

impact should a disaster occur. Suffice to mention that jet fuel is highly flammable, and whenever there is an air disaster, it is almost inevitable that a fire will break out (Coulles & Eskell, 2000).

Fire is a chemical reaction that requires three fundamental elements to take place. The points of the fire triangle are oxygen, fuel in the form of solid/liquid or gaseous combustible material and an ignition source of heat energy. In most accidents, crash survivors immediately face the dangers of fire and smoke inhalation; those who cannot exit quickly are killed by toxic smoke. The smoke contains deadly compounds, such as hydrogen chloride, hydrogen fluoride, cyanide and carbon monoxide that can cause unconsciousness in only one or two breaths (Coulles & Eskell, 2000).

This suggests that airports and aircrafts are highly vulnerable to fire disasters. It is to be borne in mind that aircraft fuel at the airports, meaning that airports keep huge reserves of jet fuel. This makes them highly vulnerable to fire disasters, even from a cigarette butt disposed of carelessly (Owen, 2003). Structural fires and medical emergencies can occur anywhere on airport property. Airports involve several square miles of concourses, terminals with shops, restaurants and parking structures.

Similarly, a heart attack experienced by a passenger or visitor to an airport may not be fatal if emergency medical personnel provide timely medical attention. Fires or terrorist attacks can occur in a busy airport terminal causing mass casualties if not quickly contained. Lacking regulations and response policies, some airports employ *ad hoc* emergency response measures leading to disparities in the delivery of emergency services; while some airports have excellent response plans to save lives, others have very poor plans (Coote, 2000).

Manchester and New York airport authorities have their firefighting and emergency medical personnel ready 24 hours a day. The two airports are the only ones in the world known to conduct Airport Emergency preparedness exercise with on-airport and off-airport fire departments every six months. Other airports of the world conduct their drills after every three years. The two airports are also known to follow FAA regulations to suspend air operations when fire protection falls below minimum levels, in extinguishing agents, staffing levels and medical emergency staff (ICAO, 2003).

2.8 Air disaster preparedness and recovery

Once a disaster has occurred, a set of activities has to be put in motion, aimed at firstly satisfying the immediate needs of the victims, their rehabilitation and the reconstruction of any infrastructure that may have been damaged or destroyed. According to Kapoor (2009), the recovery measures, both short and long term, will include returning vital life-support systems to minimum operating standards; public information and health and safety education; economic impact studies; and counselling

programmes. This requires certain procedures, as haphazard response can be sometimes problematic. Policies and objectives should actually guide the recovery, which should have been put in place for some time, tested and proved beyond doubt (FEMA, 2006).

Coordination is an essential ingredient in a disaster preparedness plan. This means arrangements and preparations put in place not only to prevent a disaster, but also to be implemented once a disaster occurs. Such plans must be both horizontal and vertical in terms of duty allocation among all the people designated to be involved, should a disaster happen. The team should be on call 24 hours a day so that in case of an emergency there is no delay in the response team (Salvano, 2002).

The necessary resources that add value to the professional training should back this team. Without this preparedness, the response and recovery operation will rapidly disintegrate. For effective response to be achieved, however, a structure for decision-making and coordination of the action plan, and the actual response must be put in place. In terms of disaster relief operations, the range of relief requirements is normally very extensive. Some of the major requirements include shelter, food, medicine, a communication system, logistics system, social workers and counsellors and a multiplicity of others (UN/ISDR, 2008).

Throughout all the activities that are meant to promote disaster preparedness, the ultimate objective should be to have plans in place that are not only agreed upon by stakeholders, but also implementable given the available resources both material and manpower. Over-ambitious plans, especially with inadequate resources, are bound to fail and lower the credibility of the organization in the eyes of the public. Indeed, any disaster preparedness plan must have adequate resources that have been committed and readily available (Salvano, 2002).

For disaster response and recovery plans to be effective and hence successful, it is important for the responders to know what to do and how to do it in case of a disaster, what is described as empowering the community to participate in disaster recovery (ISDR, 2003). For this reason, an essential part of disaster preparedness and recovery plan is the creating awareness among those who may be threatened by disaster such as an air crash at JKIA. These could include people residing near the airport.

2.9. Phases of a disaster

Disaster management is a cyclical process; the end of one phase is the beginning of another (see Figure 2.7), although one phase of the cycle does not necessarily have to be completed in order for the next to take place. Often several phases are taking place concurrently. Timely decision-making during each phase results in greater preparedness, better warnings, reduced vulnerability and/or the

prevention of future disasters. The complete disaster management cycle includes the shaping of public policies and plans that either addresses the causes of disasters or mitigates their effects on people, property and infrastructure (Carrilo, 2010).

2.9.1 Mitigation and preparedness phase

The mitigation and preparedness phases occur as improvements are made in anticipation of an event. By embracing development, a community's ability to mitigate against and prepare for a disaster is improved. As the event unfolds, disaster managers become involved in the immediate response and long-term recovery phases.

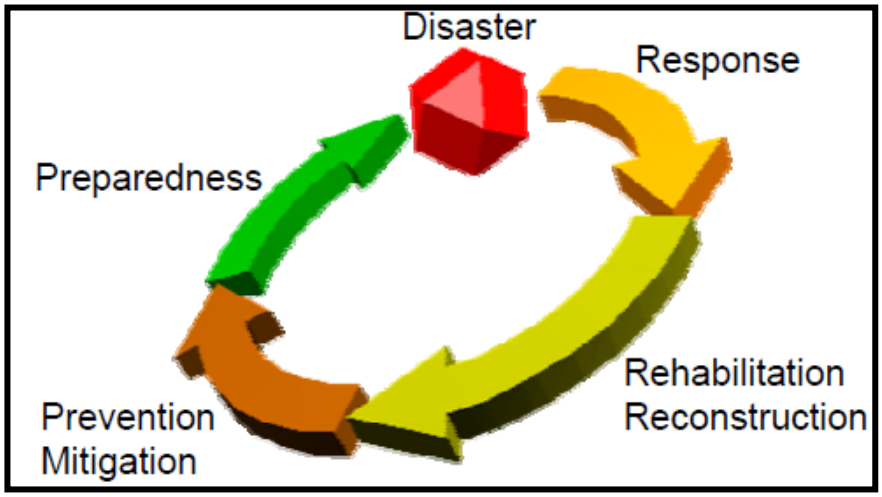

Figure 7: Disaster management cycle (Source: Garatwa & Bollin, 2002)

2.9.1 Emergency Phase

Disaster strikes. There is major disruption of the local community. Mitigating measures must immediately be taken against the disaster. Emergency response activities are those carried out during the actual emergency or immediately prior to it. This may involve emergency assistance during the disaster, and actions taken in the immediate aftermath during the time when the community is rather disorganized and basic services and infrastructure are not fully functioning. The impact phase of a disaster can vary from the slow, low-threat build-up associated with some types of floods to the violent, dangerous and destructive outcomes associated with tornadoes and explosions. The greater the scope, community destruction and personal losses associated with the disaster, the greater the psychosocial effects (Garatwa & Bollin, 2002).

Depending on the characteristics of the incident, people's reactions range from constricted, stunned, shock-like responses to the less common overt expressions of panic or hysteria. Most typically, people initially respond in confusion and disbelief, and focus on the survival and physical well-being of themselves and their loved ones. When families are in different geographic locations during the impact of a disaster (e.g. children at school, adults at work), survivors will experience considerable anxiety until they are reunited.

2.9.2 Response phase

The response or relief phase refers to the time period for humanitarian assistance, when steps are taken to save lives and to provide essential supplies to those most affected. It includes such activities as search, rescue, evacuation, provision of shelters, first aid, emergency medical care and protection, temporary restoration of transportation and communication routes, preliminary repairs to essential public utility services and early actions to register victims and record damage to public and private property. This stage may vary in its duration but, in general, it is relatively brief, depending on the magnitude of the disaster (Garatwa & Bollin, 2002).

2.9.3 Rehabilitation phase

The rehabilitation or transition stage includes activities required to return normality to the affected areas and communities. It includes non-definitive repairs to housing and buildings, and to transport and public utility service infrastructure. Problems related to the emotional and psychological recovery of the inhabitants of the regions affected by the disaster are to be addressed here. Return to work, creation of new jobs, availability of loans and financial resources, and immediate start-up projects related to the consequences of the disaster are among recovery measures that most help the victims and affected communities. Finally, the reconstruction stage includes activities designed to rearrange the affected physical space and environment, and enable the allocation of resources in accordance with the new social priorities arising from the effects of the disaster (Garatwa & Bollin, 2002).

An aviation accident is the worst nightmare of every pilot or passenger that has ever flown in an aircraft. Although air travel is one of the safest forms of transportation, accidents do happen with dramatic and terrifying results. The causes of these aviation accidents vary greatly depending on specific circumstances and problems that may develop during the flight process.

Disaster management in Kenya has not developed to the extent where systems are fine-tuned to effectively and efficiently prevent, control and manage disasters. Mawanda (2003) puts it that locally,

resources are geared towards recovery and reconstruction, rather than prevention or appropriate response.

In addition, it would seem that air disasters have been left out in research, particularly in Kenya, as most previous studies have focused on other disasters. For example Kiema-Ngunnzi (2002) looked at recovery strategies for the 1998 Nairobi bomb blast victims within the Teachers' Service Commission. In order to prevent, control or even mitigate any disaster or any other problem for that matter, the causes of the problem must be brought to the fore.

While there have been impressive humanitarian relief efforts in times of crisis, particularly related to natural disasters in Africa, Holloway (2003) says that disaster vulnerability and risk have not been taken as an important area of sustainable development planning. In Kenya, more resources have actually been allocated to relief and rehabilitation efforts than prevention. This is a major shortcoming on the part of the government and other stakeholders in the disaster mitigation sector. For example, according to the Kenya Red Cross Society- KRCS (2009), a fire outbreak in Nakumatt downtown supermarket (Nairobi) in January 2009, saw many relief efforts. In actual fact, the city planners should have foreseen the possibility of such a disaster and advised on house plans.

2.10 Airport safety management

The aviation industry has always quoted safety at the forefront of its priorities. As a general rule it has demonstrated diligence in learning from its mistakes and implementing changes that lead to further improvement. This somewhat reactive approach produced a steady decline in accident rates until the mid-1980s. Since then, the fatal accident rate in air transport operations has remained fairly stable, despite a growth in traffic during the same period. This trend implies little improvement in safety on the operation/accident ratio, and suggests that as traffic grows, the total number of accidents will grow accordingly (Ayres, 2009).

The ICAO, recognizing these facts and that "the public's perception of aviation safety is largely based on the number of aircraft accidents rather than the accident rate", issued a resolution to "reduce the numbers of accidents and fatalities irrespective of the volumes of air traffic". The ICAO further provides guidance on how to achieve this resolution, including the recommendation to "develop a civil aviation safety management framework and recommendations for improving safety" (ICAO, 2004).

In recent years a great deal of effort has been devoted to understanding how accidents happen. It is generally accepted that most accidents result from human error. It would be easy to conclude that

these human errors indicate carelessness or lack of skills on the job, but such a statement is not accurate. Accident investigators are finding that human error is only the last link in a chain that leads to an accident. Accidents cannot be prevented by changing people; they can be prevented only when we address the underlying causal factors (Ayres, 2009).

There are two ways of thinking about safety. The traditional way is that safety has been about avoiding costs. In this sense, many aviation organizations have been bankrupted by the cost of a single major accident. This makes a strong case for safety, but the cost of occurrences is only part of the story. Efficiency is the second way of thinking about safety. According to Ayres (2009) safety and efficiency are positively linked. Safety pays off in reduced losses, enhanced productivity and lower insurance costs.

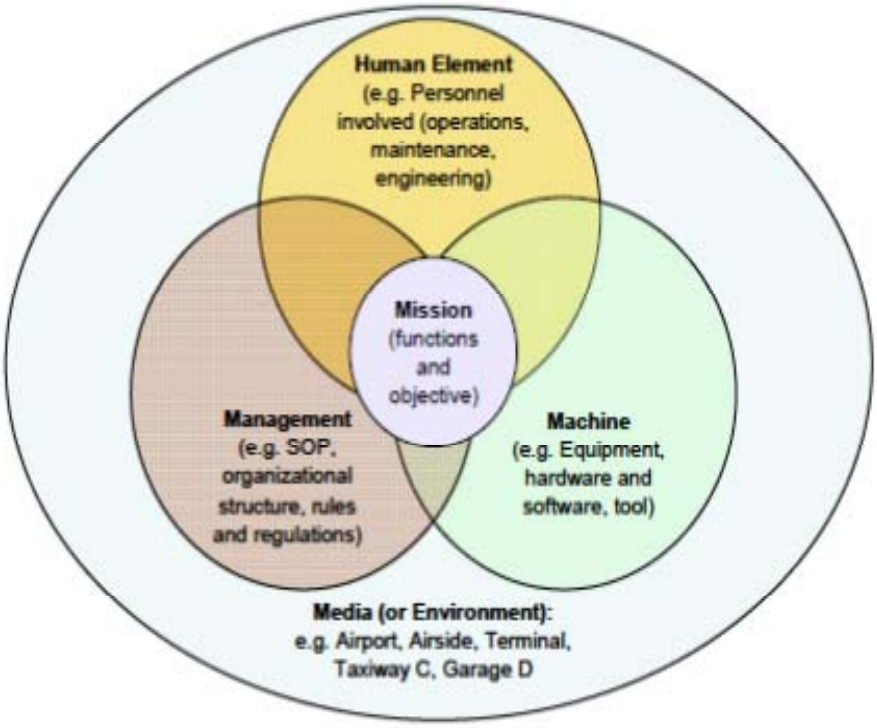

Figure 8: The '5M' Model (Ayres, 2009)

While there are many models available, the model called "5M" (see Figure 8) is simple and recognizes the interrelationships and integration of the equipment, human, environment, and procedures to the objective of the system (ICAO, 2004). The model has five components, namely:

a) *Mission:* It is the airport activity or the reason that all the other elements are brought together.
   Example: operation for transporting baggage from parked aircraft to baggage claim

area.

b) *Man:* This is the human element of a system. If a system requires humans for operation, maintenance or installation, this element must be considered in the system description.
Example: an airport construction activity is conducted by contract workers and monitored by airport staff. This group of people and the people they interact with during the construction activity comprise the human element of this system.

c) *Machine:* This is the equipment element of a system.
Example: the operation to transport baggage on the ramp may require a baggage tug and baggage carts.

d) *Media:* It is the environment in which a system will be operated, maintained and installed. This environment includes operational and ambient conditions. Operational environment means the conditions in which the mission or function is planned and executed. Operational conditions are those involving things such as volume of traffic, communication congestion, workload, and more. Ambient conditions are those involving temperature, humidity, light, precipitation, visibility, etcetera.
Example: winter operation conditions.

e) *Management:* This element includes the organization, procedures, policy, rules, and regulations involved in operating, maintaining, installing, and decommissioning a system.
Example: a construction activity will involve an organization comprised of engineers, contractors and inspection personnel, and can involve several procedures and construction specifications: escorting construction equipment on the airside signalling the construction area, specific procedures to mitigate Foreign Object Damage - FOD.

2.11. Theoretical framework

A theory is a systematic summary of interrelationships between variables in a conceptual framework (Croyle, 2005) it thus presents a systematic way of understanding events or situations. It is a set of concepts, definitions, and propositions that explain or predict these events or situations by illustrating the relationships between variables.

Underlying the disaster risk initiative is the concept that disaster risk is not caused by hazardous events *per se*, but is rather historically constructed through human activities and processes. As such the risk of death in a disaster is only partially dependent on the presence of physical phenomenon such as earthquakes, tropical cyclones and floods. In the disaster risk initiative, risk refers exclusively to the risk of loss of life and excludes other facets of risk, such as risk to livelihood and to the economy. This is because of a lack of datasets available at the global scale with national resolution. For an extreme physical event to be hazardous, by definition there has to be a subject to experience the hazard or the threat. For example people, infrastructure and economic activities have to be located in an area where earthquakes occur. In the DRI, this relationship is expressed through the concept of *physical exposure,* referring to the number of people located in areas where hazardous events occur combined with the frequency of hazard events (Kapoor, 2009).

