GREENING CONSTRUCTION OF MEGA SPORTS VENUES AND FACILITIES: THE CASE OF THE LONDON 2012 OLYMPIC GAMES

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DECLARATION

I, the undersigned, declare that this is my original work and that the work has not been submitted to any other college, institution or university other than the University of Nairobi for academic credit.

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This project paper has been presented for examination with our approval as the appointed supervisors.

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ABSTRACT

The 2012 Olympic and Paralympic Games took place in London, the United Kingdom (UK) from 27 July to 12 August and 29 August to 9 September respectively. London was selected to host the Games in June 2005 and preparations for the Games spanned through a period of seven years. While the focus of the Games was on delivering a global sporting spectacle, the integration of environmental and sustainability considerations in the Games became imperative, more so as the environment is the third dimension of Olympism, alongside sport and culture. A key focus of the London 2012 Games was the regeneration of a contaminated site in East London into the landmark Olympic Park.

The main purpose of this study was to determine the effectiveness of the greening of the London 2012 Olympic Games. The study adopted a case study research design and the target population included the main delivery agencies, contractors, NGOs and fans and athletes who participated in test events. The purposive, convenience and stratified random sampling methods were used to select the sample for the study. The study used the questionnaire, key informant interviews, focus group discussion, direct observation and documents review to collect data. The quantitative data was analysed using descriptive and inferential statistics while the quantitative data was analysed using content analysis.

The findings revealed that environmental sustainability was integrated into the London 2012 Olympic Games right from the bid phase. This led to the development of a Sustainability Strategy and a Sustainability Plan by the delivery agencies that were used to set key targets for greening of the Games. The study established that the Games led to the revitalisation of a contaminated and depressed part of London into a vibrant social, business and environmental centre. The study concluded that the environmental sustainability measures implemented by the delivery agencies of the Games played an important role in delivering a green legacy. The successful greening of mega sport events depend on effectiveness of greening measures adopted during planning/design, construction, operation, monitoring and evaluation stages as well as the handling of challenges. The London 2012 Olympic Games provided an alternative perspective for reviewing the potential for hosting mega-sport events beyond the strict cost-benefit analysis. The greening measures implemented by delivery agencies for London 2012

Olympic Games greatly influence adoption of greening measures in building industry in the UK. The London 2012 Games also presented important lessons and experiences which can be used to facilitate environmental sustainability in future mega-sports events.

The study recommends that environmental sustainability measures should be integrated into similar processes from a very early stage of the campaign; aspiring host cities and countries should come up with a plan on environmental sustainability that is relevant to the communities living around the venues; and policy makers in the event industry should use the example of the London 2012 Olympic Games as a benchmark for future events and widely disseminate the lessons of the London Games to organizers of their respective Games.

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DEDICATION

This study is dedicated to the special memory of my parents, the late Thomas Ayuk Oben and Dorothy Etake Oben who worked tirelessly to provide me with a solid educational foundation and whose memory I will always cherish.

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ABBREVIATIONS

BRE- British Research Establishment

BREEAM- Building Research Establishment Environmental Assessment Method for buildings

CCHP- Combined Cooling, Heating and Power

DEFRA - Department for Environment, Food and Rural Affairs

EERE - Energy, Efficiency and Renewable Energy

EMIMA- Elimu, MichezonaMazoezi

EPCs - Energy Performance Certificates

FIFA-International Federation of Association Football

GHG - Greenhouse Gas Emissions

HVAC- Heating, ventilation, and air-conditioning

IOC- International Olympic Committee

IISD- International Institute for Sustainable Development

LDALondon Development Authority

LEED- Leadership in Energy and Environmental Design

LOCOG-London Organizing Committee for the Olympic Games and Paralympic Games

MDGs- Millennium Development Goals

MYSA- Mathare Youth and Sports Association

NRDC-Natural Resources Defence Council

OCOGs- Organizing Committeesof Olympic Games

ODA- Olympic Delivery Authority

OECD - Organisation for Economic Co-operation and Development

SCORE-Sports Coaches Outreach

TOROC- Torino 2006 Olympic Organizing Committee

TRA- Theory of Reasoned Action

UEFA-Union of European Football Associations

UNEP - United Nations Environment Programme

VANOC - Vancouver Organizing Committee for the 2010 Olympic and Paralympic Winter Games

WFD - Water Framework Directive

WRAMS-Water Reclamation and Management Scheme

CHAPTER ONE

INTRODUCTION

This chapter introduces and presents the background of the study which covers the greening of construction of sport venues and facilities, the role of sports in sustainable development, the legacy of Olympic Games and the London 2012 Summer Olympic Games. The chapter also presents the statement of the research problem, the research questions, the objectives of the study, the hypotheses, the justification of the study, the scope of the study and operational definition of terms.

1.1 Background of the Study

Sport generally refers to physical or public activities, especially those with competitive elements, pursued for victory, pleasure, or for the demonstration of excellence (Miragaya, 2006). Sport also refers to a playful self-development, self-actualization, and competitive use of physical and mental skills (Carroll, 2000).It can also describe physical education (PE),recreation or leisure, applies to non-work, relaxation and rejuvenation with pleasure or fun as well as hunting, dancing, and even Board Games (Miragaya, 2006).

The development of sports from pre-historic times until now is a function of industrialization, modernization and telecommunication (Cashmore, 2000). Sports development is the gradual improvement in all aspects of sports and as a result of increased attention to sports by governments and peoples (Obi, 2000). The parameters for measuring such development include the steady increase in the number of sports venues and facilities, the availability of equipment and supplies, the number of people participating in sporting activities, the frequency and consistency of competition as well as the improvement in the performance of athletes in events (Ibid).

Over the past few decades, the concept of green design has evolved into one of the ways of dealing with limited and non-renewable resources and reducing human impact on the environment (Kessenides, 2005). Architects, engineers, and consultants are increasingly incorporating green design concepts and technologies in various sport projects. This study looked into the effectiveness of greening of construction of sport venues and facilities. The study reviewed the effectiveness of efforts to green the

London 2012 Olympic Games, with a focus on the influence that this has had on the building industry in the UK.

This section presented the background of the study. It defined sports and described the growing importance of sports in development. The section also introduced the concept of greening of sports in general and sport venues and facilities in particular. The next section will describe greening construction of sports venues and facilities.

1.1.1 Greening Construction of Sport Venues and Facilities

Sustainability in buildings refers to the sustainability in the performance of a structure or building during its entire life – from design, material production, transport, construction, operation, deconstruction and recycling (UNEP, 2010). It is an integrated approach to conserving the environment through design practices and construction materials that use resources such as energy and water most efficiently, operation and decommissioning (Fried, 2005). Green buildings are structures designed to use resources more efficiently and through this, minimise environmental footprint and improve occupants' health and productivity, (Environmental Building News, 1999).

According to Rydin, Seymour and Lorimer (2011) there has been an increase in sport facilities where green concept has been integrated in the UK. Rydin et al. (2011) citing the English Golf Union (2011) claim that the English Golf Union is developing non-intensive management of courses, by integrating natural-turf grasses, minimising water usage and reducing use of fertilizers and pesticides. Major sport venues such as the Millennium Stadium in Cardiff (UK) and Aviva Stadium in Dublin (Ireland) have achieved certification for sustainable management systems (British Standards Institution, 2007). Manchester United Football Club (UK) has developed a nature reserve at its Trafford Training Centre, Carrington with a lagoon with reed bed technology and a borehole to help ensure water self-sufficiency (Cheshire Wildlife Trust, 2006).

In the United States, the Target Centre home of the National Basketball Association (NBA) team, Minnesota Timberwolves has one of the largest green roofs with different kinds of plants such as Prairie Coreopsis, Wild Strawberry, Dotted Blazing-Star, and Lupine (Zeller, 2009).

The Natural Resources Defense Council (NRDC) has pioneered the 'greening' of professional sports in the United States, acting as the principle environmental advisor to the country's major sporting organizations (Climate Action, 2012). NRDC has provided

guidance and expertise to over 100 sport teams in the United States to reduce their environmental impact. NRDC has also initiated projects to reduce the carbon emissions of some of American flagship sport events and is using sport to promote environmental awareness and actions across to the multi-million dollar supply chain and the American public as a whole (Ibid).

This section introduced the concept of greening construction of sport facilities. It highlighted some benefits of the constructions of green facilities. The section also gave examples of sport facilities and organizations in various parts of the world that are making efforts to green their operations. The next section will review sport and sustainable development.

1.1.2 Sports and Sustainable Development

UN (2003) defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This definition contains within it two key concepts: the concept of needs, in particular the basic needs of the world's poor, to which major priority should be given, and, the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

The sport sector is central to the economic, social and cultural development of a nation and promotes many social benefits to participants and spectators including improved health and well-being and greater social connections and cohesiveness (Social Issues Research Centre 2006; Coalter, 2009). Sport is an ideal tool for achieving development at all levels. The United Nations (2003) states that sport directly contributes to the pursuit of the Millennium Development Goals (MDGs) through support to programmes geared towards education, gender equality, HIV/AIDS and the reduction of diseases. Sports programmes contribute to health, education, development and peace and could be a powerful medium for mobilizing societies and communicating key messages (Ibid). Coalter (2007) argues that participating in sport and other sport-based initiatives decreases social exclusion and contribute to harmony and inclusion in areas affected by conflict and poverty. Sport is an important resource for reducing delinquency and crime among young people thus promoting community safety (Donnelly et al., 2007). Sport is an important resource for facilitating educational commitment and attainment and promoting character building and moral development among young people (Ibid).

This section defined sustainable development and briefly touched on how sports can be used to promote sustainable development. It looked at how sports could be used to promote the achievement of the UN Millennium Development Goals (MDGs). The next section will review sport and environmental sustainability.

1.1.3 Environmental Policy in London 2012 Summer Olympic Games.

One week after the International Olympic Committee (IOC) awarded the XVII Olympic Winter Games to Lillehammer, the national, local and regional governments decided to make the Lillehammer Games a showcase for green mega-events. More than 200 different projects with environmental aspects were implemented. At the IOC's Centenary Congress in Paris in 1994, the environment was added as the third pillar of Olympism, alongside sport and culture. Since then, environmental sustainability has increasingly featured in the Olympic Games, most notably the Sydney 2000 Games that were considered to be the first Games to have incorporated a comprehensive environmental management programme in all aspects of the Games (UNEP, 2012).