According to Mutimba (2010) physical exposure is not an indicator of vulnerability, but is a condition *sine qua non* for disaster risk to exist. Without people exposed to hazardous events, there is no risk to human life. Clearly, however, greater physical exposure leads to greater loss of life. Assuming no change in other developmental conditions, a fivefold increase in the population living in a given flood plain would lead to a fivefold increase in mortality due to floods. Very high physical exposure in many countries reflects the concentration of population in hazard prone areas, itself a characteristic of the development process. Physical exposure, however, is insufficient to explain risk. Countries with similar levels of physical exposure to a given hazard experience have widely differing levels of risk (Holloway, 2003).

2.12. Systems theory

A system may be defined as a set of social, biological, technological or material partners co-operating for a common purpose. System theory is a philosophical doctrine of describing systems as abstract organizations independent of substance, type, time and space. A social system and its constituent parts can only be understood by assessing how each part contributes to the systemic whole. This calls for team learning to help keep individual members focused on their collective potential, building alignments meant to enhance teams' capacity to think and act in a new synergetic. Team learning also draws upon the skills of building shared aspirations through improved conversation, dialogue and skilful discussion (Birger & Jeppe, 2005).

In an organization like the JKIA, each and every department is vital in the attainment of the overall airport security, particularly in combing airport disasters. The airport services over 45 airlines and over 60 other stakeholder organizations, providing a "perfect" working conditions and high alert for

them. The 45 airlines have to work together by polling resources, which may include joint training and safety committees as they all continually affect each other and operate towards a common purpose.

The theory hence presupposes that the organization may fail to achieve the desired goals because of difficulties in interaction and coordination of the rescue operation. It will be made difficult as such as a disrupter of the working condition. Therefore there is need to have all appropriate disaster prevention and recovery strategies at the airport. This theory is used in this study to assess the combined capacities and capabilities at JKIA departments and other stakeholders with respect to disaster preparedness at JKIA.

2.13 Conclusion

Air transport has made the world a global village and has spurred growth in many nations of the world. Air-related disasters have also been on the increase due to the increase in the number of operational aircraft with large and sophisticated aircraft being designed and the volume of passengers on the increase. Disaster preparedness at JKIA is vital for any business sustainability.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter discusses the research study area, design, target population, sampling techniques and procedures, research instruments, data collection procedures, data analysis, the study variables and ethical considerations.

3.2 Research design

A research design is a “plan”, structure and strategy of investigation conceived so as to obtain answers to research questions and control variance (Mugenda & Mugenda, 1999). The function of a research design is to ensure that evidence obtained enables us to answer the initial question as unambiguously as possible. In order to precisely understand the question to disaster preparedness at JKIA with regard to air disasters, it was necessary to use triangulation method i.e. the use of both qualitative and quantitative methods of social investigations.

Thus this is a descriptive survey, and involves the determination of relationship between an explanatory variable (the disaster preparedness at JKIA) and a response variable (response capacity of JKIA). Two main methods, questionnaires (structured and unstructured) and key informant interviews were used in data collection. The interviews were carried out purposively with the heads of vital departments operating at JKIA as they were hypothesized to be more knowledgeable in terms of airport requirements, while questionnaires were given out during schedule interviews for the

responders to fill. The information gathered key informants supplemented the data from questionnaires and provided additional perspective on understanding disaster preparedness at JKIA.

3.3 Sample frame

A sample frame is a list of all organizations operating at JKIA. This list might not be exhaustive but include the government agencies directly involved in airport operations like the Police, KAA, KCAA, KRA, etcetera.45 airline operators, five cargo handling facilities, four fuel companies, five ground handlers, eight duty free and retail shops, 16 registered tours and travel agents, eight registered taxi and car rental and eight Forex bureaus and banks operating within the airport.

3.4. Methodology

3.4.1 Sampling method

A minimum sample size of 80 respondents from the stakeholders was applied to the study sampling process from a statistically significant sample of ten organizations (10% of an estimated population of over 100 organizations) using schedule interviews. Researchers rarely survey the entire population for two reasons; the cost is too high, and the population is dynamic in that the individuals making up the population may change over time. The three main advantages of sampling are that the cost is lower, data collection is faster, and since the data set is smaller it is possible to ensure homogeneity and to improve the accuracy and quality of the data.

An updated nominal roll of organizations operating at JKIA and their estimated staff strength was ascertained. Weighted criteria was used to ensure that selected organizations were apportioned the right number of responders for interview based on their staff strength. The study employed accidental sampling to get the responders from simple randomly sampled organizations operating at the airport. This is because simple random sampling for responders would mean getting the names of all the workers from the human resources departments, which would be against JKIA security regulations.

This gave a representative sample of the JKIA population. In liaison with the KAA headquarters, the sampled organizations were given a time schedule for the data collection and thus organized for the availability of respondents. In case a respondent was selected and was not willing to participate a replacement was done by selecting another respondent through accidental sampling.

Accidental sampling is a type of non probability sampling involves the sample being drawn from that part of the population which is close at hand. That is a sample population selected because it is readily available and convenient. As such, this study on JKIA fits the description as the airport departments are directly and indirectly concerned with airport operations.

3.4.2 Sample size and sampling procedure

Sample-size determination is often an important step in planning a statistical study, among the important hurdles to be surpassed; one must obtain an estimate of one or more error variances, and specify an effect size of importance. The study employed various sampling techniques to select 80 respondents from the core and peripheral stakeholders. Purposive sampling was employed to select the core and peripheral stakeholders. The core stakeholders constituted the JKIA organizations that are directly involved with airport operations including pilots associations and airlines, cargo handlers, fuel companies and ground handlers. The peripheral stakeholders include taxi operators, tour operators, and other tenants within JKIA buildings and the environs.

From these purposive samples, simple random sampling was used to sample the organizations to be visited from each stakeholder. Determination of the sample size selected for this study was due to the cost-effective reasons, considering the figure of 80 respondents within the targeted areas as non under-sized study, less than this number could be a waste of resources for not having the capability to produce useful results, while an over-sized one uses more resources than are necessary (Preacher & Hong, 2001).

Out of the total 80 respondents, 56 from the core stakeholders were targeted, the rest (24) were selected from the peripheral stakeholders. This figure had a 100% questionnaire complete rate. Besides, the survey gave emphasis to qualitative methods of social research, to which respect 5 key informants were interviewed. These key informants were selected purposively and composed of:

a) Head of investigation department (Police).
b) Head of human resource department (KAA).
c) Head of the licensing department (KCAA)
d) Head of the airworthiness department (KCAA)
e) Head of the fire- fighting team (KAA).

These individuals are hypothesized to be more knowledgeable not only in matters to do with security at the airport, but also the capacity of the airport in terms of equipments and trained manpower to

deal with disasters. They were interviewed using a key informant interview guide as a tool of data collection. These yielded mainly qualitative data.

3.4.3 Data collection method

The respondents were requested to fill a questionnaire (see Annex 1a). Participation was done at individual level to maintain confidentiality. The research assistant who was a qualified social worker was trained and deployed to assist in data collection. For those accidentally sampled, the purpose of the study was explained. Items in the questionnaire comprised structured questions which measured the objective responses and unstructured questions which measured the subjective responses. The main variables of the study were the disaster preparedness plans in place and the response capacity of JKIA. The responses enhanced formulation of useful recommendations to the study. Document analysis and key informant interviews (Annex 1b) were used in the study to corroborate responses given in the questionnaires.

3.4.4 Pilot testing

A pilot study was conducted on a few personnel based at Wilson Airport to measure the validity and reliability of the research instrument. Those selected for piloting, were not part of the main study sample as they were from a different airport though within Nairobi and managed by the same authority.

3.4.5 Validity

Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. The researcher sought expert opinion in assessing the validity of the instrument. The questionnaire of the pilot study was assessed and weaknesses identified for example few blank spaces, inaccurate responses and inconsistencies on the instrument. The instrument was modified accordingly. This also ensured accurate determination of the attitude although it entirely depended on the respondent's honesty and as well maintained privacy, confidentiality and trust with the respondents. The questionnaire was pre-tested and subjects who were not the actual sample were encouraged to write comments and suggestions concerning instructions, clarity, and relevance of the statements.

3.4.6 Reliability

Reliability is the consistency of the instrument or the degree to which it gives similar results for the same individuals at different times. To attest reliability, test-retest reliability was used. The scores were computed to establish Pearson Product Moment Correlation Coefficient. The calculated value was r = 0.6 which was relatively higher than the set value of 0.5. This showed high reliability.

3.4.7 Data collection procedure

Data collection is a term used to describe a process of preparing and collecting data - for example as part of a process improvement or similar project. The purpose of data collection is to obtain information to keep on record, to make decisions about important issues, to pass information on to others. Primarily, data is collected to provide information regarding a specific topic, as it has been pointed; this study utilized both qualitative and quantitative methods of social investigation. It specifically employed the following techniques:

(a) Survey research

This involved administering the interview on schedule to the 56 respondents from core JKIA stakeholder organizations and 24 respondents from periphery stakeholder organizations at the airport. The survey research was especially selected for the purpose of facilitating standardization of the procedures for all stakeholders. This method is suitable for descriptive, explanatory and exploratory purposes, and makes the collected data highly reliable and therefore generalizations. This technique yielded both qualitative and quantitative data.

(b) Key informant interviews

This technique was used as a tool of data collection to collect mainly qualitative data through in-depth interviewing of key informants. All key informants were drawn from the heads of departments of various JKIA stakeholder organizations. A key informant interview is a loosely structured conversation with people who have specialized knowledge about the topic you wish to understand. Key informant interviews let you explore a subject in depth. The give and take of these interviews can result in the discovery of information that would not have been revealed in a survey.

The respondents were requested and assisted to fill a pre-structured questionnaire. Participation was done at individual level to maintain confidentiality. The researcher made an introduction to the respondent and this made it easier to administer the questionnaire and also carryout the key informant interviews. All respondents who were eligible for the study were enrolled consequently. The environment was made conducive for the participants when the researcher informed the participants that the study was purely academic. The data were collected over a period of one week.

3.4.8. Secondary data

Secondary data were obtained from libraries at Kenya Civil Aviation Authority, Kenya Airports Authority, various firms at JKIA within the capital city Nairobi and its environs. These corroborated the information received from respondents and the key informants. The type of secondary data documents that were analyzed included:

a) Internal documents detailing management and other responsibilities
b) Control mechanisms
c) Information management
d) Training and awareness programmes and records
e) Permits, approvals, licenses, and exemptions
f) Contracts and specifications
g) Maintenance records
h) Specific operating procedures

3.5. Research Instruments

3.5.1. Data

It was decided to make the questionnaire as simple as possible, making it more “user friendly” for the respondents. Many factors can impact the probability that a respondent will complete a questionnaire, including the length and complexity of the form, the type of print and colour of paper, and the perception that the input will be utilized to improve a process. Keeping that in mind, the instructions on the questionnaire were kept simple and clear, the format was left uncluttered, and where possible, the respondent could answer by simply making a mark in a specific box. This produced clear quality data for ease of analysis.

3.5.2. Analysis

The thirty one questions for the stakeholders were categorized into the following sub heading namely background information, general organization disaster preparedness awareness and JKIA disaster preparedness information awareness. The key informant interview guidelines had a total of 23 questions which were used to probe further the level of disaster preparedness at JKIA. Cross tabulation was also done to show the relationship between some of the variables like the level of education and involvement in disaster response activities among others. For the purpose of computer analysis, data was coded using a codebook i.e. conversion of measurements and attributes of variables into numerical form. Once coded, the data was entered into a computer using the computer Microsoft Excel and Statistical Package for Social Sciences (SPSS) and analyzed.

According to Baker (1994), descriptive statistics are simple statistical methods which do not support or falsify relationships between variables but simply help in the description of data. The results were considered significant when the 2-sided *P-value* was less than 0.05 at 95% confidence interval. A confidence level gives some measure of how much the results can be relied on to represent all JKIA organizations. The frequencies of responses were also calculated to determine the means of responses. The results were presented in tables, graphs and charts. The frequencies and percentage were used because of their ability to distribute the responders according to the various values of the study variables for their ability to transform raw data into numerical form, after which the researcher can make sense of the data to enable us answer the research question.

3.5.3 Limitations

This study was limited to Jomo Kenyatta International Airport Nairobi Kenya – East Africa Region and mainly focused on disaster preparedness and the capacity to handle any major disaster if it occurs as well as mitigation and preparedness measures that are in place to minimize the potential effects of any air disaster occurrence. The findings were presented in a manner to provide further guidance and recommendations to various key players and partners in the government and private sector and more specific to Kenya Airports Authority that is responsible for the management of all airports in Kenya including JKIA.

3.5.4. Ethical procedures

Ethical authorization was sought from the participants. The study was conducted with ethical requirements as stipulated by the Ministry of Higher Education Science and Technology. This included consideration of the following: methods used were not intrusive, either by question or procedure to embarrass the respondent, personal data were handled and stored with confidentiality to avoid traumatizing the respondent and data collected were used for the said study only.

The confidentiality of the respondents was protected in that no names or personal information were required in the questionnaire or during key informant interview and measures were taken to ensure no coercion or undue influence was exercised by the employer on the selected responders to participate. This ensured that they gave their best (Mugenda and Mugenda, 1999).

3.6 Conclusion

The material and methods that are vital in facilitating data collection has been keenly put in place. Our focus now shifts to the next chapter of result analysis and discussion which forms the backbone of our investigations.

CHAPTER 4: DATA ANALYSIS AND DISCUSSION

4.1 Introduction

In the preceding chapters, the theoretical aspects pertaining to air traffic in the world and particularly in Kenya have been discussed. To achieve the identified aim and objectives of this study, the researcher carried out an extensive study at the JKIA in Kenya.

This chapter therefore presents analyzed results of the research conducted on 80 respondents from core (56) and peripheral (24) stakeholders at Jomo Kenyatta International Airport. The analyzed data is presented in charts, bar graphs, tables in frequencies and percentages where applicable. Data collected is analyzed and discussion on the results initiated.

4.1. Research Findings

4.1.1. Background Characteristic of Respondents

Information on the basic characteristics of the men and women interviewed in the survey is essential for the interpretation of the findings presented in this report. A total of 80 respondents were interviewed, 41 men and 39 women from both the core and peripheral stakeholders at Jomo

Kenyatta International Airport. The specific background characteristics of these respondents are presented in the presentations and discussions that follow.

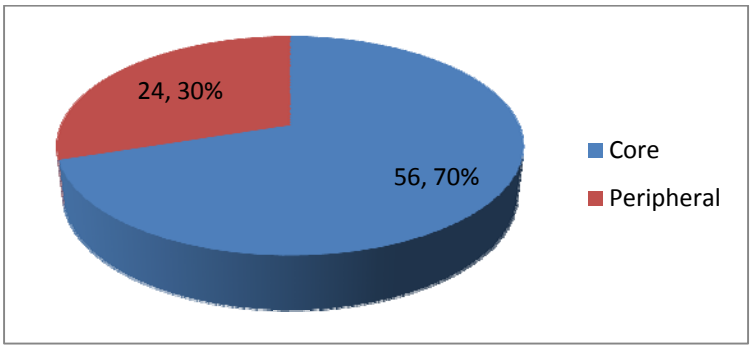

Figure 9: Type of stakeholders

As shown in Figure 9 above, the majority (70%) of those interviewed was core stakeholders while 30% were peripheral stakeholders, this ensured varied responses which richly contributed to getting very valuable information for the study

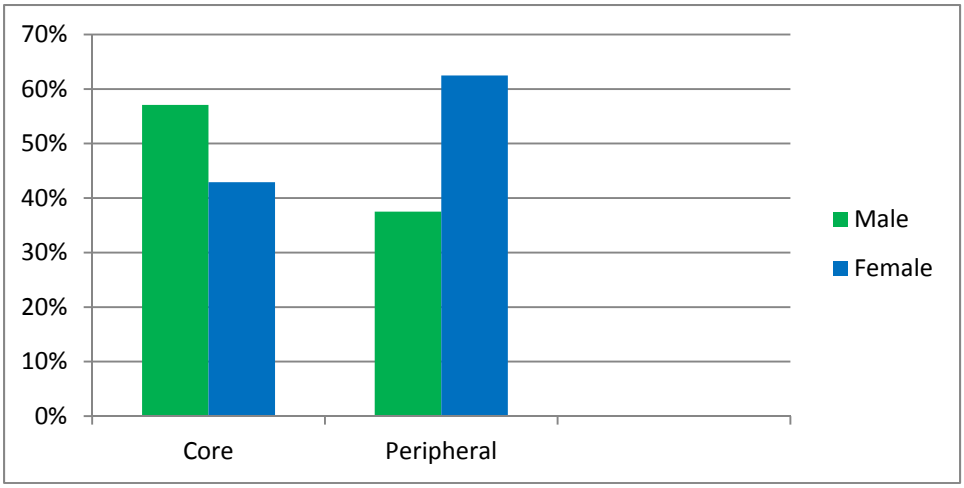

Figure 10: Gender of stakeholders

Core stakeholders interviewed males were 57.1% males and the females were 42.9%, as shown in figure 10 above, among this group, both males and females were well represented. Among the peripheral stakeholders, the females were 62.5% while males were 37.5%. This brings to focus the gender issues as far as the kinds of jobs taken up by the different genders at the airport and their vulnerability to disasters.