At the start of the preparatory phase for the London 2012 Olympic Games organisers assessed their environmental impact through ecological and carbon footprinting exercises (Centre for Sustainable Energy, 2010; LOCOG, 2010; Rydin, Seymour and Lorimer, 2011). Such assessment normally guides organizers to reduce the environmental impact of their operations (Rydin et al., 2011).

The Olympic Park of the London 2012 Olympic Games incorporated 45 hectares of wildlife habitat, with a total of 525 bird boxes, and 150 bat boxes. Local waterways and riverbanks were enhanced as part of the environmental improvement process (London2012, 2009). Renewable energy also features at the Olympics. The Games organizers originally planned to provide 20 per cent of the required energy for the Olympic Park from renewable sources; although this figure was scaled down to 11 per cent. Proposals to meet the original 20 per cent renewable energy target included a large-scale on-site wind turbines and hydroelectric generators in the River Thames which was however abandoned for safety reasons (BBC, 11 April 2011). Food packaging at the London Olympics were made from compostable materials, like starch and cellulose-based bio plastics which are re-usable or recyclable but are biodegradable. The bioplastics were used as fast food wrappers, sandwich boxes and drink cartons. After they have been used, many compostable materials are suitable for Anaerobic Digestion

(AD), and are convertible into renewable energy (National Non-Food Crop Centre, 2011).

This section provided a brief summary of the evolution of environmental considerations in the Olympic Movement starting with the 1994 Olympic Winter Games in Lillehammer and the Centenary Olympic Congress in Paris in 1994. The section also briefly presented the London 2012 Olympic Games and some of London's efforts to address environmental issues in the preparation and staging of the Games. The next section will review the legacy of the Olympic Games.

1.1.4 The legacy of Olympic Games

According to Sweet (1987), the Olympic Games were first held in Olympia in 776 B.C. Some ancient scholars suggest that the Games were initiated by the Greek demi-god Heracles or Hercules and that Games had only one event – the Stadium Race and lasted only one day (Paleologos, 1976). More activities were added to subsequent editions of the Games until 472 B.C. when the Games finally had a complete schedule with all known ancient events and lasted for five days(Athens 2004 Olympic Games, 2004).Guttmann (1992) observes that the Olympic Games gradually lost their importance when Greece became part of the Roman Empire and Christianity became the official religion of Greece. The revival of the Games began in 1821 (Young, 1996). In 1890, after attending the Olympian Games of the Wenlock Olympian Society, Baron Pierre de Coubertin was inspired to revive the Games and establish the International Olympic Committee (IOC) and subsequently conceived what is today known as the modern Olympic Games in 1894 (Ibid).

International Federations (IFs) are recognised as the global supervisors of their respective sports in the Olympic Games (Olympic Charter, 2011). There are 35 IFs represented in the Olympic Movement (Olympic Charter, 2007). The Olympic Games programme currently consists of 35 sports, 30 disciplines and nearly 400 events. It is further broken down into 14 events for men and four events for women, each representing a different weight class. The Summer Olympic Game programme includes 26 sports, while the Winter Olympic Games programme features 15 sports (International Olympic Committee, 2009b)[1].

This section traced the evolution of the Olympic Games from the ancient Greek period to the introduction of the modern Olympics in 1894. The section also looked at the

Olympic programme and provided an overview of the sports, disciplines and events of the Games. The next section will discuss the statement of the research problem.

1.2 Statement of the Research Problem

According to Dowdeswell (1994) sports, like all human activities, take place within the economic, social and environmental context of a given time and location. Sports, she argues exert an influence on society and the natural environment in which it takes place. Savery and Gilbert (2011) posit that modern sport events, whether human-made or natural, have a significant impact on the natural and socio-cultural environment. Sport teams and officials travel to events by cars, buses, trains and planes, all of which contribute to greenhouse gases. The sporting goods industry uses natural resources to produce sport equipment. All these activities have environmental consequences such as energy use and other resource consumption that result in the generation of waste materials that pollute land, water and air as well as inputs from sports events that affect social and cultural systems of communities in ways that may not be obviously discernible (Ibid).

Frey and Iraldo (2009) reflect on the characteristics of mega sport events such as the Olympic Games. The high concentration of sport activities implied by the Games in terms of time (a two-week event), space (one host city only or event specific areas within the city); and investment (the operating and infrastructure cost are in billions of US dollars). They further observe that there seems to conflict with the concept of sustainable development that calls for the distribution and sharing of environmental, social and economic impacts across time and space and the spreading of benefits and negative impacts to society. This assertion raises the issues of environmental justice and inter and intra-generational equity. Environmental justice and equity can be described as the development and implementation of environmental policies and programmes to ensure that no community or group (today and in the future) is subjected to a disproportionate share of the burden of pollution or negative environmental consequences because it either lacks political clout or is not present when policies or programmes are initiated and that all communities and generations should share the benefits of the natural environment and resources (The business directory, 2012).

Smith (2009) also holds the same view by observing that one-off sport events have little to offer to long-term sustainability of communities. Mega sports projects, he continues, are often conceived as monuments to political regimes (e.g. the Montreal 1976 Olympic

Games) and as a result epitomise unsustainable development as their financial investment often compromise the ability of host communities and in some cases host countries to meet their own needs".

Frey and Iraldo (2009) however point out that mega sport events can be vehicles for socio-economic and environmental transformation. They argue that while mega sport events may have significant negative impact on the environment, they are also becoming catalysts for new environmental standards in the host cities and countries, and could leave many positive environmental legacies for the hosts if environmental considerations are properly integrated from the very beginning of the process. UNEP (2009) seems to concur with Frey and Iraldo by observing that mega sport events are catalysing change in a host city, giving the example of the Beijing 2008 Olympic Games that accelerated efforts to improve air quality in the city and provided new perspectives on environmental protection in China. The Beijing authorities had long-term plans to improve Beijing's air quality, but the Olympic Games in 2008 provided an impetus for accelerating measures to improve air quality. Examples of such aggressive measures included the rapid adoption of new Euro vehicle emission standards, improvement of fuel quality, the introduction of cleaner vehicle technologies and expansion of public transportation system as well as the closure of heavily polluting companies.

According to the Higgins and Lewis (2007), the organizers of the London 2012 Olympic Games were committed to creating venues, facilities and infrastructures that leave a lasting social, economic and environmental legacy for London and the UK, while minimizing any other adverse impacts during the design and construction of the Olympic Park, venues, infrastructure and housing. The ODA (2011) further argued that the concerted efforts of the London 2012 Olympic Games organisers could raise the bar for mega sports events and provide a challenging step change and a new environmental ethic for urban development in the UK.

Savery and Gilbert (2011) observe that traditionally, sport should be seen as the encouragement of human efforts in harmony with the natural environment since sport is developed in settings that take advantage of natural resources such as water, land and fresh air. Overtime, sport should emerge as an industry keen on ensuring effective environmental management, sustainable use of natural resources and sound socio-economic development.

While there is extensive literature and growing knowledge on the social and environmental impact of mass sport events, an increasingly important aspect of these events is the possibility that mega sport events could catalyse positive change among various industries that are directly or indirectly associated with them. Although sports events have a potential to transform societies and economies in unprecedented ways, there has not been enough attention from scholars to try and understand how this transformation might happen and what kind of promise might come with it. This study analysed the preparations for the London 2012 Olympic Games from a context of sustainable development and greening of sports. In particular, the study examined the preparatory arrangements of the delivery agencies, particularly the ODA, and determined the effectiveness of the greening of the London 2012 Olympic Games. Ultimately, the study aimed to promote the theory that events should be seen beyond the strict cost-benefit analysis that has characterized discourse around hosting mega sport events. The institutional, socio-economic and environmental package should be comprehensively examined when reviewing the benefits for hosting mega sport events.

This section presented the statement of the problem for the study. It highlighted some of the impacts that mega sport events have on the environment. The section also raised the question of whether sport is addressing issues of environmental justice and intra and inter-generational equity. The section highlighted ways in which sports can act as a vehicle for socio-economic and environmental transformation as well as a catalyst for accelerated efforts to handle complex issues in the host cities and countries. The section also raised the issue of the lack of sufficient attention to the transformative impact on the environment by sport events. The next section will look at the objectives of the study.

1.3 Research Questions

i. Are there alternative ways of reviewing the potentials for hosting mega sport events beyond the strict cost-benefit analysis?

ii. Which measures were implemented by the delivery agencies to ensure that the London 2012 Olympic Games leave a green legacy?

iii. How were measures for green building designed, executed, monitored and evaluated for success, including handling of challenges?

iv. To what extent did the measures by delivery agencies, particularly the ODA influence the greening of the building industry with respect to construction venues and facilities?

This section has outlined the research questions for the study. The next section will present the objectives of the study.

1.4 Objectives of the Study

1.4.1 Main Objective of the Study

The overall objective of the study was to determine the effectiveness of the greening of the London 2012 Olympic Games.

1.4.2 Objectives of the Study

The study sought to achieve the following specific objectives:

i. Determine whether the Games provided alternative perspectives for reviewing the potential of hosting mega sport events beyond the strict cost-benefit analysis;

ii. Identify measures implemented by the delivery agencies that ensured that the London 2012 Olympic Games leave a green legacy;

iii. Analyse how green building measures were designed, executed, monitored and evaluated for success, including handling of challenges;

iv. Analyse the extent to which the measures taken by delivery agencies influenced greening of the building industry with respect to construction of venues and facilities;

The section provided the main objective of the study as determining the effectiveness of the greening of the London 2012 Olympic Games. The section also outlined the specific objectives of the study. The next section will focus on the hypothesis of the study.

1.5 Hypothesis

This study used the argument that sport is becoming a major aspect of the sustainable development debate to advance its hypothesis. Chernushenko (2011) observes that although mega sports events have been associated with excessive resource use,

recently, there has been a variety of environmental, social and economic initiatives taking place at all levels of the sport industry, and in all sectors of sport. He further claims that the International Olympic Committee is taking the lead to shift awareness and behaviour among Olympic Games hosts and National Olympic Committees. On the basis of these observations and arguments, among others, the study applied the following hypothesis:

- Null Hypotheses (H_o): The measures instituted by the delivery agencies of the London 2012 Olympic Games did not result in effective greening of the mega sport facilities for sustainable development. .
- Alternate Hypotheses (H_1): The measures instituted by the delivery agencies of the London 2012 Olympic Games resulted in effective greening of the mega sport facilities for sustainable development.