Table 6: Age of stakeholders

Type of stakeholder	***Age of stakeholders***					***Total***
	19-24	*25-30*	*31-36*	*Above 36*	*No Response*	

Core	*4 (7.1%)*	*15 (26.8%)*	*14 (25.0%)*	*21 (37.5%)*	*2 (3.6%)*	*56*
Peripheral	*3 (12.5%)*	*7 (29.2%)*	*3 (12.5%)*	*10 (41.7%)*	*1 (4.2%)*	*24*
Total	*7 (8.8%)*	*22 (27.5)*	*17 (23.3)*	*31 (38.8%)*	*3 (3.8%)*	*80 (100%)*

As indicated in Table 6, among the core stakeholders, the majority (37.5%) were older than 36 years. These were followed by the age bracket of 25-30 years old (26.8%) and between 31-36 years (25%). In the category of peripheral stakeholders, the majority (41.7%) were above 36 years old. These were followed by the age bracket 25-30 years old (29.2%) and aged between 31 and 36, (12.5%). This indicates that people of all ages were fairly distributed. The largest percentage of the work force shows an aging work force who would not understand the rationale for the research.

4.1.2. Organization of respondent

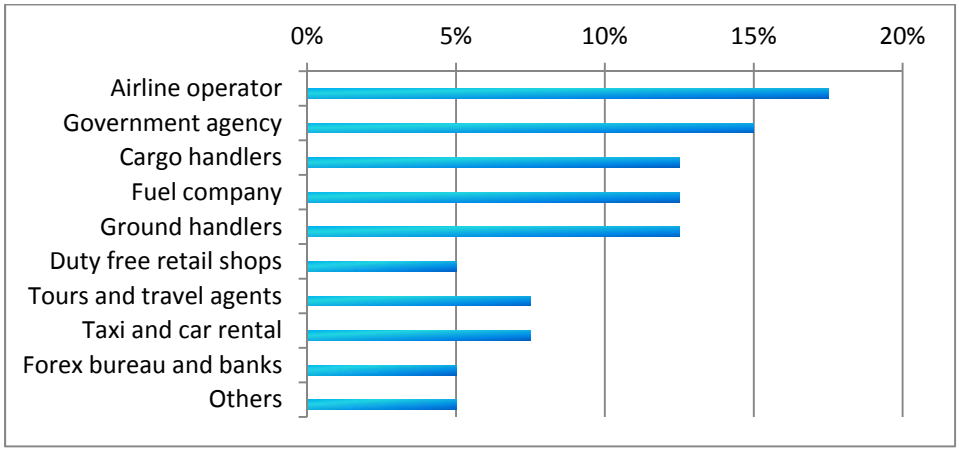

Figure 11: Respondent organization of operation at JKIA

The respondent's organization of operation was analyzed. Majority of those interviewed (70%) were from the core stakeholders with airline operators being the highest at 17.5% of the respondents (Figure 11). About 5% of respondents were interviewed from each of the peripheral stakeholders.

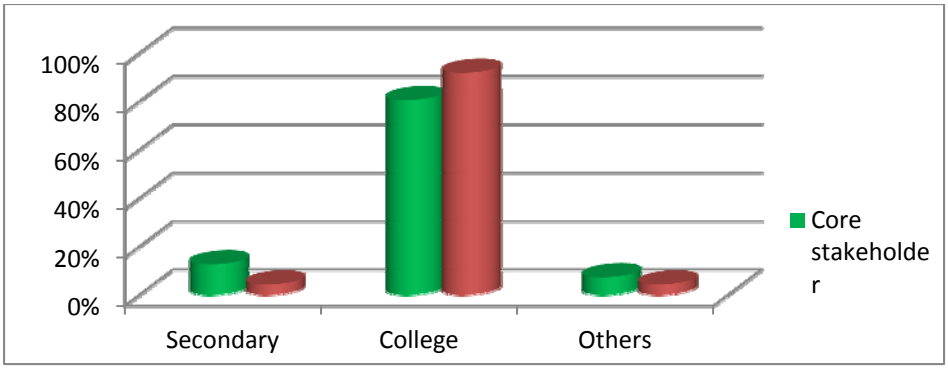

Figure 12: Stakeholders highest level of formal education

Figure 12 above shows that among the core stakeholders, majority (80.4%) of those interviewed were educated to college levels. Secondary or high school graduates were only 12.5% of those interviewed. On the other hand, among peripheral stakeholders, majority (91.7%) of those interviewed were educated to college levels. Secondary or high school graduate were only 4.2% of those interviewed. This indicates that the study was dealing with well educated stakeholders. It was important in this study to seek information on education levels because; it is assumed that the workers who are more educated are likely to get information about disasters and mitigate against them than workers who are less educated.

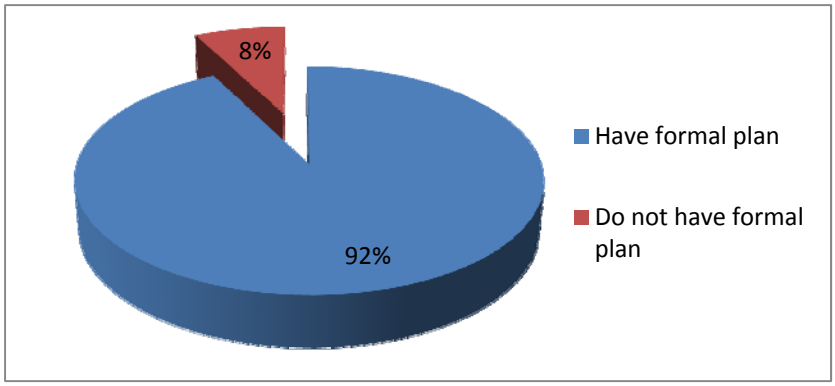

Figure 13: Formal disaster response plan

Overall 92% of the respondents indicated that their organization had some form of disaster preparedness plan. About 8% reported their organization did not have a plan. These data are depicted in Figure 13 above. All the core stakeholders had a plan with the peripheral stakeholders making the 8%. A possible explanation for this is that the core stakeholders have more financial resources and employees who are equipped to implement and produce a formal disaster preparedness plan.

4.1.3. The role of respondent department in forming disaster preparedness plan

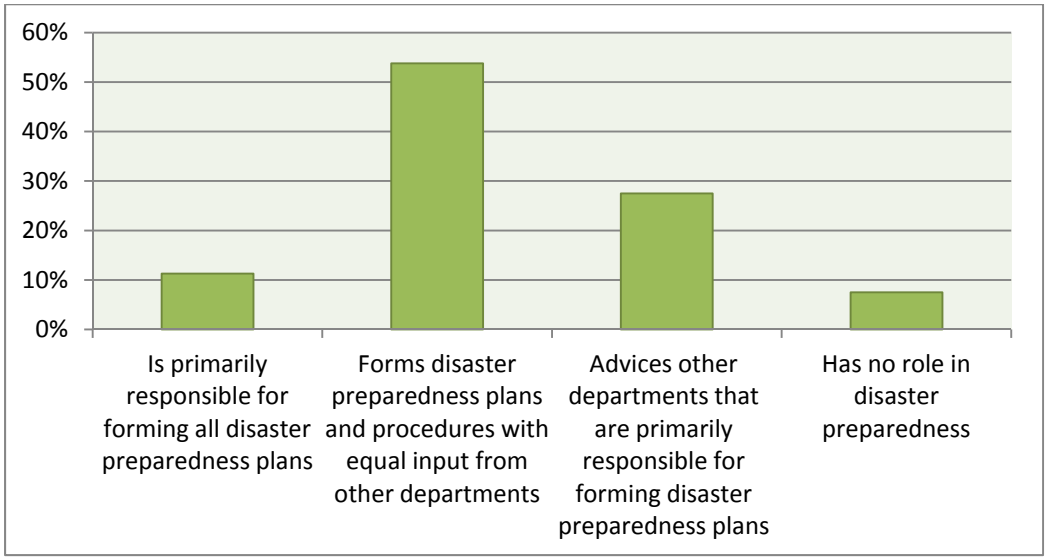

Figure 14: The role of respondent department in forming disaster preparedness plan

As shown in Figure 14, the majority of respondents reported that their department played some role in forming their organizations' disaster preparedness plans. Almost over one-half (53.8%) indicated that their department formed disaster preparedness plans and procedures with equal input from other departments, 27.5% said it advised other departments that were primarily responsible for forming disaster preparedness plans and procedures, and 11.3% responded that their department was primarily responsible for forming all disaster preparedness plans and procedures. About 7.5% indicated they had no role in forming their organizations' disaster preparedness plans.

4.1.4. Preparedness for a disaster or crisis

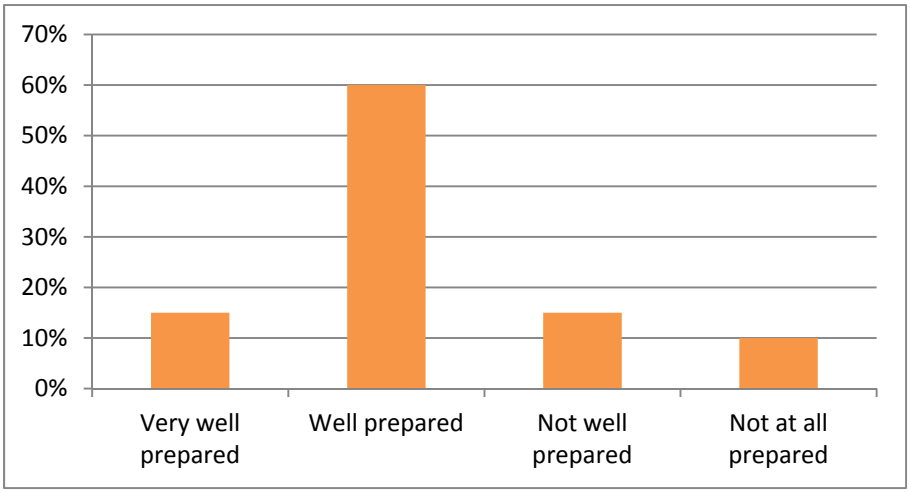

Figure 15: Preparedness for a disaster or crisis

Figure 15, compares respondents' perception of their organizations' preparedness for a disaster or a crisis. Overall, respondents perceive their organizations to be better prepared for a disaster or a crisis. Most respondents believed their organizations were well or very well (75%) while 25% indicated not well prepared or not at all prepared.

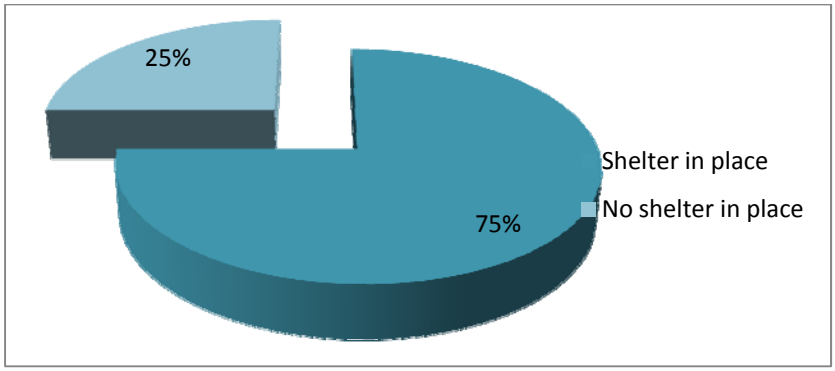

Figure 16: Shelter in place plans

A shelter in place plan is an organization's plan for employees to gather in a small interior room in the event of an emergency such as an outdoor chemical spill. Over three-quarters (75%) of the respondents indicated that their organizations had shelter in place plans as indicated in Figure 16 above.

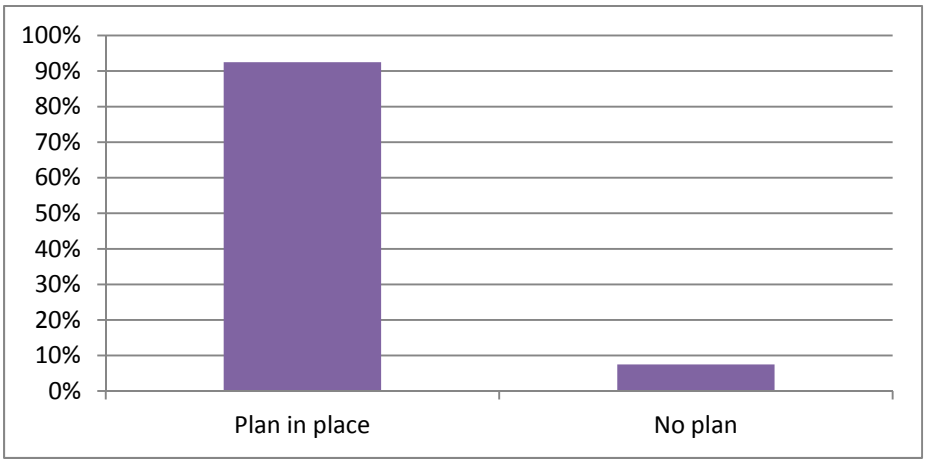

Figure 17: Fire or evacuation plan in place

The majority (92.5%) of the respondents indicated that their organizations offered some form of a fire/evacuation plan as indicated in Figure 17. only about 7.5% of the respondents whose organizations had any formal disaster preparedness plan indicated that they had no fire/evacuation plans in place.

4.1.5. Guidelines in evacuating people with disability

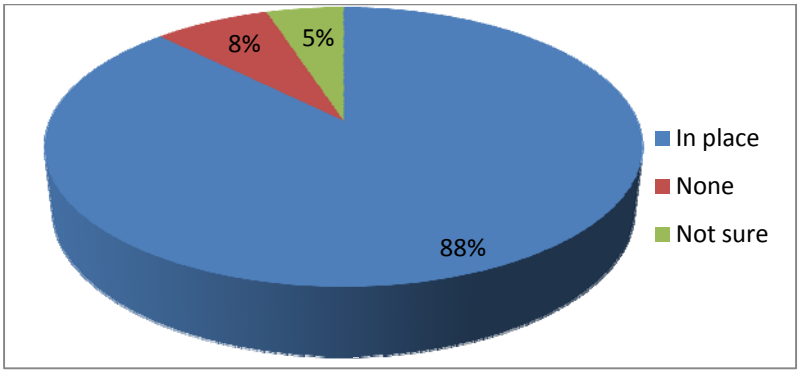

Figure 18: Guidelines in evacuating people with disability

Among the respondents who indicated that their organizations have fire/evacuation plans, 88% indicated that guidelines are in place to evacuate people with disabilities like blindness, and those of limited mobility. As depicted in Figure 18, five per cent of the respondents were not sure if these guidelines are in place while 8% said they had no such plans in place.

Table 7: Emergency communication plans

Emergency communication plans	Respondents
In place	74 (92.5%)
Not in place	6 (7.5%)
Total	**80 (100%)**

In an emergency or disaster, an organizations ability to communicate with its employees could be completely interrupted. An emergency communication plan is vital in the event of a disaster. Table 7 indicates that 92.5% of the respondent's organizations have an emergency communication plan in case a disaster occurs.