This section highlighted the hypotheses of the study. It indicated that the null hypothesis for the study focused on whether the London did not result in effective greening of mega sport events. The next section will provide the justification of the study.

1.6 Justification of the Study

Frey and Iraldo (2009) argue that although it is widely accepted that mega-sports events may have a large impact on, and leave an important legacy to the host city and region, the Olympic Games have not been part of the sustainability debate so far. In addition, the contribution of the Games to long-term urban and regional development strategies clearly deserves more attention.

While the legacy of the Olympic Games is receiving some attention and several researchers have written about this issue, one area that has not received enough attention is the extent to which mega sport events influence industries that are directly or indirectly associated with the events. Another area that has also not received much attention is the influence of these events on environmental standards in the host city and country.

In addition, events can also be instrumental in promoting environmental awareness. Savery and Gilbert (2011) observe that sports present a unique opportunity to promote environmental awareness and action. People everywhere are passionate about one

form of sport or another. Sports could therefore be an important platform from which we can reach out to fans and the general public and communicate environmental messages and get people to adopt environmentally friendly behaviours.

This research intended to contribute to literature on these areas. It aimed to advocate additional ways of evaluating the impact of mega sport events beyond the strict cost-benefit analysis. It reviewed whether there are concrete benefits beyond the Games themselves and the legacy surrounding the venues and facilities that could increase the case for cities and countries to consider hosting mega sport events.

This section provided the justification of the study. It highlighted the fact that while there have been extensive studies on the impact and legacy of mega-sport events, the extent to which these events influence local industry and sustainable development as whole has not yet received as much coverage. The Section also highlighted the fact that this study aimed to advocate for additional ways of reviewing the impact of mega sport events beyond the purely cost-benefit analysis that has characterised discussions around mass sport events. The next section will provide information on the scope of the study.

1.7 Scope of the Study

This study focused on the integration of environmental considerations into the London 2012 Olympic Games and the extent to which this experience can influence sustainable development legacy of sports. In particular, it reviewed whether practices around the development of venues and facilities influenced the construction industry and whether the Games also influenced green building standards in the UK.

It focused on the stakeholders that were directly or indirectly involved with the siting, design, construction, operations of the venues and facilities for the London 2012 Olympic and Paralympic Games. Among stakeholders, the study particularly focused on the Organizing Committee of the London Olympic Games and Paralympic Games (LOCOG); the Olympic Delivery Authority (ODA) (that was responsible for the construction of venues and facilities for the Games); contractors who were involved in the development of facilities for the Games; and non-governmental organizations that were directly or indirectly associated with the preparations for the Games.

The study focused on the preparatory stage of the Games as this was when construction of venues and facilities took place and since the interactions (directly or indirectly) with

the building industry was during this period. It did not focus on activities during and after the Games, apart from the direct observation by the researcher.

This section briefly described the scope of the study. It mentioned that the study focused on stakeholders that were directly or indirectly involved in the sitting, the construction and operations of the venues and facilities for the London 2012 Olympic Games. The next section will define the operational terms used in this study.

1.8 Operational Definition of Terms

Delivery Agencies

The delivery agencies are the organizations that are charged with the responsibility of delivering the Games. In the case of London 2012, there were two key organizations: the Olympic Delivery Authority (ODA) – a public body that was responsible for developing and building the new venues and facilities for the Games; and the London Organizing Committee for the Olympic Games and the Paralympic Games (LOCOG) – that was responsible for preparing and staging the London 2012 Games.

Environmental Legacy

Environmental legacy can be described as the positive and negative environmental impacts, over varying timescales of an action, a process or an event such as the Olympic Games (UK Department for Communities and Local Government, 2009).

Environmental Standards

Environmental standards are a set of quality conditions that are adhered or maintained for a particular environmental component and function. The different environmental activities have different concerns and therefore different standards (Wikipedia, 2012). ISO 14001 is one of the most popular international environmental standards. It was first published in 1996 and specifies the requirements for environmental management system and applies to those environmental aspects which an organization has control and over which it can be expected to have an influence (ISO, 2007).

Environmental Sustainability

The maintenance of the factors and practices that contribute to the quality of environment on a long-term basis. An environmentally sustainable organization seeks to

participate within its community and seeks to balance economy, society and environment within its operations.

Greening

The process of transforming artefacts such as a space, a lifestyle or a brand image into a more environmentally friendly version. The act of greening involves incorporating "green" products and processes into one's environment, such as the home, work place, and general lifestyle.

Greening of Mega-Sport Venues and Facilities

A green or sustainable facility can be described as a structure designed, built, renovated, or operated in an ecologically and resource-efficient manner (Dick, 2007).

Mega-Sports/Mass Sports Events

Events are described as 'mega' by virtue of their size in terms of attendance, target market, level of public financial involvement, political effects, extent of TV coverage, construction of facilities and impact on economic and social fabric of the host community.

Olympic Games

A group of a modern international athletic competition that is held every four years in a different location, consisting of summer events such as track and field, swimming, and volleyball, and, in a different city and month, winter events such as skiing, ice skating, and ice hockey.

Paralympic Games

The Paralympic Games are a major international multi-sport competition for athletes with physical disabilities; the physical disabilities include mobility disabilities, amputation, blindness and celebral palsy. Like the Olympic Games, there are winter and Summer Paralympic Games, which are held immediately following their respective Olympic Games.

Sport

All forms of activities which, through casual or organized participation, aim at expressing or improving physical fitness and mental well-being, forming social relationships or

obtaining results in competition at all levels (European Sports Charter, 1992; Sport Council of Great Britain, 1993).

Sports Facilities

These are non-competition facilities constructed for sport events such as the Olympic Press and Broadcasting Centre at the London 2012 Olympic Games.

Sport Venues

Venues in which sport events take place like the Olympic Stadium, the Aquatics Centre, the Velodrome and the Handball and Basketball Arenas for the London 2012 Olympic Games, and football and basketball stadiums.

Sustainable Development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of needs and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs (United Nation, 1987).

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[1] "The components of the programme are sports, disciplines and events. Sports are those sports that are governed by the IFs (International Federations). A discipline is a branch of a sport comprising one or several events. An event is a competition in a sport or in one of its disciplines, resulting in a ranking and giving rise to the award of a medal or diploma" (Olympic Charter, 2011, page 80).

[2] In the history the Olympic Games, the Montreal 1976 Games are known as a financial disaster for Quebec. Quebec built and built for the Games and spent an enormous amount of US$2 billion from an originally stated US$ 124 million that the city quoted during the bid face. Quebec spent over 30 years repaying the debt from the 1976 Olympic Games (Rosenberg, 1992; Patel, Bosela and Delatte, 2011).

CHAPTER TWO

STUDY AREA

2.1 Introduction

This Chapter presents the focus area of the study. It presents the United Kingdom (host country of the London 2012 Games), and London (host city of the London 2012 Games). It briefly describes the various venues for the Games and then focuses on the Olympic Park, the main area of the study.

2.2 The United Kingdom (Host Country of the 2012 Olympic Games)

The United Kingdom is officially known as the United Kingdom of Great Britain and Northern Ireland and it is made up of:

- Great Britain – the formally separated realms of England and Scotland and the Principality of Wales;
- Northern Ireland;
- Many small islands including Archipelagos, Shetland, Herbridean, Anglesey, Scilly, Orkney and the Isles of Wight.

The UK is also responsible for several dependencies including the Crown dependencies and the British Overseas Territories.

It is an Island nation in Western Europe, just off the coast of France (see map of Europe below) (www.woodlands-junior. Kent.sch.uk, 2012, accessed on 10 September 2012).

Figure 1: Map of Europe

Source: http://www.google.com/maps/europe (accessed on 14 September 2012)

The UK lies between the North Atlantic Ocean and the North Sea and it is 35 km off the northwest coast of France. The only country that shares a boundary with the UK is the Republic of Ireland which is in the south of Northern Ireland. The total land area of the UK is 245,000 km2 (42 per cent of the size of Kenya – 580,367 km2). The total population of the UK is 62 million (exploredia.com, 2012, accessed on 6 September 2012).

The political system of the UK is a constitutional monarchy. The Monarch (currently the Queen) is the Head of State and the Prime Minister is the Head of Government. Executive power is exercised by her Majesty Government on behalf of and by consent of the Queen and by the devolved Governments of Scotland and Wales, and the Northern Ireland Executive. There are two chambers of Parliament – the House of Commons and the House of Lords – as well as the Scottish Parliament and the Wales and Northern Ireland Assembles. The Judiciary is independent with the Supreme Court of the United Kingdom as the highest court (www.everyculture.com/To-Z/United Kingdom, 2012, accessed on 10 September 2012).

Figure 2 Demographic and Geographic Map of the UK

Source: http://mapsof.net/map/map-united-kingdom#.UFjMLUVWhEI (accessed on 14 September 2012)

The main religion of the UK is Christianity which makes up over 80 per cent of the population. This is split between the Church of England and Catholicism. The Church of England was established in 1534 by King Henry VIII from the Catholic Church and remains the official Church of England. The Archbishop of Canterbury is the head of the Church of England which is considered the mother church of the worldwide Anglican Church. Other smaller religions include Islam, Hinduism, Sikhism and Judaism (http://uk.internationalstudent.com, 2012, accessed on 10 September 2012).

The main language of the UK is English which is spoken all over the country. However, there are several dialects of English in the UK, some of which are very difficult even for people in England to understand (Ibid). UK dialects include:

- Cockney – the most famous and spoken by people around London;
- Brummy – spoken by people from Birmingham;
- Mancunian – spoken by people from Manchester;
- West Country – spoken by people from Devon, Cornwall and Bristol area;
- Scouser – spoken by people from the Liverpool area;
- Geordie – spoken by people from Newcastle, Middleborough and Sunderland;
- Scottish – spoken by people from Scotland
- Welsh – spoken by people from Wales

The UK is a diverse and a multicultural society open to new religion and cultures. As people, the British are generally described as being very reserved, curt and polite. However, like language, cultural traits vary from region to region in the UK. London is considered the crossroad of British culture and because of its international nature, people in London can easily be described as easy going and tolerant (www.everyculture.com/To-Z/United-Kingdom, 2012, accessed on 10 September 2012).