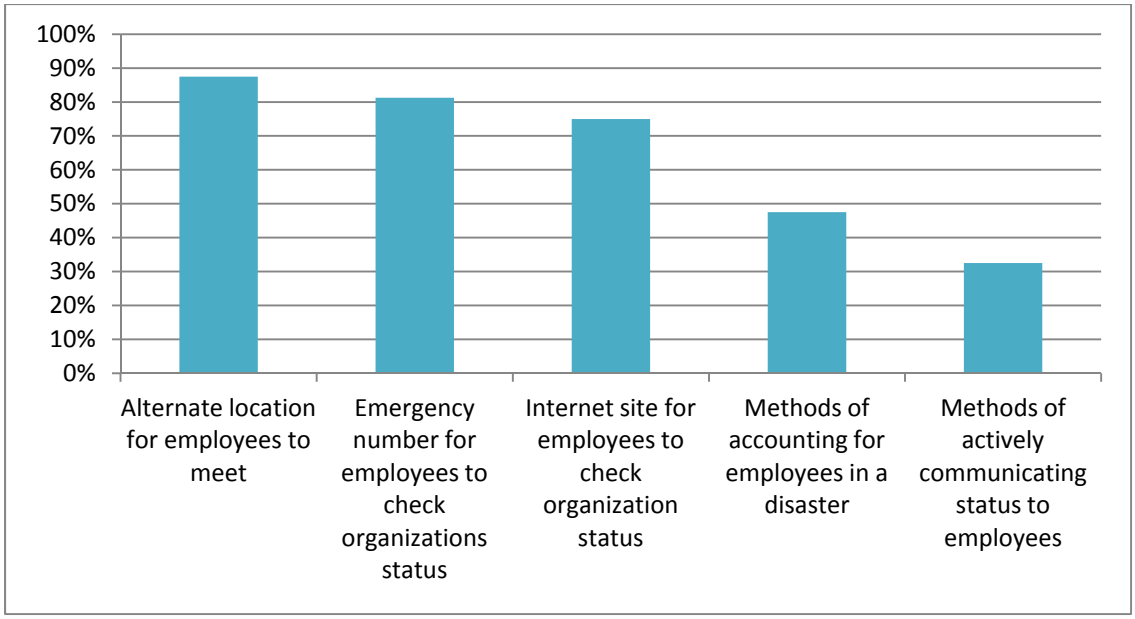

Figure 19: Features of an organization communication plan

Figure 19 above shows that the most frequently cited attributes of emergency communication plans were setting up an alternate location for employees to meet (87.5%) providing an emergency number for employees to check the organization status (81.3%) and providing an internet site for *employees to check organization status (75%).*

4.1.6. Ways organizations disseminate their emergency communication plans to employees

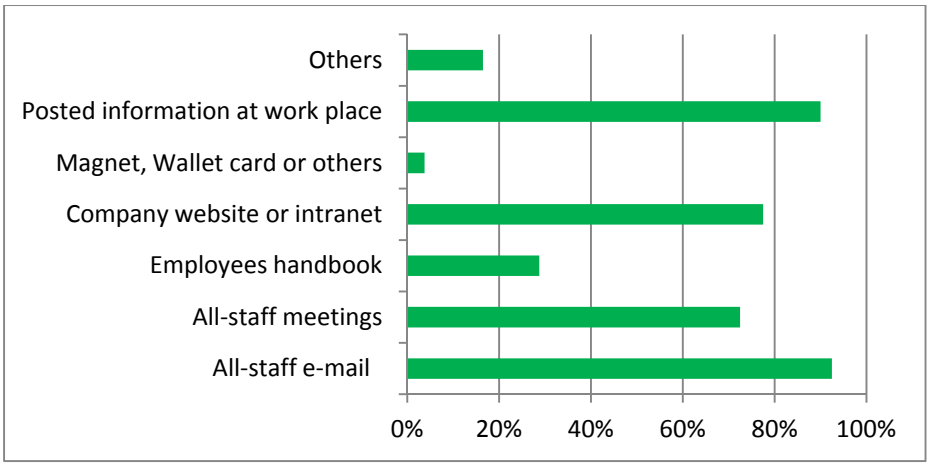

Figure 20: Ways organizations disseminate their emergency communication plans

Figure 20 above depict how organizations disseminate their emergency plans to employees. Communication strategies most frequently cited by the respondents included all staff e-mail (92.5%), or posted information in the workplace (90%) or company website or intranet (77.5%).

4.1.7. Selection of employees for emergency leadership roles

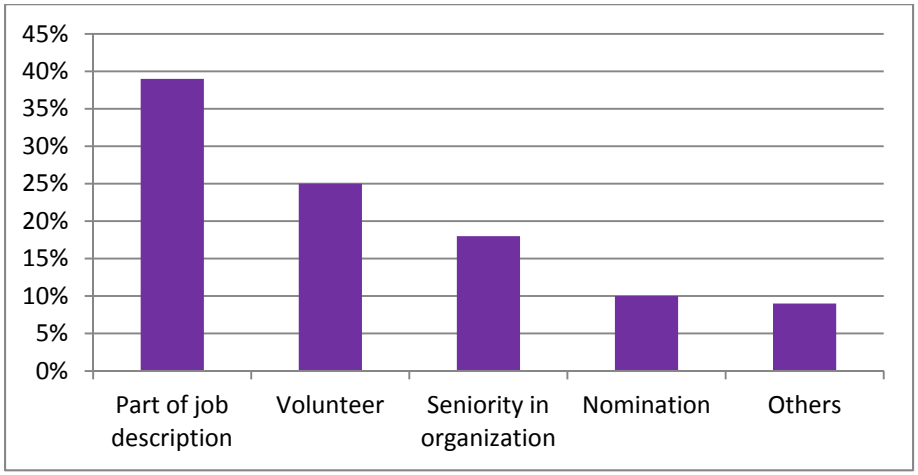

Figure 21: Selection of employees for emergency leadership roles

The majority (92.5%) of the respondents indicated their organizations had employees specifically tasked with playing a leadership role in the event of a crisis, and 39% of these respondents indicated that the role was part of the employee's job descriptions while 25% indicated these employees volunteered. These data are depicted in Figure 21.

4.1.8. Type of disaster response training

Table 8: Types of disaster response training

Type of training	*Response*
CPR and/or First Aid training	66 (83%)
Crisis management	35 (44%)
Training in organization-specific disaster response plans	51 (64%)
Fire suppression	38 (47%)
Training in assisting persons with disabilities during disasters	30 (38%)
Training in dealing with hazardous materials	29 (37%)

Almost all of the respondents (92.5%) indicated that employees in leadership roles had received some form of disaster response training. The majority of core stakeholders were likely to have formal disaster preparedness training in place as depicted in Table 8.

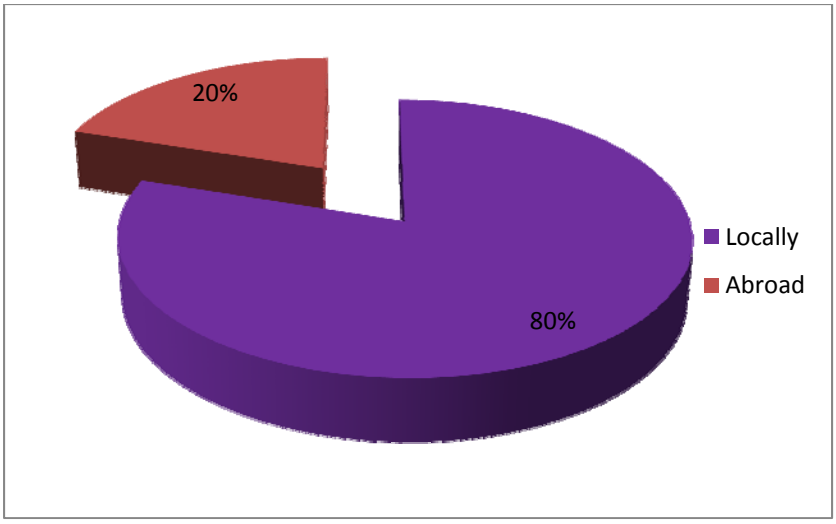

Figure 22: Disaster management training

Of the 37.5% of respondents who indicated that they had training in disaster management, 80% indicated that this training was locally sourced while only 20% had been trained outside the country. These are indicated in Figure 22. The overseas training can be attributed to the cost in that it is too expensive to train abroad.

4.1.9. Level of disaster preparedness

Table 9: Level of disaster preparedness

Preparedness activity	Have done	Plan to do	Not done	Unable to do
Trained in first aid/fire fighting drill/ etc	47 (58.75%)	12 (15%)	18 (22.5%)	3 (3.75%)
Involved in the development of organizational emergency plan	14 (17.5%)	21 (26.25%)	45 (56.3%)	-
Worked with/handled disaster/emergency kits over the last six months	22 (27.5%)	13 16.25%)	44 (55%)	1 (1.25%)
Discussed airport emergency with members of my organizations	34 (42.3%)	11 (13.75)	34 (42.5%)	1 (1.25%)
Attended meetings on disaster management	25 (31.25%)	16 (20%)	38 (74.5%)	1 (1.25%)
Read disaster management materials	42 (52.5%)	14 (17.5%)	22 (27.5%)	2 (2.5%)
Undertaken a course in early warning system	11 (13.75%)	20 (25%)	48 (60%)	1 (1.25%)

Table 9 gives a brief overview of level of disaster preparedness of the respondents, what they have done, plan to do, what they have not done and what they think they are unable to do.

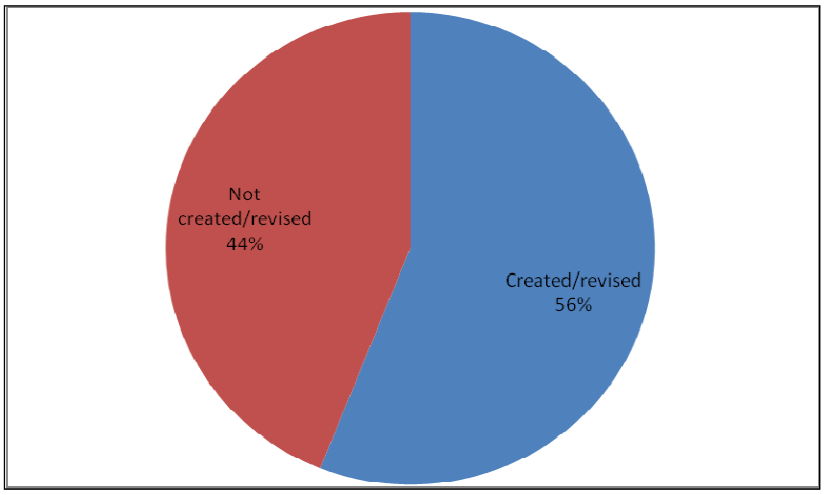

Figure 23: Plans created or revised because of 9/11 attacks

The 9/11 terrorist attacks had caused many organizations especially those operating in airports to create or revise their disaster preparedness plans. About 56% indicated that part of their organizations' plans had been created or revised specifically as a result of the 9/11 attacks. This data are depicted in Figure 23 above.

4.1.10. Disaster preparedness

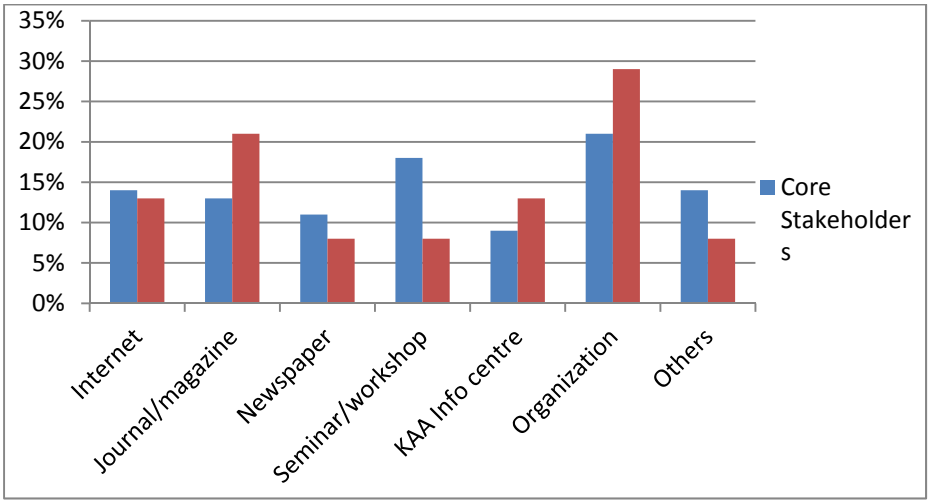

Figure 24: Stakeholder's source of information

Almost 100% of the respondents indicated that JKIA had a disaster preparedness/management policy in place. As indicate Figure 16 above, among the stakeholders, all channels of information were explored as indicated by the frequencies. The distributions were fairly equal. Majority (21% core and 29% peripheral) stakeholders got information from organization. Others claim that disasters are acts of God and as such, nothing can be done to prevent them. This poses serious risks to them and those around them in case of a disaster.

Table 10: Functions related to disaster preparedness

Functions related to disaster preparedness	***Response***
Communicates plans and procedures to employees	46 (57%)
Communicates information about available assistance programmes	42 (52.5%)
Coordinates "drills"	27 (34%)
Evaluates effectiveness of disaster preparedness plans	26 (33%)
Trains employees in disaster plans	27 (34%)
Others	4 (5%)

As indicated in Table 10 majority (57%) of the respondents indicated that at least their organization communicates JKIA plans and procedures on disaster preparedness to employees while only 5% indicated that their organizations have no function as far as JKIA disaster preparedness is concerned.

Table 11: Involvement in a disaster response activity

Type of stakeholder	***Have you been involved in a disaster response activity***		
	Yes	**No**	**Total**
Core stakeholder	21 (37.5%)	35 (62.5%)	56 (100%)
Peripheral stakeholder	7 (29.2%)	17 (70.8%)	24 (100%)
Total	28 (35%).	52 (65%)	80 (100%)

A majority of core stakeholders (65%) reported having not taken part in any disaster response activity. This means that this majority did not have experience in handling emergencies. Only 35% had been involved in a disaster response activity. Among the peripheral stakeholders majority (70.8%) had not taken part in any disaster response activity (see Table 11). Only 29.2% of the peripheral stakeholders had taken part in a disaster response activity. This also confirms the report that there have not been serious emergencies at JKIA. Also the results show that more core stakeholders have been involved in disaster response activities than peripheral stakeholders

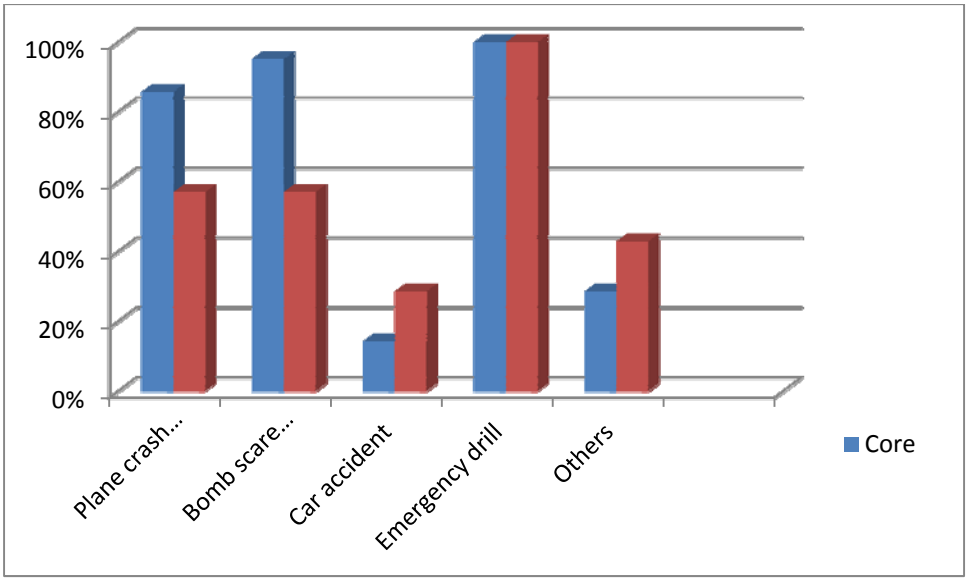

Figure 25: Disaster response activities

Looking at the kind of response activities, the 35% of respondents who indicated yes were involved in disaster response activities, the study found that it was plane crash evacuation, bomb scare evacuation, car accident evacuations emergency drills and others. This makes it clear that they had not dealt with major disasters like airport fires. As can be observed in Figure 25, a majority of the core stakeholders (85.7%) who had responded to a disaster participated in plane crash evacuation.