The UK is one of the most industrialized countries of the world. Major products include machine tools, aircraft and ships, motor vehicles, electronics, chemicals, coal, petroleum, textile and food processing (www.everyculture.com/To-Z/United Kingdom, 2012). By the end of the 20th Century, 80 per cent of the land was reserved for agricultural use. Only one out of ten people in the UK live outside in towns and cities (www.woodlands-junior. Kent.sch.uk, 2012, accessed on 10 September 2012).

The section described the United Kingdom, the host country of the 2012 Olympic Games. It provided the geography of the UK as well as the political system of the UK – a constitutional monarchy – with the Queen as the Head of State and the Prime Minster as the Head of Government. It also described the religion, culture, and the language and dialects of the UK. The next section will describe London, the host city of the 2012 Olympic Games.

2.3 The City of London (Host City of the 2012 Olympic Games)

London is the capital of England and the United Kingdom. It is situated in the South East of the UK (see map of the UK below) and the London Metropolitan area has a population of between 12 and 14 million out of the total population of 62 million for the UK (exploredia.com, 2012, accessed on 6 September 2012).

Figure 3: Map of the UK

Source: http://www.travelodge.co.uk/search_and_book/ 27 August 2012

London is a leading global city with arts, commerce, education, entertainment, fashion, tourism and transport as its main activities. It is the world's leading financial centre alongside New York in the United States (Wikipedia, 2012). London is believed by some people to be the culture capital of the world and is renowned for its theatre quarter, and its theatre district has given the name "West End Theatre". London is the only metropolitan settlement in the UK (exploredia.com, 2012, accessed on 6 September 2012), has the fifth largest metropolitan gross domestic product (GDP) in the world. It is the largest metropolitan area in the European Union (Wikipedia 2012). London is a historic city and several globally renowned landmarks including four World Heritage Sites: the Tower of London; the Maritime Greenwich (in which the Royal Observatory marks the Prime Meridian, 0^0 Longitude and GMT); Palace of Westminster and Westminster Abbey including St. Margaret's Church; and, the Royal Botanical Gardens, Kew (the London Government, 2012). London is home to globally known cultural attractions such as the British Museum, the Tate Galleries, the National Gallery, the Nottinghill Carnival and the O^2 (www.wikipedia.com, 2012, accessed on 6 September 2012).

This section briefly described the City of London as the capital of England and the United Kingdom and its population. It also presented some of the features that make London historic and unique. The next section will briefly discuss the London 2012 Olympic Games and Paralympic Games.

2.4 The London 2012 Olympic Games and Paralympic Games

The 2012 Olympic Games and the 2012 Paralympic Games took place in London, United Kingdom from 27 July to 12 August and 29 August to 9 September 2012 respectively (International Olympic Committee, 2012). London was selected to host the 2012 Olympic Games on 6 July 2005 during the 117^{th} IOC Session in Singapore, defeating Moscow, New York, Madrid and Paris (International Olympic Committee, 2012b). London became the first city to officially host the modern Olympic Games three times, having previously hosted the Games in 1908 and in 1948 (Barden, 2008). London had seven years to prepare and organize memorable Games that will leave a sustainable legacy for the city and communities living around the main venues of the Games.

This section presented information on the selection of London as the host city for the 2012 Summer Olympic and Paralympic Games. It also provided information that London

is the only city to have hosted the modern Olympic Games three times. The next section will provide information the venues for the London 2012 Olympic Games.

2.5 Venues of the London 2012 Olympic Games

The 2012 Olympic and Paralympic Games used new venues, existing and historic facilities, as well as temporary facilities, some of them in well-known locations in London such as Hyde Park and Horse Guards Parade. After the Games, some of the new facilities are being maintained and used in their Olympic form, while others will be resized or relocated (ExCeL, 2005). Although the Games were awarded to London and while most of the events took place in London, a number of other locations in the UK also hosted events for the Games.

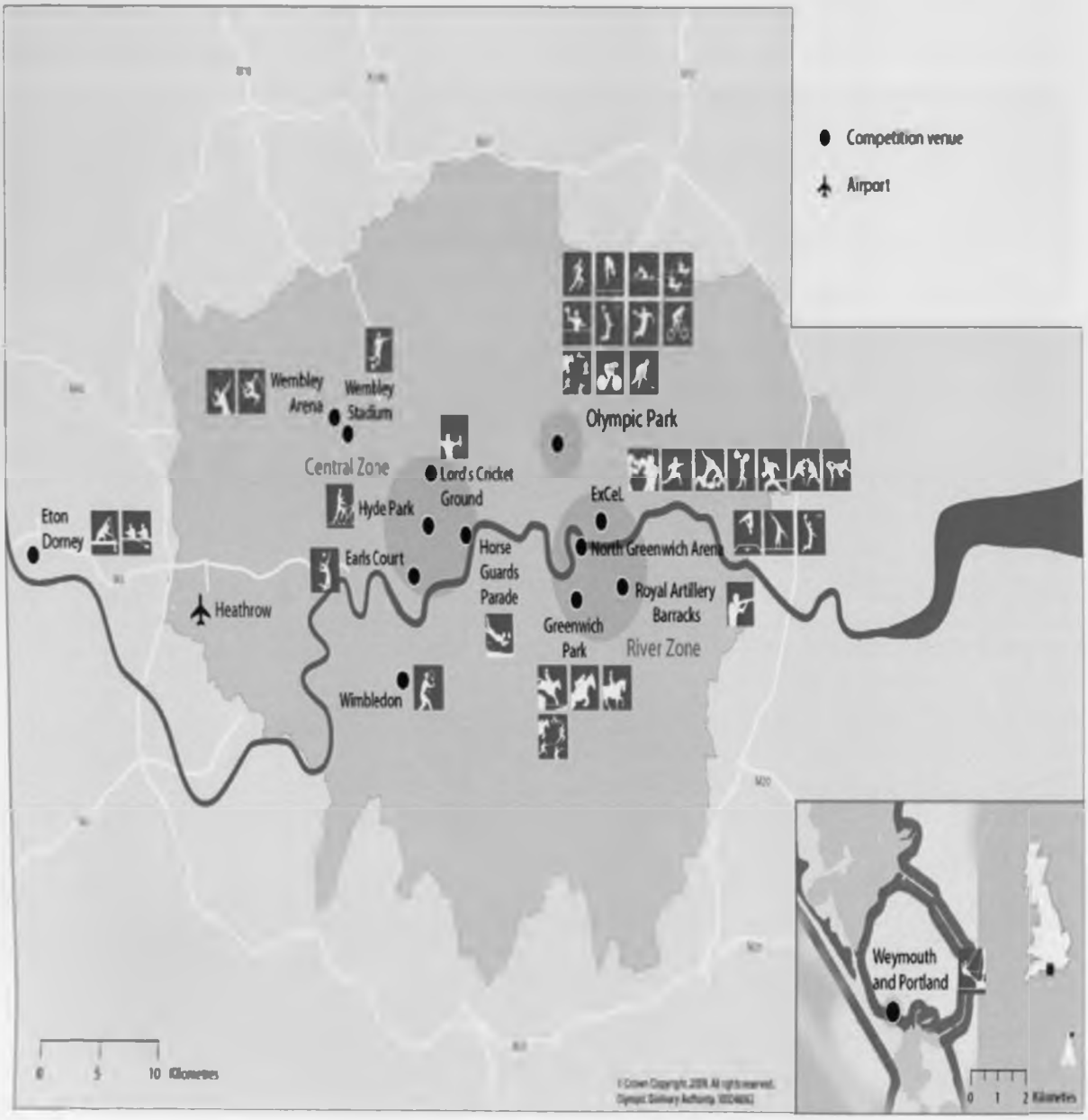
The majority of venues were divided into three zones within Greater London: the Olympic Zone, the River Zone and the Central Zone. In addition and as mentioned previously, there were venues that, by necessity, were outside the boundaries of Greater London, such as the Weymouth and Portland National Sailing Academy located on the Isle of Portland in Dorset some 125 miles (200 km) southwest of the Olympic Park, which hosted the sailing events. The football tournament was staged at several grounds around the UK (BBC, 3 December 2008).

This section briefly described the distribution of venues for the London 2012 Olympic Games in London. It established that although the majority of the venues were located in London, some venues by necessity were placed outside London. The next section will provide information on the venues in London.

2.5.1 Venues in London

London hosted several of the venues for the Games, most of which were located at the Olympic Zone or the Olympic Park in Stratford.

Figure 4: Map of London Venues



Source:http://geography.about.com/od/countryinformation/a/olympiccities.htm (accessed on 10 September 2012)

The venues in London were divided into three zones: the Olympic Zone; the River Zone and the Central Zone (London 2012, 2012). The next sections will provide information on the venues and events that took place in each of these venues:

2.5.1.1 The Olympic Zone (the Olympic Park) had the following venues:

The Olympic Stadium which was one of the iconic venues of the Games. It was used for the athletics events and the opening and closing ceremonies of the Games.

Figure 5: Olympic Stadium

Source: http://www.runnerslife.co.uk/latest-news/what-will-happen-to-the-london-olympic-stadium/1169 (Accessed on 11 September 2012)

The Aquatics Centre – a wave shaped venue for swimming disciplines (swimming, diving, and synchronised swimming and diving).

Figure 6: Aquatics Centre

Source: http://www.london2012.com/venue/aquatics-centre/visitor-information (Accessed on 11 September 2012).

The London Velopark – popularly known as the "Velodrome" – was one of the most environmentally-friendly venues of the London 2012 Olympic venues. It housed all the cycling events for the London 2012 Olympic Games.

Figure 7: Velodrome

Source: Author (10 August 2012)

The other venues at the Olympic Zone included the Olympic Hockey Centre (Riverside Arena) which hosted field hockey; the Basketball Arena, the venue for basketball events and the handball semi-finals; the Cooper Box (Handball Arena) the venue for handball preliminary events and the quarter-finals, and modern pentathlon shooting and fencing events; the Olympic Village where the athletes and team officials stayed during the Olympic and Paralympic Games and the Olympic Press and Broadcasting Centre, a non-competition venue which hosted the media for the Olympic and Paralympic Games.

2.5.1.2 The River Zone – located at the River Thames gateway area.

Venues included the ExCel Exhibition Centre which hosted boxing, fencing, judo, tennis, taekwondo, weightlifting, and wrestling events; the O^2 Arena (called the "North Greenwich Arena" during the Games), hosted artistic gymnastics, trampolining and basketball finals; the Greenwich Park which hosted the equestrian events, and; the Royal Artillery Barracks which hosted the shooting range events for the Games.

2.5.1.3 The Central Zone had the remaining Olympic Venues in Greater London.

The venues included the Wembley Stadium which hosted the football finals; the Wembley Arena which was the venue for badminton and rhythmic gymnastics events; the All England Tennis and Croquet Club which was the venue for tennis events; the Lord's Cricket Ground that hosted the Olympic archery events; Regent's Park which hosted the road cycling racing; the Horse Guard Parade which hosted volleyball events; Hyde Park which hosted triathlon events, and; Earls Court which was the venue for volleyball events.

These sections described the venues in London and the events that they hosted for the Olympic and Paralympic Games. The sections also provided maps of the locations of these venues in London and photos of some of the iconic venues. The next section will provide information on the venues that were located outside London.

2.5.2 Venues outside London

Football venues included Hampden Park in Glasgow, the Millennium Stadium in Cardiff, Old Trafford in Manchester, St. James' Park in Newcastle and Ricoh Arena in Coventry.

Other venues were the Lea Valley White in Hertfordshire which hosted the canoe/kayak slalom events; the Dorney Lake in Buckinghamshire which hosted rowing and canoe/kayak flatwater events; the Hadleigh Farm in Essex, venue for mountain biking, and; the Weymouth and Portland National Sailing Academy in Weymouth which hosted the Olympic sailing events. See map below on the venues outside London.

Figure 8: Map of Venues outside London

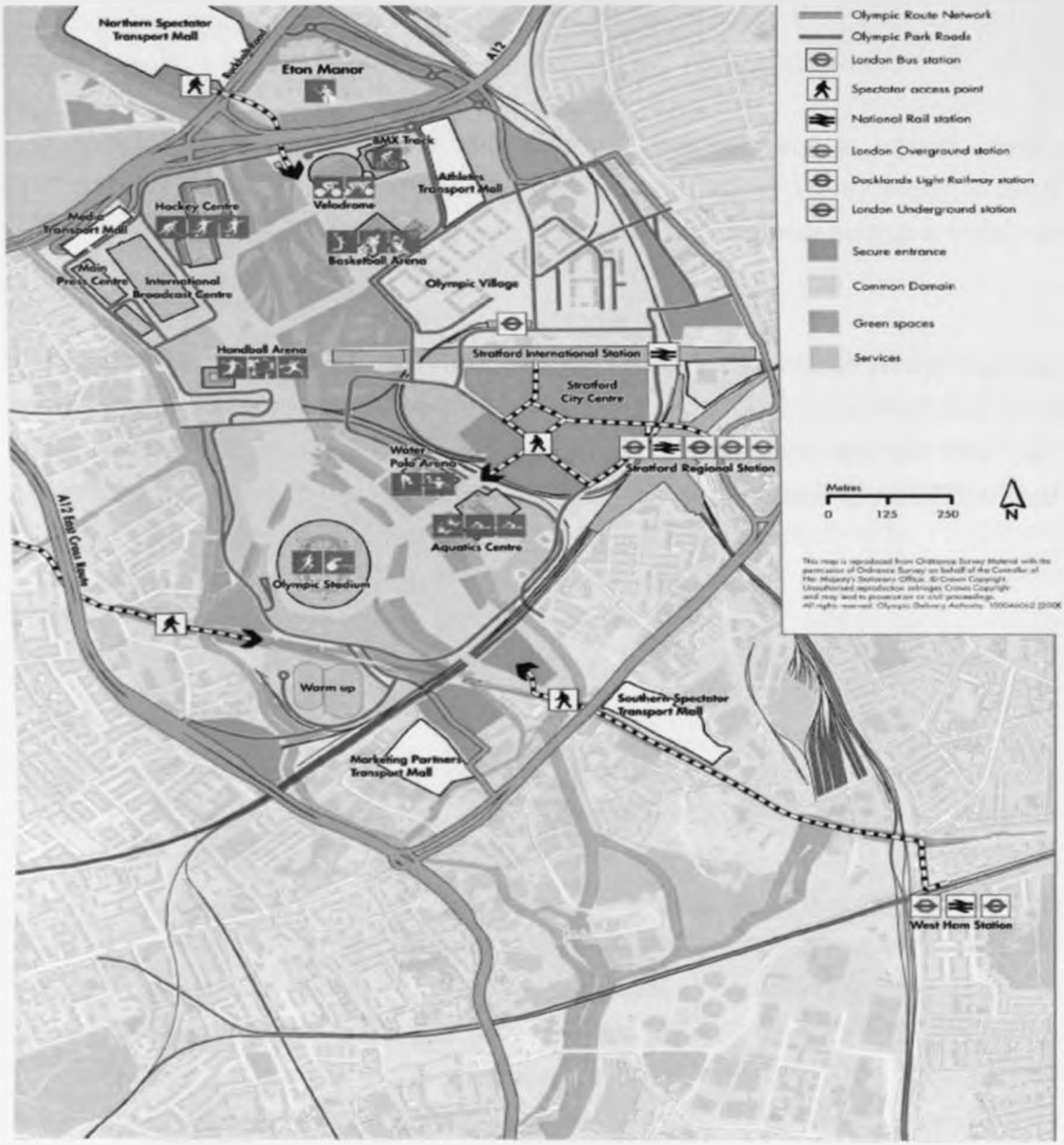
Source: http://0.tqn.com/d/golondon/1/0/o/r/-/-/uk-venues-map.jpg (9 September 2012)

This section provided information on the venues for the Olympic and Paralympic Games that were located outside London. The next section will briefly describe the London Olympic Park, the main focus area of the study.

2.6 The Olympic Park

The main area of focus for the study was the London 2012 Olympic Park where most of the construction of the new venues and facilities took place. The venues and their events have been described previously, however a map of the Olympic Park and the distribution of venues is shown in Figure 9.

Figure 9: Map of Olympic Park



Source: http://en.wikipedia.org/wiki/London (accessed on 27 August 2012)

According to Epstein (2011), London 2012 Olympic Games organisers adopted an approach that had been used by many previous host cities of Olympic Games – to use the Games as a catalyst for urban renewal and new development. The Games organizers focused on regenerating a highly depressed part of East London. While budgetary considerations for the Games have generated some criticism, the Games have also been welcomed by others as having prompted a redevelopment of many of the areas of London in which events are to be held (Politics.co.uk, 2011, accessed on 6 September 2012).

The study looked at the greening measures that were undertaken by the delivery agencies in the construction of venues and facilities to ensure that the London 2012 Games leave a sustainable legacy.

This section briefly described the Olympic Park – the main area of focus of the study. It provided information on the state of the site before the Olympic project and highlighted the fact that the Olympic Games were used to rehabilitate this highly depressed and contaminated part of East London.

CHAPTER THREE

LITERATURE REVIEW

This chapter reviews empirical and theoretical literature pertinent to the study. The theoretical literature covers the Theory of Sustainability, Social Capital Theory and the Theory of Reasoned Action (TRA). The Empirical literature entails the history and legacy of the Olympic Games, sports and sustainable development, the impact of mega-sport events, greening of sports and its influence on environmental standards of industries associated with sports. The chapter also presents a critique of the reviewed literature and the conceptual framework.

3.1 Theoretical Framework

3.1.1 Theory of Sustainability

The theory of sustainability attempts to align social responses to environmental and cultural problems (Barry, 1997). Sustainability is the ability to ensure that some outcome or process is maintained over time, for example, forest management might be deemed sustainable, if the use of the forest does not exhaust the forest resources (Norton, 2005). The use of the term "sustainability" also refers to social conditions; for instance, a peace treaty that ensures the long term support of a political community (Solow, 1993). In its increasingly common use, the concept of sustainability relates the ways in which environmental issues affect economic, social and ecological systems today and in the future (Ibid,).

The challenge of sustainability raises a set of basic issues. By focusing on the interdependence between ecological, economic and social systems, it presents the mutual effects between human-induced environmental degradation and the perils to human systems presented by environmental problems (Agyeman, 2005). The concept thus raises a fundamental question: can human activities be maintained without depleting the resources on which they depends? Asking this question brings to focus the impact of human activities on the planet and calls for a reflection on the manner in which human beings interact with nature. Problems such as climate change, deforestation, biodiversity loss, water and air pollution point to the scale of the risks associated with human activities (Plumwood, 2002). Mitigating these impacts and risks would require transformation in political, financial, production and consumption,

energy, transportation, and even communication and educational systems as well as in human behaviour (Ibid).

Sustainability therefore draws attention to the complex interconnections between human and ecological systems. Economic health, ecological integrity and intra and inter-generational equity must be central in our efforts to ensure global sustainability (Robinson, 2004). This study achieved its objectives within the confines of the Theory of Sustainability. The study looked into the effectiveness of green construction of sport venues and facilities as a means of enhancing environmental sustainability. To this effect, the study focused on construction of green venues and facilities for the London 2012 Olympic Games.

3.1.1.1 Critique of the Theory of Sustainability

Sustainability directs attention to the complex connections between human and ecological systems at all levels. The theory advocates for the integration of economic health, ecological integrity, social justice, and responsibility to the future be in efforts to address global problems. That inclusive scope and vision makes sustainability ideologically absorptive and politically popular. Sustainability is ironically used to argue for and against climate treaties, in favour and against free markets and for and environmental conservation (Rolston, 1994). The literature reviewed revealed that sustainability aligns and integrate social responses to environmental and cultural problems (Barry, 1997), ensure that an entity, outcome, or process is maintained over time (Norton, 2005), ensures the support of a political community (Solow, 1993), and relates the ways in which environmental issues affect economic, social and ecological systems today and in the future (Solow, 1993).

Any appeal to sustainability proposes to somehow integrate responses to social and ecological problems, taking account of feedback between human and ecological systems and assuming that there are limiting conditions to those systems. By integrating ecological systems into social and economic systems, the concepts of sustainability mitigate perceived tensions between human and environmental goals. However, Zundeau (2005) questions the extent to which, and in particular below which spatial level, non-sustainability are justified in terms of the sustainable development of a larger territory. It is therefore not always easy to integrate national or continental strategies for sustainable development in urban strategies. Zundeau (2005) further notes that

sustainability on a local scale sometimes leads to social conflicts, in form of for example, "not in my backyard actions".