Table 12: JKIA most probable disasters/accidents

Type of stakeholder	**Most probable airport incident at JKIA**					
	Plane accidents	***Fire***	***Car accidents***	***Bomb***	***Emergency landing***	***Total***
Core stakeholder	18 (32%)	19 (33.9%)	1 (1.8%)	6 (10.7%)	12 (21.4%)	56 (100%)
Peripheral stakeholder	10 (41.6%)	5 (20.8%)	2 (8.3%)	1 (4.2%)	6 (25%)	24 (100%)
Total	28 (35%)	24 (30.0%)	3 (3.8%)	7 (8.8%)	18 (22.5%)	80 (100%)

On responding to what are perceived as the most probable airport disasters/accidents at JKIA, the core stakeholders indicated that plane accidents/crashes and fires were the most probable at the airport as shown in Table 12. As for the peripheral stakeholders, emergency landing, fire and plane accidents were the most probable disasters/accidents at the airport. This finding helps in identifying

the training needs of the JKIA community such that the most important area is given priority i.e. fire and plane crashes.

Table 12: Rating JKIA disaster preparedness

Type of stakeholder	*Rating JKIA disaster preparedness*		
	Satisfactory	**Unsatisfactory**	***Total***
Core stakeholder	20 (35.7%)	36 (64.3%)	***56 (100%)***
Peripheral stakeholder	5 (20.8%)	19 (79.2%)	***24 (100%)***
Total	***25 (31.25%)***	***55 (68.75%)***	***80 (100%)***

Majority of the core stakeholders (64.3%) were not confident of the airports disaster preparedness only 35.7% were satisfied by the airports state of disaster preparedness. On the other hand, majority of peripheral stakeholder, 79.2% were not confident of the airports disaster preparedness only 20.8% were satisfied by the airports state of disaster preparedness. This clearly implies that the respondents know what needs to be in place for effective preparedness and response. These data are depicted in Table 13.

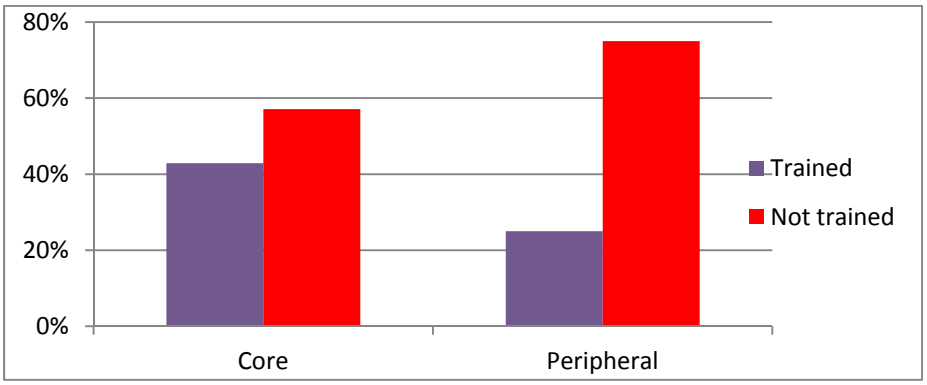

Table 13: Training on fire, plane crashes and other JKIA emergencies

To emphasize the need for appropriate training, stakeholders were asked whether they were trained specifically to help deal with fire, plane crashes or any other emergency. Majority of the core stakeholders 57.1% reported having not been trained while about 42.9% reported that they were

trained (see Figure15). On the part of peripheral stakeholders, 75% reported no training while only 25% were trained specifically to deal help deal with fire, plane crash and other airport emergencies.

4.1.11. Disaster response centre at JKIA

Table 14: Handling of emergencies

Equipped	*Core stakeholders*	*Peripheral stakeholders*	*Total*
Very well equipped	2 (7.7%)	1 (14.3%)	***3 (9.0%)***
Fairly equipped	14 (53.9%)	4 (57.2%)	***18 (54.6%)***
Not well equipped	10 (38.5%)	2 (28.6%)	***12 (36.4%)***
Total	***26 (78.8%)***	***7 (21.2%)***	***33 (100%)***

Approximately (46.4%) of the core stakeholders reported knowledge of a disaster response centre at the airport. While 38.8% did not report any knowledge, 14.3% did not know whether the centre existed or not. According to the peripheral stakeholders, majority (70%) reported that they did not know of any disaster response centre. This suggests that there is lack of knowledge or awareness on the issue and there is need for sensitization. In finding out how technically equipped JKIA is, the study showed varied responses as shown in Table 14.

According to the core shareholders who indicated the existence of a disaster response centre, majority (53.9 %) said it was fairly equipped, 38.5% indicated that it was not well equipped while 7.7% indicated it was very well equipped. According to peripheral stakeholders, 57.2% said it was fairly equipped.

About 28.6% indicated that it was not well equipped with only 14.3% reporting that it was very well equipped. The lack of knowledge on response facilities may mean respondents too did not know the status of JKIA on that issue of technical equipment.

4.1.12. Facilities and equipment compliance

Table 15: Compliance of facilities and equipments

Facility	**Compliance**		
	Fully	***Mostly***	***Occasionally***
Health centre	4 (5%)	58 (72.5%)	18 (22.5%)

Fire brigade	6 (7.5%)	44 (55%)	30 (37.5%)
Ambulance	12 (15%)	62 (77.5%)	6 (7.5%)
Communication	9 (11.25%)	48 (60%)	23 (28.75)
Water hydrants	8 (10%)	37 (46.25%)	35 (43.75%)
Others	0 (0%)	52 (65%)	28 (35%)

On finding out how compliant some facilities were at JKIA, the study found out that 72.5% thought the health centre mostly compliant and 22.5% reported that it was occasionally compliant. About 5% the respondent further noted that at times the health centre becomes fully compliant. The results of this compliance are depicted in Table 15 above.

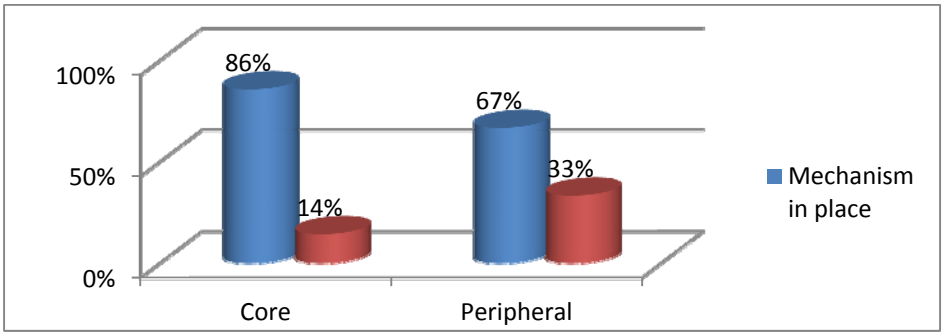

Figure 24: Mechanism in place for coordination of operations with organizations

According to Figure 27, among the core stakeholders 86% reported that there were mechanism coordinating operations while 14% reported that there were no mechanisms for coordinating operations with other organizations. Among the peripheral stakeholders, majority (67%) reported that there were mechanisms. Such a case indicates that, the stakeholders have important information as disaster response is concerned for them to respond appropriately.

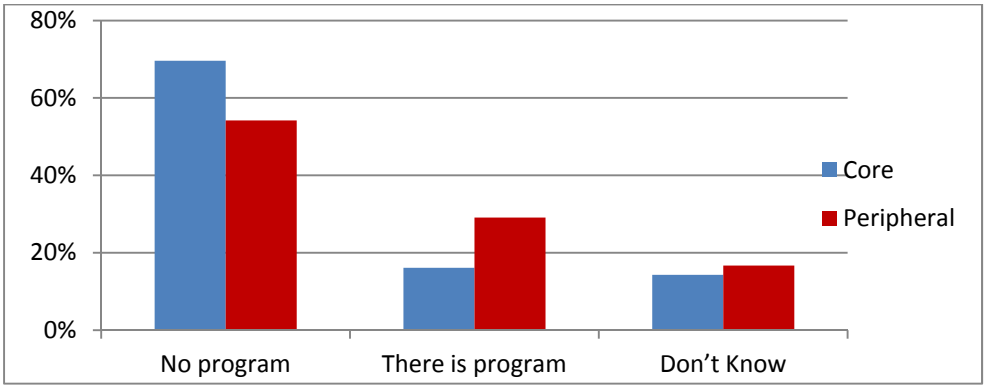

Figure 25: Community outreach programme

According to the study, majority of the core stakeholders (69.6%) said that there was no community outreach programme in terms of disaster preparedness. Only 16.1% said that there was a community outreach programme. Some stakeholders 14.3% did not know whether or not there was a community outreach programme. As indicated in Figure 28, among the peripheral stakeholders, majority of the stakeholders (54.2%) said that there was no community outreach programme in terms of disaster preparedness. Only 29.1% said that there was a community outreach programme while the rest of the stakeholders (16.7%) did not know whether or not there was a community outreach programme.

4.1.13. Stakeholders attitudes towards disaster preparedness at JKIA

In order to understand better disaster preparedness at JKIA, the opinion of the stakeholders on how prepared JKIA is to handle any kind of disaster was assessed. Several areas of disaster preparedness looked at are tabulated in Table 16 are as follows: (a) general disaster preparedness information, (b) disaster preparedness training and capacity development and (c) disaster preparedness facilities and equipment.

Table 16: Stakeholders' attitude to JKIA disaster preparedness

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
JKIA emergency action plan helps deal with severe air crash/ fire related emergency.	2 (2.5%)	14 (17.5%)	15 18.75%)	20 (25%)	29 (36.25%)
I have sufficient information or training about the types of airport disaster relevant to JKIA.	4 (5%)	6 (7.5%)	5 (6.25%)	47 (58.75%)	18 (22.5%)
JKIA is well prepared and has well trained manpower to handle terror emergencies.	2 (2.5%)	9 (11.3%)	8 (10%)	40 (50%)	21 (26.3%)
I am well prepared to handle any kind of disaster here at the airport.	2 (2.5%)	5 (6.3%)	6 (7.5%)	37 (46.3%)	30 (37.5%)
Foreign trained workers are better equipped to handle airport disasters than locally trained workers.	13 (16.3%)	11 (13.8%)	5 (6.3%)	30 (37.5%)	21 (26.3%)
There are good refresher courses and drills offered at JKIA to enable handle any emergencies/disasters.	2 (2.5%)	10 (12.5%)	4 (5%)	46 (57.5%)	18 (22.5%)
JKIA has facilities and is well prepared to handle fire emergencies at the airport.	7 (8.8%)	9 (11.3%)	4 (5%)	50 (62.5%)	10 (12.5%)
JKIA has facilities and is well prepared to handle terror emergencies at the airport.	2 (2.5%)	5 (6.3%)	7 (8.8%)	45 (56.3%)	21 (26.3%)

In case of airplane threat I know how to respond to cushion the airport from the adverse effects.	2 (2.5%)	6 (7.5%)	9 (11.3%)	45 (56.3%)	18 (22.5%)

4.1.14. Key informants

The qualitative data from the key informant interview will be used to corroborate the quantitative results in the discussion.

4.2. Discussion

4.2.1. Disaster preparedness and strategies at JKIA

High profile tragedies like the terrorist attacks on September 11, 2001, have elevated the need for organizations to prepare for the unexpected, and ensure their security and safety. While natural disasters are infrequent at JKIA, these events could take lives and cause great damage. In the occurrence of unforeseen events, there is need to plan in order to minimize damage as much as possible by creating or revising the disaster preparedness plan.

A total of 80 respondents took part in the study comprising 70% of core stakeholders and 30% peripheral stakeholders. Of these 52% were male while 48% were female airport employees. The gender of the respondents was important in this study in that disaster has an impact on gender and the way different genders prepare and respond as far as vulnerability is concerned.

The age of the respondents was also taken into account to determine whether the majority of the respondents were old requiring special attention and equipment in as far as disaster preparedness and response is concerned. The majority of the respondents were young with only about 39% being above 36 years of age. As the workforce aged, for example employees will face increased risks of disabling conditions. In turn, site evacuation and other disaster recovery procedures may have to pay more attention to the possibility of disabled employees.

The level of education was considered and it is reported that majority of those working at the airport have some formal education with college education being 84%. This means that majority can access information on disaster preparedness for themselves. The organizations involved in the operations at the airport were also looked into, and airline operators represented the major organizations at the airport comprising of about 18% of the total airport stakeholders. This stakeholders form the core of airport stakeholders as they are the backbone of the airport.

To answer the key question of the study on how ready JKIA is to manage a large-scale airport disaster in the event of one occurring in future, the first specific objective (*What disaster*

preparedness policies and strategies are in place to prepare JKIA airport in the event of a disaster) came up with the following findings.

From the study findings overall, 92% of the respondents indicated that their organizations had a formal disaster response plan while eight per cent were not sure whether there was a disaster response plan in their organization. This corroborated the evidence from key informants which indicated that almost 80% of all the stakeholders had a disaster response plan, and that measures were taken by KAA to ensure that they were tested and updated time and again through drills.

The role the responders' played in formulating the organization disaster preparedness plan was assessed. About 50% indicated that their departments were actively involved in the preparation of the organizations disaster preparedness plan. When members of an organization are involved in the process of preparing a disaster response plan, such a plan becomes part and parcel of their daily activities, and is not looked at as a managerial issue, but an attempt to improve the working conditions and safeguard their lives in a demanding working environment. When workers own the process, they achieve a lot in terms of preparedness.

Having a disaster preparedness plan is one thing while being prepared is another. The respondents were asked to indicate how prepared their organization was in dealing with a disaster or a crisis. The majority (60%) indicated that their organizations were well prepared with only 15% indicating very well prepared. On the level of preparedness, only 75% of those prepared had a shelter in place for employees to take shelter in a small interior room at their workplace in the event of an emergency. About 93% of those organizations that had plans in place had fire and evacuation plans with 88% of the respondents indicating that there was a policy or procedure for evacuating those with disabilities.

Before, during and after a disaster, communication plays an integral part in ensuring that the effects of a hazard are lessened on the society, for example people and property. Most of the respondents (92%) indicated that their organizations had emergency communication plans in place. The most frequently cited attributes of the emergency communication plans were setting up an alternate location for employees to meet, and having an emergency number where employees could check the organization's status. The most common ways the plans were communicated were through posted information in the workplace, staff e-mails and information on the company website.

4.2.2. Capacity of JKIA to handle disaster

In answering the second specific study question (*How well equipped i.e. training and facilities is the airport to handle airport disasters),* the following issues which are discussed below emerged.

Capacity building is an important part in disaster preparedness. When asked about the selection of employees in leadership roles in disaster management, over 38% indicated that it was part of the job description while 25% indicated that it was voluntary. Almost 93% of the respondents indicated that employees in leadership roles had received some form of disaster response training either locally or abroad. The majority of the core stakeholder organizations, regardless of size, were likely to have formal disaster preparedness training in place. The most frequently cited form of training were CPR and first aid (83%), training in organization-specific disaster response plans (64%) and fire suppression (47%). From the response given by the respondents on their level of disaster preparedness, it is clear that only 52% was prepared and 56% of the respondents indicated that their organizations created or revised their disaster preparedness plans specifically as a result of the 9/11 attacks.

From the key informants, it was reported that there is a disaster management/preparedness policy at JKIA. This policy highlights areas of training in firefighting, fire trucks serviceability, CCTV surveillance or coverage and ambulances and that the equipment and facilities are maintained well above the minimum standards. It also highlights bomb threats, hijackings, terrorism and emergency landing procedures as some of the common threats JKIA is likely to experience. Other areas of the policy include the role of various organizations in response, for example the military, the police and other agencies involved in disaster response.

With close to 100% indicating that JKIA had a disaster preparedness plan, the majority (24%) indicated that most of the information concerning disaster management at JKIA was found within their organizations while 15% of the respondents received this information from the seminars and workshops organized by KAA for airport stakeholders. The same number of respondents (15%) indicated that most of the information was found from journals and magazines indicating that there was a reading culture, which is very important in terms of capacity development. As part of strengthening information and communication much needs to be put in place in order to ensure that airport stakeholders have the most relevant information, and are sensitized as much as possible to avoid doubt about preparedness information. From the findings, it is clear that most of the seminars and workshops organized by KAA mostly target the core stakeholders.

The majority (57%) of the respondents indicated that at least their organization communicates JKIA plans and procedures on disaster preparedness to employees, while only five percent indicated that their organizations had no function as far as JKIA disaster preparedness was concerned. Among the functions that were carried out by the organizations were related to disaster preparedness including communicating plans and procedures to employees, coordination of drills and training of employees.