Sustainability includes also social justice, which is very important on a local and global scale. However, Foster (2002) posit that sustainable development is set in the existing economic system, that encourages competition, also between cities and regions and makes it difficult for those cities and regions to focus on social and environmental issues. This is in conflict with the concept of sustainable development because it leads to inequality between different regions and also in a city. The problems with the concept of sustainable development in projects such as an urban planning or transportation planning project is that it creates conflicts between different groups of the society -those who are for and those who are against the project. But those conflicts are often invisible in the discourse of sustainable development plan (Baeten 2000).

According to Swyngedouw (2003), it is difficult to define sustainability or unsustainability. Different scholars have different meanings or perspectives of what sustainability or unsustainable development is. Swyngedouw (2003) further argues that nature and urban nature or landscape and the environment is imaginary. It is people's interpretations of what nature is and therefore also what kind of nature needs to be protected. It is therefore difficult to reach a common understanding of what sustainability is.

The broad nature of the term sustainable development and sustainability can be used in order to find practical solutions for various situations. One can redefine the term in order to strengthen ecological and social development in a certain region or city (Bell & Morse, 2006). The scope and definitions can also be modified when dealing with sustainable development and urban sustainability in order to focus on the most important aspects of practical work in urban planning and contribute to a more just and ecological sustainable city (Gibbs, 2000).

This section presented the Theory of Sustainability. It defined sustainability and argued that economic health, ecological integrity, social justice, and responsibility to future generations must be integrated in addressing global problems. The section also looked at some of the challenges of sustainability. It has also looked at critique to the theory of sustainability. It has presented literature that point to the fact that different scholars have different perspectives of sustainability and that the sustainability is ironically used

for and against environmental conservation by proponents of different schools of thoughts. The next section will discuss the Social Capital Theory.

3.1.2 Social Capital Theory

One of the key social theories related to this study is the Social Capital Theory. The Social Capital Theory has important theoretical implications as the study rests on social cohesion and common resources of various stakeholders in the preparation of the London 2012 Olympic Games and greening of the construction of sports venues and facilities. Vygotsky (cited in Nesbakken, 2003) writes that the social context that includes local social-economic conditions, ways of life, common cultural patterns and common shared resources have a profound influence on development and the environment. Social capital is the fabric of a community as well as the available pool of human resources calculated in terms of personal connections, social networks and the norms of reciprocity and trustworthiness that arise from them (Putnam, 2000).

Social capital also refers to the time and energy that the individual and community devote to things such as community improvement, civic engagement and responsibility, recreation, and other activities that create social bonds and cooperation between individuals and groups for individual and group outputs (Banik, 2006). In this study, the individual and communal time and energy are geared towards environmental improvement through the greening of sports venues and facilities for the London 2012 Olympic Games.

Moletsane, Morrell, Unterhalter and Epstein (2004) view social capital as the resource that social actors have because of their affiliation to an association with various groups and is key to enabling their full potential and participation in society. Environmental conservation is associated to the level of social capital channelled towards conservation effort. This means that the success of the greening initiatives for the London 2012 Olympic Games depended on the extent to which the initiatives were supported by the collective participation of all stakeholders in the process. This study considered the roles of the London 2012 Organizing Committee for the Olympic Games and Paralympic Games (LOCOG), the Olympic Delivery Authority (ODA), the local and central governments, companies that were involved in the constructions of Olympic venues and facilities, non-governmental organizations that were directly or indirectly associated with the preparations of the London 2012 Olympic Games in facilitating environmental

sustainability through their greening efforts. Hence, the social capital theory was also a good basis on which to set the study.

3.1.2.1 Critique of Social Capital Theory

A sizable body of research suggests that social capital plays an important role in innovation through features such as learning and communicating, and developing relations based on trust (for example Maskall, 2000; Landry, Amara & Lamari, 2002; Molina et. al., 2008). Social capital helps companies to improve their innovative capability and to conduct business transactions without much fuss and has implications for economic performance (Maskell, 2000). Westlund and Nilsson (2005) argue that there are indications linking an enterprise's investment in social capital and its growth.

However, a number of weaknesses have been identified in different aspects of the social capital theory. Arrow (1999) argues that the word "capital" implies three elements: extension in time; an intended sacrifice for deferred benefit; alienability but that the concept lacks any of the three elements required to be a genuine example of capital (Arrow 1999). Maraffi (1994) points to the difficulty of defining and mapping social capital's network as another problem with the concept. Neither social capital nor its effects can be accurately measured in comparable ways(Morlino, 1995). Foley and Edwards (1999) observe that attempts to quantify attitudes, norms, and social traits at a national level yield no information as to which groups possess usable social capital. Durlauf (2002) argues that the use of observational data to identify substantive forms of social capital is unlikely to be successful. Attempting to develop a unit of analysis small enough to capture the effects of social capital in facilitating the dissemination of resources to groups or individuals, has limited data collection to a reliance on methods such as questionnaires and difficult to make the distinctions between outcomes of social capital with forms or indicators of its presence (Ibid).

This section presented the links between the social capital theory and the greening of the London 2012 Olympic Games. It argued that social capital was a resource for the London 2012 Olympic Games as the many stakeholders fully participated in the greening of the Games because of their affiliation to an association with the success of the greening of the Games. The section also provided a critique of the social capital theory. It cited literature that indicate the lack of any genuine element of capital in the theory. The section also cited the difficulties with measuring with certainty the effects of social capital. The next section looks at the Theory of Reasoned Action.

3.1.3 Theory of Reasoned Action (TRA)

The greening of construction of sport facilities for the London 2012 Olympic Games can be looked at in terms of behaviour change towards environmental conservation initiatives. To this effect, the study is informed by the Theory of Reasoned Action (TRA). The Theory of Reasoned Action (TRA) explains and predicts a variety of human behaviours (Fishbein & Ajzen, 1980). TRA is based on the premise that humans are rational and can modify their behaviours to attain certain greater objectives and links individual beliefs, attitudes, intentions, and behaviour (Fishbein, Middlestadt and Hitchcock, 1994). The variables of the theory, as described by Fishbein *et al.,* (1994), are: behaviour (which is action, target, context, and time), intention (which is considered as the most immediate predictor of behaviour (Langridge, Sheeran & Connolly, 2007) and refers to the intent to perform a behaviour), attitude (a person's overall feelings toward performing a behaviour) and norms (which is a person's perception of other people and society's opinions regarding the defined behaviour), (Fishbein et al., 1994).

The TRA provides a framework for connecting the above variables together. The behavioural and normative beliefs influence individual attitudes and subjective norms. In turn, a person's attitudes and norms shape his or her intention to form behaviour. Finally, as Fishbein *et al.,* (1994) argue that a person's intention remains the best indicator that the person will behave in a desired way. Overall, the TRA model supports a linear process in which changes in an individual's behavioural and normative beliefs will ultimately affect the individual's actual behaviour. In line with TRA, sport has proven to be an important vehicle for securing positive behaviour especially for children and youths (Kruse, 2006). Kruse (2006) further argues that the critical variable in behaviour change among people involved in sport for change programmes is quality in programme materials and how the whole programme is implemented. Delva and Tammerman (2006) state that for any sport for change programme to be effective, it has to be driven at three levels - the intervention; the targeted behaviour, and; the behavioural change in itself.

3.1.4 Critique Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) emphasized the modification of human behaviours to attain certain greater objectives and links individual beliefs, attitudes, intentions, and behaviour (Fishbein *et al.,* 1994). The TRA posit behavioural and normative beliefs influence individual attitudes and subjective norms. In turn, a person's attitudes and norms shape his or her intention to form behaviour. Delva and Tammerman (2006) and Kruse (2006) argue that TRA is applicable in sport through the promotion of positive behaviour. However, TRA has limitations such as the inability of the theory to consider the role of structural issues due to its individualistic approach, and the linearity of the theory components (Kippax& Crawford, 1993). Individuals may first change their behaviour and then their beliefs and attitudes about things. For example, people may change their attitudes about the importance of environmental conservation through sports by being accustomed to the green constructions associated with sport events.

This section argued that the greening of construction of sport venues and facilities for the London 2012 Olympic Games can be looked at in terms of behaviour change towards environmental conservation. It described the Theory of Reasoned Action (TRA) as what links individual beliefs, attitudes, intention and behaviours. It also argued that in line with TRA, sport can be a powerful tool for securing positive behavioural change in society. The section also provided a critique of literature on TNA. It argued that one of the limitations of the theory is its inability to consider the role of structural issues due to its individualistic approach. The next section focuses on the history and legacy of the Olympic Games.

3.2 The History and Legacy of the Olympic Games

According to Sweet (1987), the origin of the Olympic Games can be traced to 776 B.C. when they were first held in Olympia. Up to 724 B.C., the Games had only one event and lasted for one day, but more athletic activities were added in subsequent editions until 472 B.C. when the Games finally had a complete schedule with all the known ancient athletics events and lasted for five days (Paleologos, 1976; Athens 2004 Olympic Organizing Committee, 2004).

The Games lost their importance when the Romans conquered, and introduced Christianity in Greece (Guttmann, 1992) In 1894 Baron Pierre de Coubertin, inspired by

the Wenlock Olympic Society's games, conceived the modern Olympic Games that have taken place every four years since 1896 (Buchanon and Mallon, 2006).

Vigor, Mean and Charlie (2004), point out that over the 108 years and twenty-eight Summer Games since 1896, the Olympics has evolved considerably. From 241 participants representing 14 nations in 1896, the Games have grown to about 10,500 competitors from 204 countries at the 2008 Summer Olympics (International Olympic Committee, 2009a). The Olympic Games is currently one of the only Fora that can claim universal representation as the IOC allows the formation of National Olympic Committees representing countries that do not meet the strict requirements for political sovereignty that other international organizations demand (International Olympic Committee, 2007). Colonies and dependencies are allowed to compete at Olympic Games and examples of these include territories such as Puerto Rico, Bermuda and Hong Kong, all of which compete as separate nations despite being legally a part of other countries (Ibid).

According to the Olympic Charter (2011), the Olympic Movement encourages and supports a responsible attention to environmental issues and promotes sustainable development through sport, particularly through the Olympic Games. Henson (2011) observes that in line with the above, the IOC publicly declared the environment as an important aspect of the Olympic Games, established a Commission to deal with matters of Sport and Environment and formally signed an agreement of cooperation with the United Nations Environment Programme (UNEP).