It is important to note that there is no policy or law on what is expected of organizations or the mandate of organizations operating in the airport as concerning their specific functions or roles in disaster preparedness. This is an oversight and needs to be corrected. The organizations should be required to have a given number of manpower training on certain specifics of disaster preparedness for them to continue operating at the airport.

About 35% of the respondents have at one time involved themselves in disaster response activities with 65% having not participated. This may be due to two factors. One, a major disaster has never occurred at JKIA recently. The respondents were not equipped or trained to respond and hence became bystanders. However, the emergency activities they have been involved in are mainly drills in fire, emergency landing and bomb scare as the most probable accidents anticipated in JKIA are plane crashes (35%) due to poor navigation equipment and terrorist attacks, fires (30%) and emergency landings (22%) because of mechanical defects.

From the above disaster preparedness activities we can see that there is an active policy advising on the importance of disaster preparedness, and especially the need to participate in some of these drills as they help in improving or modifying some of the shortfalls experienced before the actual event. It was reported by the key informants that there was a disaster management training programme at the airport, and that it offered training every six months and there was modern aircraft recovery equipment in place.

From the key informants, the wind and turbulence environment at JKIA is a matter of growing concern. JKIA tends to attract corporate real estate. Offices and other buildings are increasingly being located in the immediate proximity of runways. The wind turbulence caused by these buildings has been such that in some cases aircrews have temporarily lost control of the aircraft shortly before touchdown or shortly after lift-off resulting in incidents. Owing to the large monetary value of building space at JKIA, the pressure to allow such building activities will continue to grow. The current ICAO obstacle clearance criteria do not provide adequate protection. A lack of understanding of the turbulence aerodynamics and aircraft dynamic responses to turbulence upsets, hamper the development of appropriate regulation.

Wake vortex constraints govern the minimum required distance (separation) between aircraft lined up in sequence on the approach to the runway. During peak capacity operations, this distance effectively determines runway capacity and thus airport capacity. Capacity constraints lead air traffic controllers to consider a reduction in separation minima from the current minima under certain conditions.

The respondents were requested to rate disaster preparedness at JKIA and in their own opinion, only 31% felt that it was satisfactory. This leaves a lot of questions to be answered as the majority (69%) indicated that the level of preparedness is unsatisfactory. The respondents felt that with only 38% of them having been trained in fire or plane crash handling, which are the most anticipated events in such an environment, much training is needed to uplift the level of disaster preparedness to acceptable international standards.

JKIA has a disaster response centre. However, only 46% of the respondents indicated this while 38% indicated there was no centre with almost 15% indicating they did not know. From the key informants, it was clear that JKIA had a disaster response centre responsible for the search and rescue operations within the Nairobi Instrument Flight Route and covered parts of Tanzania, Uganda and Southern Sudan. The reason why most respondents are not aware of this response centre is because the centre is dormant and only activated during an emergency, and personnel are drawn from different organizations to man the centre depending on their expertise and nature of the emergency.

The strategy in place in case of a disaster is the emergency orders which give a plan on how and what should be done by different agencies. These guidelines require, for example that the response centre be manned on a 24 hour basis. This is not adhered to either because of lack of enough trained personnel. However, the stakeholders need to be made aware of such a facility at the airport as it is a crucial aspect of disaster preparedness since the centre executes the plans. From the respondents who knew the centre existed, only 50% felt that it was fairly technically equipped to handle any emergency at the airport. It is worth noting that 70% of the peripheral stakeholders were not aware of such a centre.

On average 40% of the respondents felt that the facilities that were available at JKIA for disaster preparedness and response were mostly compliant, and 30% indicated they were occasionally compliant. From the above responses on how compliant these facilities are, there is serious lack of information on their state among the stakeholders. These facilities like health services, fire brigade, search and rescue need to be compliant in order to effectively prepare and respond to a disaster situation without aggravating the event. The gaps and needs for JKIA also imply that the airport cannot handle a major disaster without getting so many casualties due to non-compliance on the part of facilities.

Results from the key informants indicate that disaster management facilities that are available at the airport are reported at the emergency operations centre. The disaster management centre at the

airport is the communication room, which is occasionally poorly staffed whenever there is an emergency. This centre at times becomes a source of chaos in disaster response as those called in to take control usually find themselves unaware of where to start.

Mechanisms to coordinate other organizations involved in disaster preparedness and response at the airport are in place according to 80% of the respondents while only 20% indicated that there were no mechanisms in place to coordinate operations with other organizations. This is supported by key informants who acknowledge that steps have been taken to ensure that there is harmony on the part of organizations that respond to disasters at the airport. This has been achieved by taking all concerned on board in the planning and drills carried out. In the area of fire, JKIA works closely with the city council of Nairobi's fire department. The department offers fire trucks. JKIA also works with urban fire, G4S and the Kenya air force.

The mechanism used to coordinate the various activities or operations within the organizations are the Emergency Orders − a plan to minimize the effects of an emergency, particularly in respect to saving lives and maintaining aircraft operations. The emergency orders set forth the procedures, which are followed to coordinate the responses of different airport agencies or services and those agencies in the surrounding community that can provide assistance in order to achieve the objective of disaster mitigation.

Various organizations are involved in airport disaster response operations. These include the African Medical research Foundation (AMREF) which helps in air lifting of the injured, St. Johns Ambulance and Red Cross which helps in relief and first aid and the Police. The Police have the Airwing section which helps in search and rescue and airlifting of the injured and the dead and also the Kenya Airports Police Unit (KAPU), concerned with the general security at the airports. These agencies together with other agencies work hand in hand with KAA in ensuring that normalcy prevails at JKIA.

The majority of stakeholders (65%) reported there is no community outreach programme, and all the key informants responded likewise. This means that in case of a disaster the communities around JKIA will not have the opportunity to know what to do. Hence many lives will be lost and destruction of property increased. The community living around the airport becomes part and parcel of the JKIA community. Any attempt to mitigate the impact of a hazard on this society must adequately take them on board. This can be done by training and awareness campaigns and involvement in drills.

According to Table 18 (stakeholders attitudes towards disaster preparedness), the general disaster preparedness state of JKIA is not appealing, and most stakeholders have no confidence in it. Much

needs to be done to ensure that any kind of disaster can be well handled at JKIA and other airports in Kenya. Generally, the results are skewed towards the belief that disaster preparedness at JKIA is wanting, and needs much more improvement as most respondents were dissatisfied. The key informant also attests to the fact that JKIA has not reached a level where people can be comfortable that the airport is fully prepared for any eventuality.

4.3. Conclusion

In summary, the results presented and discussed above clearly outline the many challenges in disaster preparedness at JKIA. From the respondents and key informants, it is evident that JKIA is still not prepared to handle any major airport disaster due to lack of proper disaster preparedness policy awareness and training. Even though the airport has mechanisms in place to coordinate any major operation with the external community, measures have not been taken to incorporate the adjacent community in disaster preparedness awareness. The next chapter presents the overall conclusion and recommendations put forward in line with the general objective of the study.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provides the conclusion and recommendations drawn from the findings to explain the implications of airport disaster preparedness at JKIA.

5.2 Conclusion

Rapidly increasing traffic volumes and forecasts of continued growth into the next decades put a strain on JKIA capacity. Airbus Industries, for example predict an average annual passenger traffic growth rate of 5.0% during the next 20 years. At the same time, public tolerance of the environmental effects of air traffic around airports such as noise, air pollution and third party risk would appear to have decreased. These conflicting trends lead airports, airlines, air traffic control organizations and the aircraft and equipment industry to devise new technologies and innovative ways of operating airports and aircraft in order to meet both the capacity demands and the environmental limitations.

Consequently, new hazards emerge and existing hazards become difficult to contain unless adequate attention is given to safety aspects in this combination of emerging trends. In addition, a new dimension, third party risk, presented itself as a safety concern in a growing number of airport community. Airports are hubs in the air transport system. Consequently, their presence causes a convergence of air traffic over the area surrounding the airport.

For the population living in the vicinity of an airport this implies involuntary exposure to the risk of aircraft accidents. Although the probability of an accident per flight is very small, according to the Statistical Summary of Commercial Jet Airplane Accidents, 1959 - 2008, chances of an accident are 1 in 9.2 million per flight if you fly one of the 25 safest airlines. Local risk levels around airports are higher than one might expect, which are caused by the fact that while the probability of an accident per take-off or landing is very small, the number of landings and take-offs is often very large (typically several hundred a day). The resulting annual probability of an accident at JKIA is therefore much greater than the small probability of being involved in an aircraft accident as a passenger.

In addition, accidents tend to happen during the take-off and landing phases of flight and hence close to an airport. Safety data from studies show that approach and landing phase accidents account for a significant proportion of fatal air transport accidents. Historical data confirms that aircraft accidents involving considerable numbers of third party victims occur several times a year. Probably the best known example is the tragic accident of a Boeing 747 in suburban Amsterdam in 1992. Others occurred in Taiwan (Taipeh), Russia (Irkoetsk), Paraguay and Zaire (219, 3rd party victims). This environmental effect is of growing significance to airport safety, responsibility and decision-making regarding airport development and land-use planning for JKIA.

The main objective of the study was to find out how prepared JKIA was to handle a large-scale airport disaster in the event of one occurring at present or in the rear future. In conclusion the study

established that JKIA was not ready for any large-scale disaster in terms of facilities and trained personne,l and that the disaster preparedness policies and strategies for JKIA are not very clear to many of the stakeholders. JKIA has not networked very well with its potential partners, and that many should be working partners in disaster preparedness are not involved in disaster preparedness initiatives. This has also been seen in the area of community outreach programmes.

It is indicated that JKIA has a 24 hour first aid clinic within the airport and also a well equipped port health clinic. Enough standby ambulances were also reported to be in existence at the airport. The airport has a fully equipped 24 hour fire fighting station/department with enough well maintained fire extinguishers and portable extinguishers available at the airport. Effective fire outbreak control systems with functional equipment are in place at the airport. The fire equipment is at strategic points known to the police, stakeholders and KAA employees.

In terms of airport security, there is 24 hour police patrol and back-up and well trained airport security personnel both in the police unit and KAA. There are good security alert systems and electronic security aid (CCTVs). JKIA also has well trained air traffic controllers under the KCAA. Very few high level trained personnel on disaster management exist within the airport, and this is an area of great concern if disaster preparedness is to be enhanced.

From the study findings, the airport has experienced a few incidences in security lapses which in future might bring risk to the airport. The lack of frequent disaster preparedness drills and also lack of disaster management control centre that is operational throughout, puts the airport community in a wanting situation. Very few disaster preparedness drills are done to prepare people for any eventuality. JKIA tenants and KAA need to improve their linkages on matters of disaster preparedness since there is inadequate knowledge on disaster management/preparedness in JKIA. There is no forum incorporating all stakeholders involved within the airport on disaster preparedness initiatives. Not everyone is involved at the same forum, and KAA usually discusses issues of disaster preparedness with various stakeholders at different forums and times, for example peripheral stakeholders and core stakeholders hold different forums.

The airport has inadequate fire/emergency escapes routes and few trained personnel in fire fighting. Some safety equipment are under serviced, for example fire extinguishers. Generally, the equipment is inadequate compared to the number of people. The parking lot is too congested with taxi operators and visitors to the airport. Owing to the inadequacy of some equipment some of the officers working for the airport are likely to be corrupt and can let in drugs and terrorists.

Although flying is one of the perceived safest forms of transportation in the world, aviation disasters will continue to occur but with lessened impact as a result of preparedness. Airports are increasing and improving on the level of preparedness and the capacity to handle any disaster of any magnitude and JKIA is no exception. In general it is evident that JKIA is doing all that is necessary to meet the acceptable international standards. However at present JKIA is ill equipped and not well prepared to handle a disaster like the May, 2007 Kenya Airways crash in Cameroon effectively and efficiently to minimize loss of life and damage to property.

5.3 Recommendations

From the study findings and the conclusion made, the following recommendations are put forward for the improvement of JKIA disaster preparedness.

5.3.1 Disaster preparedness and management training

This should be a priority in JKIA policy planning. From the study findings, the majority of the JKIA stakeholders have not been trained in disaster preparedness and management by their organizations or by the KAA. KAA should determine the minimum percentage of the workforce in an organization that should receive training in disaster preparedness and management in order to operate at the airport. In providing training there should be joint operations between various security agents under KAA. This will promote the spirit of togetherness, and make the workforce more effective. This is because security agents at the airport are not working in harmony and are bent on outmanoeuvring one another in their activities for selfish gains and not for the good of the airport or the nation.

A common, high disaster preparedness standard at JKIA cannot be achieved by any single stakeholder since the level of preparedness at the airport is, to a large extent, governed by the interaction of multiple organizations. An integrated disaster management system involving all organizations operating at the airport is thus required. The KAA, the main airlines, a representative of all other airline operators, ground handling providers, refuelling services and the air traffic control organization should work together to improve disaster preparedness at JKIA.

To that end, stakeholders have to establish a Terms of Reference, have regular meetings and use a common Operational Airport Information System. All participating organizations could be connected to this system and capture information about air and ground incidents into a common database. This information exchange, the regular meetings and common objectives provide the necessary premises for the early identification of disaster preparedness bottlenecks, the design of achievable corrective

measures and their effective implementation. Consideration needs to be given on how this approach could be developed on a national level.

5.3.2 Security and safety

JKIA is complex multi-organizational systems, with diverse safety standards and practices. Frequently, there is a lack of integration amongst airport users with regard to these safety standards and practices. In view of the multi-organizational nature of risks in the operation of JKIA, the lack of a mechanism to integrate the safety standards and practices of the different stakeholders in and around the airport has a detrimental effect on safety. Such a mechanism is difficult to establish since the respective stakeholders in the overall airport organization are subject to different regulatory regimes. These include aircraft maintenance, flight operations, ground handling including fuelling, security services, airside services and air traffic control. Even where some of these processes are frequently done by the same organization, they are usually subject to different management systems, different training standards and exhibit a different safety culture.

Currently JKIA is on an ambitious expansion plan due to the growth in passenger volume. There is an urgent need for a second runway just in case operations on runway 06/24 become interrupted as a result of an aircraft emergency landing or crash during takeoff. Effective planning of new buildings should take into consideration possible disasters and insecurity. The building should be well lit. Effective security policies that meet the current patterns of security should be developed. There is need for enhancement of the existing CCTV surveillance equipment to the modern and high-tech equipment due to the ever increasing threat of terrorism. Involvement of tenants and all stakeholders in security and disaster preparedness planning and programme implementation is of paramount importance, and it should be encouraged. Owing to increased human traffic, the future expansion and modernization of the airport should consider a provision for more and bigger emergency exits and a public address system that can be relied upon in case of a disaster. The expansion, will also require powerful standby generators to be put in place in case of a power blackout.

5.3.3 Policy on disaster management

The country currently lacks a disaster management policy. There is need for a clear policy on disaster management. This is likewise lacking in JKIA. If it exists, it is not clearly spelt out to all stakeholders, and every stakeholder needs this sensitization to the policy. This is necessary for guidance on what to do when any situation arises that relates to the risks and threats at the airport in relation to the aircraft accidents and other airport hazards.

Planning for an effective response to disaster at or near an airport requires particular co-ordination between emergency services, for both short-term and long-term response; it should encompass such aspects as the accessibility of potential accident sites near the airport to emergency vehicles. Experience has also shown the critical importance of effective and comprehensive debriefing following emergency exercises. Such debriefing should include all staff that has a role in the disaster response, and is essential if KAA is to evaluate its disaster preparedness and to learn how to improve its disaster planning.

5.3.4 Community/stakeholders outreach programme

No organization can thrive by ignoring its neighbours or the community in which it operates. It is the social responsibility of KAA to ensure that the community living around the airport is sensitized to the need to uphold safety at the airport. This ranges from holding workshops for such communities, supplying information bulletins, a counselling programme to mitigate after a disaster, to advising on safety issues. A working partnership between KAA and all organizations at the airport should involve a forum for incorporating all players and their needs, for example training of members of the adjacent community and all stakeholders on disaster preparedness. Disaster management awareness training should be part of the orientation as one takes up premises within the airport. This will change the perception that disaster management at the airport is the sole responsibility of KAA.