The International Olympic Committee (2012), observes that environmental issues first surfaced in the Olympic Games during the planning and construction for the Olympic Winter Games in Lillehammer, Norway in 1994. The local community and other stakeholders pressurized the organizers to take into account of environmental issues, including the integration of efforts to curb deforestation and air pollution and the creation of a bird sanctuary. The Lillehammer organizers developed a collaborative action plan that transformed the 1994 Games into an environmental showcase, with venues built, mainly with local materials, the redesign of ski-runs to avoid impacting on virgin forests and the use of millions of recyclable plates and utensils by spectators and guests. The 1994 Games marked the beginning of the integration of environmental considerations in the Olympic Games and other mass spectator sports (IOC, 2012).

The Sydney 2000 Summer Games, held six years after the Lillehammer Winter Games, were acclaimed as an extremely successful "green games" (Roper, 2006). The Sydney Games were the first to be audited throughout by the environmental watchdog Greenpeace who issued detailed and fairly positive reports (the London Assembly, 2007). The core of the Sydney environment programme was the remediation of the main Olympic site at Homebush Bay. The Homebush Bay – a location for abattoirs, factories and an industrial dump for more than 100 years – was transformed by the development of 450 ha Millennium Parklands, including a 50 ha aboriginal forest and 40 kms of pedestrian and cycle trails, surrounding the Olympic venues. The Olympic Village became a suburb, housing more than 5,000 people, complete with a retail centre including a supermarket, service station and a range of shops, which, during the Games had been used for retail, administration, entertainment and athlete services (the International Olympic Committee, 2012).

The London Assembly (2007) observes that the organizers of the 2004 Games in Athens sought to utilise the Games to achieve several goals. First, to tackle the infrastructure and transport systems in particular as well as environmental pollution that required urgent attention; second, to enhance its share of tourism which had dropped from 40 per cent of arrivals in Greece in 1980 to 16 per cent in the mid-1990s; third, to increase the availability of industrial and commercial space, releasing an additional 1.1 million square feet of space for use by the Games; fourth, to use the opportunity to create significant numbers of new permanent and temporary jobs, and; finally, to re-brand the city as a European city of commerce and tourism, and an important location for economic activities in the eastern Mediterranean.

According to Epstein (2011), many hosts of Olympic and Paralympic Games have sought to use the Games as a catalyst for urban renewal and new development. London 2012 Olympic Games adopted a similar approach, seeking to use the Games to catalyse the regeneration of a highly depressed area in East London. Newlands (2011) observes that London emulated Sydney in its bid for the 2012 Olympic Games by making sustainability central to its bid and the development plans for London have strong similarities with Sydney's. The ground was contaminated from years of neglect and pollution. The LDA used over 364 million UK pounds for to carry out environmental remediation on what was one of Europe's most heavily polluted sites (Ibid). Epstein (2011) further observes that the London organizers focused not just on regeneration but also on making the Games truly green. Creating the Olympic Park in the Lower Lea Valley, a core target

growth area for London, effectively accelerated plans for regenerations by 20 years or more. For seven years before and for many years afterwards, London would have changed. The Olympic Games have an enormous impact on people, industry and the planet (LOCOG, 2011).

This section presented relevant literature on the history and legacy of the Olympic Games. It demonstrated how the Games evolved from a single competition (event) in ancient Greece into one of the biggest and most popular sporting event of modern times. The section also provided the history of the greening of the Olympic Games from Lillehammer, Sydney, Torino, Beijing and Vancouver to London. The next section will review Literature on Sport and Sustainable Development.

3.3 Sports and Sustainable Development

Chernushenko (2002) contends that sustainable sport makes all sides winners, and that sport can be popular, profitable and at the same time socially and environmentally responsible. This is possible if the organization of sport adheres to principles such as engaging communities, governmental and non-governmental institutions and people, embracing the economic, social and environmental needs of society and introducing appropriate tools to assist with the planning and efficient use of materials and technologies.

Sport provides a unique opportunity for linking sustainability to fun. On the other hand, the sustainability agenda also provides sports with a new focus in its relations with society (Stubbs, 2011). Stakeholders are increasingly realizing that sport has the potential of becoming an important driver for sustainable development and can promote lasting change in a host city, host nation and around the world (Savery, 2011).

According to the United Nations (2003), sport directly contributes to efforts to achieve the Millennium Development Goals (MDGs), particularly targets such as education, gender equality, HIV/AIDS and the reduction of major diseases. According to Donnelly, Darnell, Wells and Coakley (2007), there is significant evidence that sport facilitates the development of children and youths. They further state that sport and other sport related initiatives increase social inclusion and contribute to community-building in many social contexts, such as post-conflict and poverty affected areas in least developed countries.

The Sports Coaches Outreach (SCORE), a South African NGO is using sports to achieve social transformation and economic and social empowerment in different communities (SCORE, 2008). SCORE feels that community sports can make a difference by changing the behaviours of children and youth and promoting the adoption of healthy lifestyle alternatives and open-mindedness towards people living with HIV/AIDS. Elimu, Michezo na Mazoezi[iii] (EMIMA) in Tanzania is another organization which uses sport to facilitate development programmes in some slums of Dar es Salaam. The organization disseminates HIV/AIDS information through the use of sport, movement games, play and traditional dances (EMIMA, 2008).

In Kenya, the Mathare Youth and Sports Association (MYSA) is using sport and physical activity, especially football to attract young people to its programme and in turn, the young people are taught to care for the environment. Under the MYSA project, young people and their teams (mainly football teams) are encouraged to voluntarily clean up their community. They remove waste from their community and unblock open sewers to reduce diseases (MYSA, 2008).

In Lebanon, sport is being used to rescue children from anxiety and depression as a result of the civil war. Studies have shown that children and young people who experienced the Lebanese civil war in the 1980s still suffer from anxiety and depression today (Swiss Academy for Development, 2008). As a result, there is a great need for interventions that alleviate stress and trauma, risks of disorientation and substance abuse. A meaningful and comprehensive programme that uses sport and games to support psychosocial rehabilitation among children and youth has been developed (Ibid).

Similarly mega sport event organizers are also integrate the concepts of environmental sustainability in sport. For example, the Republic of Korea strove to make the 2002 FIFA World Cup a more environmentally sustainable event through measures such as the construction of "eco" stadiums, energy and water conservation efforts, water quality improvements, waste reduction initiatives, the planting of 10 million trees, and the creation of several new urban parks. Both the Seoul Stadium and the World Cup Ecological Park were constructed on a former landfill site, and the methane gas from the landfill was recycled to provide renewable energy (Roper, 2006).

This section attempted to build a case for sport and sustainable development as well as on sports as a viable tool for promoting efforts to achieve the UN Millennium

Development Goals (MDGs). It provided examples of organisations and programmes where sports is being used address challenges such as HIV/AIDS in communities around the world. The next section reviews the impact of mega-sport events on the environment.

3.3.1 The Impact of Mega Sport Events

According to Guala (2002), over the past few decades, the Olympic Games have experienced unparalleled growth and universal popularity. The Games are the largest and most successful sporting event in modern society with a rapidly increasing participation and global interest.

Henson (2011) observes that mega sport events like Olympic Games and the FIFA World Cup will continue to have significant increase in consumption of natural resources. She further argues that due to extensive resource consumption, a single mega sport event must be considered an anomaly in terms of the regeneration and resource consumption and the requirement for a different, but complimentary, sustainable approach than typically long-term regeneration projects. Essex and Chalkley (2004), points out that the Olympic Games have gradually emerged, especially since the 1960s, as strong catalysts for urban regeneration. The Games not only entail the building of new facilities, but wider investments in tourism, transport infrastructure (including public services) hotel accommodation, as well as environmental improvement and sustainability.

Dodouras and James (2004) observe that, as far as mega sports events are concerned, it has been accepted that, apart from the aim of playfulness and joyousness, the development policies that come with such event should not only pursue socio-economic objectives but also strive to attain environmental stability. When a city is nominated to host a mega sports event, this generates endless debates about the types of impact that the mega event would bring. Mega sport events can have wide-ranging economic, political, commercial, physical, socio-cultural, and psychological effects. They are being viewed by hosts and potential hosts as an integral part of their economic development and marketing plans. A vital challenge for any mega sport event is to build quickly and confidently upon the host region's economy while maintaining a sound environmental balance. A targeted and well-managed economic, environmental and social programme linked to mega sporting events and multi-cultural investment could bring a host city and its greater region a handsome dividend in the future.

Essex and Chalkley (2004) note that mega events have always had implications for the host centre's urban infrastructure by providing opportunities for new investment and tourism. These impacts are becoming more significant as the scale and profile of these events grow. Wider changes in the global economy have increased the role of mega events as catalysts of sustainable urban transformation. UNEP (2009), points out how mega sport events can catalyse change in a host city and country and uses the example of Beijing where the 2008 Olympic Games prompted the acceleration of efforts to improve air quality and provide new perspectives on environmental protection. UNEP (2009) further states that the Beijing authorities had long-term plans to improve air quality, but the Games gave added impetus for aggressive implementation of measures to revamp public transport, limit vehicles emissions and introduce renewable energy.

This section reviewed the footprint of mega sport events such as the Olympic Games and the FIFA World Cup. Through literature, it argued that while mega sport events have a significant impact on the environment, these events are also becoming catalysts for positive change. The next section will expand on this thought by reviewing literature on how current sport events are influencing environmental standards in the sports industry.

3.3.2 Influencing Environmental Standards in the Sports Industry

Since the times of the industrial revolution in the 1700s, human impact on the environment has continued to raise serious concerns. Environmental challenges on our planet have increased dramatically in recent decades and are now among the most serious challenges affecting humanity (The World Bank Group, 2008). Besides climate change, other environmental problems are becoming more serious, from local air and water pollution to soil erosion, water scarcity, deforestation, and loss of biodiversity. Addressing environmental degradation, confronting poverty and ensuring environmental sustainability are inextricably linked to efforts aimed at reducing human suffering and improving people's wellbeing and both the public and private sectors including organizers of mass spectator events have critical roles to play and must act together to address these challenges. (The World Bank Group, 2008).