Air accidents frequently occur near, rather than at airports. Therefore integrating the activities of local and airport emergency services becomes a major issue for planning. ICAO requires major accident simulations and exercises on regular annual basis. However, this requirement does not encompass planning for potential accidents outside the airport limits. Furthermore recent experience of major disasters has highlighted the importance of planning to manage the traumatic aftermath of major disasters for survivors, relatives and operational personnel. Recent US regulations place requirements on airlines to draw up plans and commit resources to dealing effectively with the traumatic aftermath of aviation disasters (Federal Family Assistance Plan for Aviation Disasters). Consideration should be given to how such a scheme could be instituted in Kenya.

5.4 Suggestion for further study

a) This research was limited to JKIA. It is necessary to study other airports in Kenya regarding the same research.

b) Another study should be done on pilots and engineers to determine how their knowledge, attitudes and practices affect air safety.

c) A similar research should be carried out with a global outlook with the aim of determining the disaster preparedness and management level at airports to improve safety world-wide.

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ANNEXES

Annex 1a: QUESTIONNAIRE FOR CORE AND PERIPHERAL JKIA EMPLOYEES

Instructions

1. Please respond to all questions and kindly note that all responses are valued
2. For questions where there are no options, you are to answer in own words

Section A: Background information

1. Gender [ ] Male [ ] Female.

2. Age [ ] 19-24 [ ] 25- 30 [ ] 31-36 [ ] 36 and above [ ] No response
3. Department of operation

- Airline operator
- Government agency
- Cargo handlers
- Fuel company
- Ground handlers
- Duty free and retail shops
- Tours and travel agents
- Taxi and car rental
- Forex bureau and banks
- Other (please specify): _____

4. What is your highest level of formal education?
   [ ] Secondary [ ] College [ ] Others

Section B: General Organization Disaster Preparedness Information awareness

5. Does your organization have any form of formal disaster preparedness plan in place (e.g., a plan for what to do in case of an emergency or disaster)? This would include fire drills, shelter-in-place drills, emergency communication plans, business continuity plans, etc.
   [ ] Yes [ ] No

6. What role does your department play in forming your organization's disaster preparedness plans?
   [ ] Primarily responsible for forming all disaster preparedness plans and procedures, with minimal input from other departments
   [ ] Forms disaster preparedness plans and procedures with equal input from other departments
   [ ] Advises other departments that are primarily responsible for forming disaster preparedness plans and procedures
   [ ] No role in disaster preparedness

7. Overall, how would you rate your organization's preparedness for a disaster or crisis?
   [ ] Very well prepared [ ] Well prepared [ ] Not well prepared [ ] Not at all prepared

8. Does your organization have a shelter-in-place plan (e.g., a plan to gather in a small interior room in the event of certain types of emergencies)?
   [ ] Yes [ ] No

9. Does your organization have a fire/evacuation plan?
   [ ] Yes [ ] No

10. Does your organization have specific guidelines and/or equipment in place to help evacuate persons with disabilities such as blindness or limited mobility in the event of a disaster?
    [ ] Yes [ ] No [ ] Not sure

11. Does your organization have an emergency communication plan?
    [ ] Yes [ ] No

12. What does your organization's emergency communication plan consist of? (Please select all that apply.)

- Alternate location for employees to meet
- Emergency number for employees to check organization's status
- Internet site for employees to check organization's status
- Method of accounting for employees in a disaster
- Method of actively communicating status to employees (e.g., phone tree)
- Other (please specify): _____

13. How does your organization communicate its emergency communication plan to employees? (Please select all that apply.)

- All-staff e-mails to communicate plan
- All-staff meetings to communicate plan
- Information in employee handbook
- Information on company Web site or intranet
- Magnet, wallet card or other method employees can carry or bring home information
- Posted information in the workplace
- Other (please specify): _____

14. Does your organization have any employees who are specifically tasked with playing a leadership role in the event of a crisis?
    [ ] Yes [ ] No

15. How are these employees primarily selected?

- Nomination
- Part of job description
- Seniority in organization
- Volunteer
- Other (please specify): _____

16. What type of special training do these employees receive? (Please select all that apply.)

- CPR and/or first aid training
- Crisis management
- Fire suppression
- Training in organization-specific disaster response plan
- Training in assisting persons with disabilities during a disaster
- Training in dealing with hazardous materials
- Training in helping keep others calm in a crisis

17. Are you trained on disaster management [ ] Yes [ ] No . If yes, where was this ……..

18. What is your level of disaster preparedness

Preparedness activity	**Have done**	**Plan to do**	**Not done**	**Unable to do (reason)**
Trained in first aid/fire fighting drill/ etc				
Involved in the development of organizational emergency plan				
Worked with/handled disaster/emergency kits over the last six months				
Discussed airport emergency with members of my				

organizations				
Attended meetings on disaster management				
Read disaster management materials				
Undertaken a course in early warning system				

19. Has any part of your organization's disaster preparedness plan been created or revised specifically as a result of the 9/11 terrorist attacks on America?
    [ ] Yes [ ] No [ ] Not sure

Section C: JKIA Disaster Preparedness Information Awareness

20. Do you think there is a disaster preparedness/management policy for JKIA
    [ ] Yes [ ] No

21. Where do you get information concerning disaster management_____

22. What functions does your organization perform in JKIA disaster preparedness plans?

- Communicates information about available assistance programmes
- Communicates plans and procedures to employees
- Coordinates "drills" (e.g., fire drills, etc.) to prepare employees in case of emergency
- Coordinates offsite work location
- Evaluates effectiveness of disaster preparedness plan
- Trains employees in disaster plans
- Other (please specify):

23. Have you ever been involved in disaster response at JKIA [ ] Yes [ ] No. If yes which one …….....

24. What are the most probable disasters/accidents at JKIA……..

25. How do you rate JKIA disaster preparedness
    [ ] Satisfactory [ ] Unsatisfactory

26. Have you undergone specific training to help deal with fire/plane crash or other emergencies at JKIA [ ] Yes [ ] No

27. Is there a disaster response centre at JKIA [ ] Yes [ ] No [ ] Don't Know. If yes, how technically well equipped is it in handling airport emergencies

[ ] Very well equipped [ ] Fairly equipped [ ] Not all well equipped

28. Please rate the compliance of any disaster preparedness facilities at JKIA

S/No.	**Facility**	**Compliance**		
		Fully	***Mostly***	***Occasionally***
a)				
b)				

29. Do JKIA have mechanisms in place to coordinate operations with these organizations

[ ] Yes [ ] No

30. Is there a community outreach disaster management programmeme at JKIA

[ ] Yes [ ] No [ ] Don't Know

31. Mark in the appropriate box, your opinion on JKIA disaster preparedness

Statement	***Strongly***	***Agree***	***Neutral***	***Disagree***	***Strongly***
JKIA emergency action plan helps deal with severe air crash/ fire related emergency					
I have sufficient information or training about the types of airport disaster relevant to JKIA					
JKIA is well prepared and has well trained manpower to handle terror emergencies					
I am well prepared to handle any					

kind of disaster here at the airport					
Foreign trained workers are better equipped to handle airport disasters than locally trained workers					
There are good refresher courses and drills offered at JKIA to enable handle any emergencies/disasters					
JKIA has facilities and is well prepared to handle fire emergencies at the airport					
JKIA has facilities and is well prepared to handle terror emergencies at the airport					
In case of airplane threat I know how to respond to cushion the airport from the adverse effects					

THANK YOU

Annex 1b: INTERVIEW GUIDE FOR KEY INFORMANTS

1. Is there a disaster management policy for JKIA
2. If yes, what are its core highlights
3. What disaster management programmemes exist at JKIA
4. What disaster resource infrastructure and possible risks/hazards exist at JKIA
5. How are existing disaster preparedness plans implemented
6. What are the achievements in the last one year in disaster preparedness
7. Have there been any past emergency incidents at JKIA and how were they handled

8. What future plans are there for JKIA disaster preparedness
9. Are there mechanisms to evaluate disaster preparedness activities
10. What criterion is in place for recruitment of disaster management personnel at JKIA
11. What qualities, competencies, skills and knowledge should such personnel posses
12. What on job training/refresher training are such personnel exposed to
13. Where are such trainings conducted (abroad or locally, probe why)
14. What disaster management facilities exist at JKIA
15. Is there a disaster management centre at JKIA
16. If yes, how is it managed (staffing, facilities, strategies)
17. What disaster relief mechanisms are in place at JKIA
18. What are the major organizations outside JKIA that collaborate in disaster preparedness and response with JKIA (area and nature of collaboration agreement)
19. What mechanisms are in place to coordinate operations with these organizations
20. Is there a community outreach disaster management programmeme at JKIA? What strategies exist for public awareness on disaster management
21. If yes how do you interact with the community on issues of disaster preparedness
22. What early warning systems are in place at JKIA and how are these communicated to other organization

Annex 2: Airport disaster global perspective (Global General, 2010)

May 12, 2010: Afriqiyah Airways plane en route to Tripoli, Libya, from Johannesburg, South Africa, crashes into the desert less than a mile from the runway, killing 103 people.

April 10, 2010: The plane of Polish President Lech Kaczynski crashes outside the western Russian city of Smolensk, killing all 96 aboard.

June 30, 2009: Yemenia Airbus 310 en route to the Comoros Islands crashes into the Indian Ocean with 153 people on board.

June 1, 2009: Air France Airbus A330 runs into thunderstorms and crashes into Atlantic Ocean en route from Rio de Janeiro to Paris, killing 228 people on board.

February 19, 2003: Iranian Revolutionary Guard military plane crashes into a mountain. 275 dead.

May 25, 2002: China Airlines Boeing 747 breaks apart midair and crashes into the Taiwan Strait. 225 dead.

November 12, 2001: American Airlines Airbus A300 crashes after takeoff from JFK Airport into the New York City borough of Queens. 265 dead, including people on the ground.

October 31, 1999: EgyptAir Boeing 767 crashes off Nantucket; the NTSB blames actions by the co-pilot. 217 dead.

September 2, 1998: Swissair MD-11 crashes off Nova Scotia. 229 dead.

February 16, 1998: China Airlines Airbus A300 crashes on landing at airport in Taipei, Taiwan. 203 dead.

September 26, 1997: Garuda Indonesia Airbus A300 crashes near airport in Medan, Indonesia. 234 dead.

August 6, 1997: Korean Air Boeing 747-300 crashes on landing in Guam. 228 dead.

November 12, 1996: Saudi Boeing 747 collides with Kazakh cargo plane near New Delhi. 349 dead.

July 17, 1996: TWA Boeing 747 explodes and crashes into the Atlantic off Long Island, New York. 230 dead.

April 26, 1994: China Airlines Airbus A300 crashes on landing at Nagoya Airport in Japan. 264 dead.

December 12, 1985: Arrow Air DC-8 crashes after takeoff from Newfoundland, Canada. 256 dead.

August 12, 1985: Japan Air Lines Boeing 747 crashes into a mountainside after losing part of its tail fin. 520 dead in the world's worst single-plane disaster.

August 19, 1980: Saudi Tristar makes emergency landing in Riyadh and bursts into flames. 301 dead.

May 25, 1979: American Airlines DC-10 crashes after takeoff from Chicago's O'Hare Airport. 275 dead.

January 1, 1978: Air India 747 crashes into the ocean after takeoff from Mumbai. 213 dead.
March 27, 1977: KLM 474, Pan American 747 collide on runway in Tenerife, Canary Islands. 583 dead in world's worst airline disaster

Annex 3: Lists a chronology of aircraft accidents which is by no means exhaustive:

1) In 1974, a Lufthansa-operated Boeing 747-130 crashed at the Jomo Kenyatta International Airport on take-off en route to Johannesburg International Airport, South Africa. The accident claimed 59 lives out of a total of 157 people inside. The accident was blamed on human error.
2) In 1975, a plane carrying a Kenyan government minister, Bruce Mackenzie, exploded into flames and crashed after entering Kenyan airspace while returning from Uganda. The accident claimed the lives of all on board, including the minister and other dignitaries.
3) In 1987, a government pathologist P. R. Ribeiro died in a plane crash atop Ngong Hills on his way to Nyanza to testify in a murder case.

4) In 1993, the then Kenya Wildlife Service chairman Dr. Richard Leakey survived an air accident after his plane crashed into the Kikuyu area of Kiambu district. He unfortunately lost both feet and has since used artificial limbs.
5) In 1996, the then Samburu District Commissioner James Nyandoro and others died when armed cattle rustlers shot their plane while traversing the Suguta valley within Samburu district. He was in a security mission chasing cattle rustlers who had taken refuge in the valley.
6) In 1996, former Rift Valley Provincial Commissioner Ishmael Chelang'a died together with several other provincial administrators when the plane they were traveling on developed mechanical problems and crashed immediately after take-off at Marsabit airstrip.
7) In February 2000, an air accident off the coast of Ivory Coast involving a Kenya Airways Airbus 310 crashed into the ocean killing 159 people. The plane had just taken off from Abidjan International Airport destined for Nairobi, Kenya.
8) In January 2002, a helicopter transporting former president Moi's security entourage from Mombasa to Tana River district crashed in Makueni district killing six crew members.
9) In November 2002, a plane crashed in one of the Maasai Mara Game Reserve's airstrips killing one person and injuring 19 others.
10) In February 2003, a plane crashed immediately after take-off at Busia airstrip in western Kenya killing former Labor Minister Mohammed Khalif and seriously injuring other government dignitaries. They were returning to Nairobi from a victory party for a colleague in Funyula constituency.
11) In July 2003, 12 American tourists and two South African pilots were killed when their plane crashed into Lenana peak on Mt. Kenya while on their way to Samburu. This accident was blamed on bad weather.
12) In July 2003, a Canadian researcher and an American pilot lost their lives when their plane burst into flames before crashing in Laikipia district.
13) In October 2003, a plane destined for Manda Island airstrip in Lamu District lost altitude and crash-landed into the Nairobi National Park, with the pilot narrowly escaping death.
14) In December 2003, a plane operated by East Africa Safaris crash-landed at Lokichoggio airstrip as it tried to land, with no fatalities.
15) In May 2004, a plane Let 410 operated by Bluebird Aviation crashed near Mwingi town killing 2 passengers.
16) In May 2004, a plane operated by Bluebird Aviation collided with Bluebird's 5Y-VVD which had crashed in an open field in Mwingi.

17) In June 2005, a plane Hawker Siddeley HS-780 Andover C.1 operated by 748 Air Services was damaged when the propellers hit the runway on landing. The loadmaster and pilot evacuated themselves. There were no fatalities.
18) In June 2005, a plane Lockheed L-100-300 operated for United Nations suffered landing gear problems causing the airplane to land on its belly.
19) In April 2006, Y-12 military aircraft carrying government officials to a peace meeting crashed in Marsabit killing 14 people including government ministers. Mechanical problems were cited as the main cause of the accident.
20) In September 2006, a DHC-5D buffalo operated by Trident Aviation veered off the runway when the propeller struck the ground on landing.
21) In May 2007, a Kenya Airways Boeing 733-800 crashed in Duala, Cameroon killing 105 passengers. Bad weather was cited as the main cause of the accident.
22) In December 2007, a DHC-5D buffalo operated by Trident Aviation ran into the right wing of a Cessna while taxiing at Wilson Airport.
23) In August 2008, a plane Fokker F27-500 cargo aircraft operated by Fly 540 crashed 20km from Namber Kontom Airport killing 3 crew members.
24) In June 2008, a Cessna 210 crashed at Nairagie Engare area, about 140 Kilometres (85 miles) west of Nairobi killing four people who included two cabinet ministers.
25) In August 2009, a plane Cessna U206 operated by African Inland Mission crashed at Nairobi. There were five survivors though fatally injured. **Source:** The East African Standard of February 1st, 2004.

Annex 4: List of some major air crashes in Africa (Breaking News Reuters, 2008)

a) January 8, 1996 – At least 350 people die when a Russian-built Antonov-32 cargo plane crashes into a crowded market in central Kinshasa, capital of Zaire (now DRC).
b) November 23, 1996 – One hundred and twenty-five of 175 passengers and crew are killed when a hijacked Ethiopian Airlines Boeing 767 crashes into the sea off the Comoros Islands.
c) January 30, 2000 – A Kenya Airways Airbus A-310 crashes into the sea shortly after takeoff from Abidjan in Ivory Coast, killing 169 of the 179 passengers and crew.
d) May 4, 2002 – A Nigerian EAS Airlines BAC 1-11-500 crashes in the north Nigerian city of Kano. At least 148 people are killed, 75 on the plane and 73 on the ground.

e) March 6, 2003 – An Algerian Boeing 737-200 crashes shortly after takeoff from Tamanrasset airport, killing 103 passengers and crew.
f) May 8, 2003 – Cargo door opens in mid-flight on an Ilyushin 76 transport plane in the Democratic Republic of Congo, sending at least 70 passengers plummeting to their deaths.
g) July 8, 2003 – A Sudan Airways Boeing 737 crashes shortly after takeoff near Port Sudan, killing 104 passengers and the crew of 11. One child survives.
h) Dec 25, 2003 – A Boeing 727 bound for Beirut clips a building after takeoff in Benin and plunges into the Atlantic Ocean, killing 111 passengers and crew. Twenty-two survive.
i) October 22, 2005 – A Nigerian Bellview Airlines Boeing 737-200 airliner with 111 passengers and six crew crashes north of Lagos, shortly after takeoff. All aboard are killed.
j) December 10, 2005 – A Nigerian Sosoliso Airlines DC-9 flight from Abuja carrying 110 passengers and crew crashes on landing. Four people survive.
k) May 5, 2007 – All 114 people on board a Kenya Airways Boeing 737 are killed when the plane crashes in torrential rain after takeoff from Douala in Cameroon en route to Nairobi.
l) April 15, 2008 – A Hewa Bora Airways McDonnell Douglas DC-9 crashes after aborting its takeoff from Goma, in the east of the Democratic Republic of Congo. At least 50 people were killed and more than 100 people were injured on the aircraft and on the ground.
m) June 10, 2008 – A Sudan Airways plane, identified as an Airbus, with 203 passengers and 14 crew on board burst into flames after careering off the runway on landing at Khartoum airport. At least 33 people were killed and 113 survived. Another 50 to 60 remain unaccounted for and may have left the scene.

Annex 5: world's deadliest air disasters

1) May 12, 2010: Afriqiyah Airways plane en route to Tripoli, Libya, from Johannesburg, South Africa, crashes into the desert less than a mile from the runway, killing 103 people.
2) April 10, 2010: The plane of Polish President Lech Kaczynski crashes outside the western Russian city of Smolensk, killing all 96 aboard.
3) June 30, 2009: Yemenia Airbus 310 en route to the Comoros Islands crashes into the Indian Ocean with 153 people on board.
4) June 1, 2009: Air France Airbus A330 runs into thunderstorms and crashes into Atlantic Ocean en route from Rio de Janeiro to Paris, killing 228 people on board.
5) February 19, 2003: Iranian Revolutionary Guard military plane crashes into a mountain. 275 dead.

6) May 25, 2002: China Airlines Boeing 747 breaks apart midair and crashes into the Taiwan Strait. 225 dead.
7) November 12, 2001: American Airlines Airbus A300 crashes after takeoff from JFK Airport into the New York City borough of Queens. 265 dead, including people on the ground.
8) October 31, 1999: EgyptAir Boeing 767 crashes off Nantucket; the NTSB blames actions by the co-pilot. 217 dead.
9) September 2, 1998: Swissair MD-11 crashes off Nova Scotia. 229 dead.
10) February 16, 1998: China Airlines Airbus A300 crashes on landing at airport in Taipei, Taiwan. 203 dead.
11) September 26, 1997: Garuda Indonesia Airbus A300 crashes near airport in Medan, Indonesia. 234 dead.
12) August 6, 1997: Korean Air Boeing 747-300 crashes on landing in Guam. 228 dead.
13) November 12, 1996: Saudi Boeing 747 collides with Kazakh cargo plane near New Delhi. 349 dead.
14) July 17, 1996: TWA Boeing 747 explodes and crashes into the Atlantic off Long Island, New York. 230 dead.
15) April 26, 1994: China Airlines Airbus A300 crashes on landing at Nagoya Airport in Japan. 264 dead.
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19) May 25, 1979: American Airlines DC-10 crashes after takeoff from Chicago's O'Hare Airport. 275 dead.
20) January 1, 1978: Air India 747 crashes into the ocean after takeoff from Mumbai. 213 dead.
21) March 27, 1977: KLM 474, Pan American 747 collide on runway in Tenerife, Canary Islands. 583 dead in world's worst airline disaster.

Annex 6: Hazard categories and consequences (Ayres, 2009)

A - Hazard Category	B - Main Components	C - Potential Consequences
Jet blast	Operating aircraft jet engines	• Blowing over vehicles, equipment, objects, particularly in the ramp area • Displacing people, particularly in the ramp area
FOD	FOD management, maintenance and construction activities, airside activities, pavement deterioration, aircraft operations and maintenance	• Jet blast of FOD striking people, aircraft, equipment or infrastructure • FOD being ingested into the engines of operating aircraft • FOD damaging the aircraft during operations (e.g. accident with Concord aircraft)
Runway usage	ATC, aircraft, vehicles	• Runway incursions • Insufficient runway distance available for landing or taking off • Wrong runway usage • Aircraft undershoots and runway excursions • Lack of or misleading NOTAMs
Taxiway routings	Traffic control, weather conditions, communication, markings	• Routing errors with aircraft and vehicle collisions • Runway incursions • Low visibility • Incorrect phraseology • Human errors • Deficient marking and signing
Airside ground traffic	Traffic control, visibility and adverse weather conditions, communications, equipment maintenance,	• Vehicles and aircraft running over people • Collisions in the non-movement areas • Runway incursions and collision with aircraft • Speeding of ground vehicles • Poor equipment maintenance and malfunctions • Human errors • Incorrect phraseology
Winter services procedures (de-icing, anti-icing and snow	Procedures, equipment, training, materials, poor operation conditions, timing, monitoring of	• Lack or incorrect de-icing procedures may disable aircraft ability to fly • Improper snow removal or anti-icing may lead to

A - Hazard Category	B - Main Components	C - Potential Consequences
removal)	surface conditions, reporting of surface conditions	improper braking capability on the runway with risk of overruns and veer-offs • Asymmetric drag during operations may cause veer-offs • Poor braking performance causing collisions in movement and non-movement areas • Lack of sufficient materials • Equipment coordination disruption • Delay to employ safety measures • Low runway friction • Pilot unawareness of surface conditions
Rescue and fire fighting	Deficient ARFF facilities and equipment, lack of appropriate access routes, poor planning and training, lack of appropriate materials and protective equipment, poor maintenance, poor emergency awareness	• Improper training can delay rescue and firefighting • Lack of appropriate access routes may delay operations • Inoperative equipment can restrict ARFF capabilities • Insufficient equipment and materials can restrict capability • Poor equipment maintenance may jeopardize effectiveness • Improper protective equipment may restrict rescue and firefighting operations • Level of protection lower than that required will restrict capability during major accidents • Lack of water rescue capability at airports close to great stretches of water or swampy areas will restrict rescue capabilities • Inappropriate facilities that provide for rest, exercise, drill, training etc. will pose restriction to staff working at the fire station. • Delay to initiate operations will restrict occupant survivability • Poor communications procedures and equipment

A - Hazard Category	B - Main Components	C - Potential Consequences
		readiness will restrict ARFF capability
Crisis and contingency management (medical, disabled aircraft removal, etc.)	Planning and training, coordination, communications, equipment, procedures, command	• Delay to respond to emergencies and decrease in survivability • Delay to isolate the accident area • Delay to remove accident obstacles • Delay to inform other pilots and operators • Lack of coordination (key staff, discipline and agencies) • Incorrect phraseology • Lack of appropriate equipment and procedures • Poor alerting services • Dated contact information • Loss of operational control • Unavailable resources • Command structure decay and delay
Special events (air shows, etc.)	Coordination, security, procedures for non-standard operations, spectator proximity to aircraft and operations, spectator unawareness of risks, communication, FOD, marking and barricading of restricted areas, new ignition sources	• Damage to aircraft • Loss of aircraft control during maneuvers • Runway incursions • FOD and jet blast consequences • Collisions • Damage to equipment • Fire • Vandalism • Poor event performance • Loss of public relations opportunity • Other vehicle, aircraft, staff and spectator accidents
Adverse environmental conditions (night, low visibility, adverse wind conditions, precipitation)	Training and experience for adverse weather conditions, preparation and communication, visibility and lighting conditions, runway surface conditions, approach conditions	• Visual aid and electronic device malfunction or destruction • Aircraft and ground vehicle collisions • Increased aerial and surface condition hazards • Aircraft and vehicles running over airport workers and passengers

A - Hazard Category	B - Main Components	C - Potential Consequences
		• Aircraft overruns, veer-offs and undershoots • Reduced emergency response capability
Airport development, construction and maintenance activities	Impact of construction on operations, impact of operations on construction, coordination (air traffic, apron management, security, etc.), access routing, communication (e.g. NOTAMs), FOD and dust control, construction signage, temporary airfield signage, interference with operations and NAVAIDS, off-peak construction, construction worker training and awareness, safety and emergency plans, construction quality, construction equipment maintenance, construction OSH compliance, location of existing installations	• Breakdown of construction equipment • Jet blast affecting construction area • FOD • Runway incursions • Malfunction of NAVAIDS • Damage to aircraft • Pilots, ATC, airport workers and contractor unaware of construction and changed operation conditions • Accidental interference with existing installations • Equipment, stockpile and construction location within airfield safety areas • Material stockpiles or construction equipment obstructing the view of ATC • Permitted times for construction not strictly followed • Displacement of construction equipment and materials by prop wash, jet blast or wind • Edge and threshold lights for closed portions of a runway not properly disconnected or covered to prevent pilots use the areas
Wildlife hazards (birds and other wildlife)	Fencing, wildlife detection systems and procedures, deterrent devices, wildlife management plan, training and equipment for wildlife control, feeding and airport trash and garbage receptacles, airport zoning and minimization of attractants	• Bird and wildlife strikes to aircraft and vehicles • Loss of aircraft and vehicle control • Improper use of wildlife deterrent devices • Damage to perimeter fences • Poor field monitoring and reporting • Poor wildlife control
Security issues	Access control	• Runway incursions • Vandalism • Terrorism

A - Hazard Category	B - Main Components	C - Potential Consequences
Visual and non-visual aids for approach and landing	Adequacy and reliability, interference, runway approach area updates	• Inaccurate approach and landing • Unavailability of NAVAIDS • Collision with obstacles • Aircraft overruns and undershoots
Inspection and survey activities (internal and external)	Frequency, personnel training, equipment	• Failure to identify and report existing hazards • Runway incursions • Failure in communication procedures • Use of incorrect phraseology • Equipment malfunction
Protection of NAVAIDS and related sites	Fencing, vigilance, maintenance, zoning, signage	• Inoperative or damaged equipment • Interference to NAVAIDS from new developments in the area • Aircraft collisions • Failure to ensure a secure and safe area • Airport closure
Obstacles	Signage, monitoring, awareness of pilots and ATC	• Aircraft collision with obstacles • Vehicle and equipment collisions • Presence of unreported obstacles • Change in obstacle condition • Inaccurate location and elevation of obstacle
Fuel handling	Operating procedures, spillage control procedures, proximity of ignition sources, supervision and training, equipment compatibility, fuel storage	• Spillage • Misuse • Fire • Contamination • Damage to asphalt pavements • Environmental impacts • Improper handling and spillage control • Procedural violations • Vapor inhalation and ingestion • Downtime of resources
Hazardous materials handling	Handling procedures, spillage control procedures, supervision	• Spillage • Environmental impacts

A - Hazard Category	B - Main Components	C - Potential Consequences
	and training, storage	• Damage to equipment • Improper handling and spillage control • Procedural violations • Human injuries • Downtime periods • Airport closure
Passenger handling	Handling and control procedures, supervision, monitoring, operation of passenger bridges, operation of buses, evacuation procedures	• Vehicles striking passengers • Slips and trips • Unawareness of airport dangers • Inadvertent or deliberate damage to aircraft and equipment • Improper use of safe routes • Running aircraft engines • Speeding of passenger buses • Passenger exiting designated routes
Communications	Communication procedures, equipment maintenance, training	• Miscommunication • Incorrect use of communication devices • Incorrect phraseology • Impact on operations and emergency services • Equipment failure • Loss of coordination and control • Operator error • Loss of airport operations capabilities
Airport reporting (AIP, NOTAMs, etc.)	Responsibility, up to date information	• Improper notification and update procedures • Delay in operations • Change in conditions • Failure to publish NOTAM • Runway incursions • Collisions
Apron management	Airport rules and regulations, SOPs, access control, gate assignment, ramp congestion, turnaround	• Aircraft assigned to incorrect gate • Collision between aircraft and vehicles • Inadequate lighting, glare or confusing lights

A - Hazard Category	B - Main Components	C - Potential Consequences
	times, airport infrastructure, technology available and maintenance	• Non enforcement of rules, regulations and SOPs • Lack of centralized and uniform management • Poor, misleading or non-standard markings • Poor supervision of ramp activities • Deficient coordination with ATC, tenants, and service providers • Low capacity of infrastructure • Mal-function of ground control equipment • Aircraft stands are not serviceable, clean and free of obstructions • Passenger bridge not retracted or correctly parked • Non availability of emergency equipment • Lack of functional check of the passenger bridge before utilization • Improper use of apron real estate and reduced capability • Delay of operations
Ground operations (marshalling, catering, towing, baggage handling, apron bridges, etc.)	Airport rules and regulations, equipment parking, SOPs, supervision, pilot blind area, personal protection equipment (PPE), training, self-maneuvering operations	• Propeller blades striking people or equipment • Jet blast displacing materials and equipment, and striking people • People and objects being sucked by jet engine intakes • Unsafe aircraft towing • Pilot can not perceive presence of equipment and people • Vehicles striking aircraft and/or people • Falls and falling objects • Inappropriate aircraft chocking • Activities starting before aircraft engine shutting down • Hot aircraft brakes • Untrained aircraft Marshaller • Use of non-standard marshalling signals

A - Hazard Category	B - Main Components	C - Potential Consequences
		• Improper passenger bridge operation • Lack of emergency stop procedures • Improper parking location by vehicles and aircraft
Training and licensing	Competency training and evaluation, access requirements for movement, non-movement areas	• Poor training • Non qualified workers performing activities at the ramp • Violations of rules and regulations • Failure to perform duties • Incorrect execution of procedures
Infrastructure, pavements (FOD, runway friction, roughness, pavement condition) Safety areas Markings Signs Lighting Electrical systems Engineered Materials Arresting Systems (EMAS)	Pavement management, marking and lighting, aircraft arresting systems	• Deteriorated pavement • FOD • Inappropriate Pavement Condition Number (PCN) • Poor runway surface friction condition, contaminated surface (rubber build-up, ponding, ice, snow, dirt), ungrooved pavement • Uneven or non-smooth pavement may damage aircraft equipment • Bumps, potholes, rutting • Excessive difference in elevation between adjacent areas • Malfunction of lighting system • Missing, unclear or deteriorated markings • Lack of maintenance of aircraft arresting systems
Occupational health and safety	Equipment, procedures	• Improper procedures • Lack of PPE
Helicopter operations	Segregation, location and type of operations	• Helicopter blades striking people, vehicles and equipment • Rotor wash displacing objects
Equipment maintenance and conditions	Airport ground equipment, visual aids, NAVAIDS, surface movement guidance and control	• Disruption of operations • Runway incursions • Runway excursions and undershoots • Collisions • Aircraft and vehicles striking people

A - Hazard Category	B - Main Components	C - Potential Consequences
Shift work	Effects on health, coordination, timing	• Fatigue • Lack of concentration • Human errors • Poor duty performance
Change in conditions	New equipment, new aircraft, new employee, new regulation, new SOP, new or withdrawal of services, new tenant	• Deficient risk assessment for new conditions • Deficient infrastructure to effect change • Untrained workers on new procedures • Employees unfamiliar with new workplace • Lack of coordination between services
Landside hazards	Landside traffic, parking, pedestrian crossings	• Vehicle collisions • Vehicles striking pedestrians • Accidents in parking areas
Passenger terminal hazards	Maintenance activities, electric carts (at larger terminals), airport equipment, people movers, escalators, elevators, spillages	• Slips, trips and falls • Carts striking pedestrians • Hands, feet, clothing or shoes that become entrapped in the escalator or people mover • Injuries caused by sudden stops, misleveling, and mechanical malfunctions of elevators

Annex 7: Photo plates

Photo 3: Google air view of JKIA runway and apron

Photo 4: Total Kenya boozer fuelling an aircraft at JKIA