Rydin, Seymour and Lorimer (2011) state that some evaluation on the impact of mega sport events on the environment have been done using ecological footprint[iv] and carbon footprint[v] analysis. . Collins, Flynn et al. (2007) cited in Rydin, Seymour and Lorimer, 2011) observe that an example of an event in the UK where ecological footprint

evaluation has been undertaken was the 2004 Football Association Cup Final at the Millennium Stadium in Cardiff. Studies on carbon footprint have been done on the 2006 and 2010 FIFA World Cups in Germany and South Africa (Econ Pöyry AB 2009; Dolles and Soderman 2010, cited in Rydin *et al.,* 2011). The London 2012 Olympic Games went a step further by undertaking an assessment of both their ecological and carbon footprints (Centre for Sustainable Energy 2010; LOCOG 2010, Rydin et al., 2011).

Dolf (2011) observe that the need for guidelines, standards and tools for sports administrators and event managers is increasingly necessary. As sport provides a platform for the entire global population, it presents the best vehicle to influence environmental sustainability, therefore using and recreating tools and standards on sustainability through sport will lead to wide application of environmentally, socially and economically sustainable practices.

This section reviewed literature on the influence that sport is having on environmental standards. It provided information on some of the efforts that organizers of sport events are making to address various environmental challenges. The next section will review literature on the greening of sports.

3.4 Greening of Sports

According to Roper (2006), the key principles of "greening" major events that should be considered for incorporation by host organizations include environmental best practices such as technologies and behavioural practices that minimize waste, energy usage, and air and water pollution, as well as processes that utilize resources sustainably and conserve biological diversity. Other elements to take into account include the promotion of public awareness on environmental issues, community involvement in decision-making, job creation, urban economic growth, institution of monitoring, evaluation and reporting processes to assess the effectiveness of greening activities before, during, and after the major event; and ensuring a positive legacy. The greening of sports can be achieved through energy efficiency, water management, waste management, transport management, green procurement and behaviour change. These elements are discussed below.

This section has provided information on the various aspects that should be incorporated in the greening of mass-sport events. These aspects are described in the subsequent sections starting with energy efficiency.

3.4.1 Energy efficiency

Energy plays an important role in development and access to sustainable energy could contribute to the eradication of poverty, help provide for basic human needs, improve health and save lives (UN, 2012). However, the current highly carbon-intensive energy system depends on a finite supply of fossil fuels that are getting harder and more expensive to extract leading to concerns about energy security in many countries (Ibid). The challenges include the need to provide clean and efficient energy services to over 2.5 billion people who do not have ready access to energy. The current energy situation is not sustainable in economic, social, and environmental terms and exposes many countries to fluctuations in oil prices as well as costs billions in public subsidies (UNEP, 2011).

Greening the energy sector will require improvements in energy efficiency and a much higher supply of renewable energy both of which will lead to reducing greenhouse gas emissions (GHG) and pollution. Global demand for energy is still likely to grow to meet development needs, in line with growing populations and income levels. Greening the sector therefore aims to end "energy poverty" for the estimated 1.4 billion people who currently lack access to electricity and derive healthier and sustainable energy for the estimated 2.7 billion people who are depend on traditional biomass for cooking (IEA, 2010). Modern renewables offer considerable potential for enhancing energy security at the global, national and local levels. However, enabling policies are required to ensure that investments for greening the energy sector are made (UNEP, 2011). According to Chernushenko (2002), the cost of energy is rising everywhere and as many environmental problems are energy-related, there is a power motivation for conserving energy. The IEA (2010) argues that improvement in energy efficiency has net economic benefits in most instances.

The buildings sector is the single largest contributor to global greenhouse gas emissions (GHG), with approximately one-third of global energy end use taking place within buildings (UNEP 2011). Constructing new green buildings and retrofitting existing energy-and resource intensive buildings stock for mega-sports events can achieve significant savings. There are significant opportunities for improving energy-efficiency in buildings, and the sector has one of the greatest potential to reduce global GHG emissions. Improving energy efficiency, increasing the share of renewable energy and cleaner and efficient technologies are crucial for sustainable development and for addressing climate change (UN, 2012). Emission reductions through increased energy

efficiency in buildings can be achieved at an average abatement cost of US$ 35 per tonne, reflecting energy cost savings, compared to US$ 10 per tonne costs in the transport sector or positive abatement costs on the power sector of US$ 20 per tonne (UNEP, 2011).

Unfortunately, building regulations still set unambitious energy efficiency levels which only apply to some buildings and ignore many other factors that influence energy use. The building industry is notoriously conservative, and with a few exceptions does only the minimum required by the law (Mean & Tims, 2004). The use of Voluntary Initiatives (VIs) as a tool for self-regulation and improved environmental performance, is only starting to take root in the building industry. There are still plenty of opportunities to save ten to thirty per cent of energy with no additional cost or even saving money, simply through a bit more care and attention in the design and construction process (Ibid)

Building of sporting venues is also a major source of energy consumption and greenhouse gas emissions, in their construction, operation and decommissioning during the after the event (Mean & Tims, 2004). Chernushenko (2002) states that methods for minimising energy use and climate change from buildings include:

- Building structures that will keep unnecessary lights and equipment shut down during summer to reduce heat. Designing and locating the building in a way that will ensure comfort under the widest range of possible weather and other use conditions with the least use of building and services such as mechanical heating/cooling air conditioning, lift, artificial lighting. Buildings where the electric requirements of the buildings and their occupants are also met by solar power (Mean & Tims, 2004; UNEP, 2011);

- During the hot season, leave shades and blinds open on sunny days, but close them at night to reduce the amount of heat lost through windows. Close shades and blinds during the summer or when the air conditioner is in use or will be in use later in the day (NDRC, 2004).

- Reusing and adapting existing building in preference to replacing with new build where possible (Mean & Tims, 2004).

- Salvaging, reusing and recycling reclaimed materials (Kralj & Markic, 2008).

- Move from electricity or oil to natural gas and more efficient alternative including solar photovoltaic or wind turbines on buildings or the site of the building where applicable(Chernushenko, 2002; Ashden, 2012).

- Designing to facilitate eventual separation, reclamation and reuse of structural elements and materials (Mean & Tims, 2004).

This section presented the importance of energy in development and its contribution to poverty alleviation. The section made a case for investing in renewable and efficient energy particularly in buildings. Finally, the section has outlined ways of minimising energy consumption in sport events. The next section will focus of water management.

3.4.2 Water management

By 2050 global population is forecast to reach 9.3 billion people with more than 50 per cent of the population living in urban areas (United Nations, 2010). Population increase and demographic change is already exerting serious pressure on water resources through increasing demand for drinking water and the volumes of wastewater to be treated (Verstraete and Vlaeminck 2011). In addition, urbanization and climate change will affect the water cycle by reducing infiltration into and run-off from land, making it difficult for aquifers to replenish themselves (Jat, 2011). Scholars and practitioners argue that the current, centralized intensive treatment water and wastewater management systems typical across the developed world cannot meet the challenge of delivering reliable service whilst preventing ecological degradation (Elster and Bennett, 2011; Verstraete and Vlaeminck; 2011).

Based on a review of 53 studies of innovation process in water and wastewater management, Brown and Farrelly (2009) argue that the main barriers to efficient water management are socio-institutional rather than technological in nature e.g. limited community engagement and regulatory framework, fragmented responsibilities and insufficient resources. Further, Brown and Farrelly (2009) observe that the socio-institutional barriers are recognised by others including (Neimczynowicz, 1999, Wong, 2006), however, there is insufficient understanding of those barriers and ways of overcoming them. In the EU, the Water Framework Directive or WFD (EC, 2000) is an important policy for water and wastewater management, seeking to tackle many of the challenges to efficient water management in Europe (Van der Brugge and Rotmans, 2007).

Institutional barriers have hindered change in water and wastewater management by UK water utilities (Spiller, 2010). Thomas and Ford (2005) also attribute this lack of innovation on the way that the UK water industry is economically regulated on the attitudes of civil engineers who dominate the industry and act to privilege the selection of large, centralised infrastructural approaches. Two recent UK Government reviews into the water industry have recommended some institutional reforms including reform on the system of regulation and in particular the practices of the water utility economic regulator (Cave, 2009; DEFRA, 2011). The more recently constituted review undertaken by DEFRA identifies the complex set of formal and evolved behavioural relationships between Ofwat, other regulators and the utilities as a key element underlying low innovation rates (DEFRA, 2011).

Large volumes of water are typically consumed by sport facilities for indoor pools, landscaping and turf maintenance. Artificial snowmaking is another major consumer of water. Actions are necessary by sport organizers to save water (Chernushenko, 2002). The Sydney 2000 Olympic Park provided a good example where the Park was serviced by an ambitious site-wide water recycling plants called Water Reclamation and Management Scheme (WRAMS). WRAMS sourced sewage and storm water from within Park area and treated it for non-portable reuse at the venues. The $1.3 million system produces an estimated 800 million litres of treated water each year (the equivalent of 258 Olympic pools). The water provided 50 per cent of the water needs for the area (Chernushenko, 2002).

According to the International Olympic Committee (2012), the Torino 2006 Olympic Organizing Committee (TOROC) developed a strategy to optimize the use of water, the storage facilities required for effective snow-making, and the Olympic facility supply system. Initial estimates suggested that 20 reservoirs would be required for snow-making, with a combined capacity of 350,000 m^3. Careful planning helped identify optimum catchment points and ways of managing the times of abstraction that minimised both the impact of taking water on the supply system as a whole and interference with civil, agricultural, and industrial uses, reducing estimates of need by more than a third, and the number of storage facilities to just nine. The planning, thanks to a better understanding of the water-cycle valleys brought about by the construction of the Olympic facilities, also allowed for improvements in the local water system after the Games were over (Ibid).

This section briefly presented the global water crisis. It described the barriers that prevent a transition to a more sustainable water management programme. The section also gave examples of how two Olympic Games (Sydney 2000 and Torino 2006) instituted measures to ensure better water management. The next section will focus on waste management.

3.4.3 Waste Management

The growing volume and complexity of waste associated with economic and population growth are threatening ecosystems and human health (UNEP, 2011). Every year, 11.2 billion tons of solid waste is generated worldwide and the decay of organic waste is estimated to be contributing to about five per cent of global Greenhouse Gas emissions (Ibid). E-waste has become one of the major environmental challenges of the 21st century and is the fasted growing stream in the world (UNEP, 2012b). These e-waste as well as other growing stock of waste accumulate around shopping malls and fast food areas, parking lots, bus and train stations, roads, public parks and gardens, landfill sites and recycling areas where they remain until they are removed by the local authorities, or are transported by wind and/or surface runoff into the drainage system where they sometimes reach the ocean. In many cases, solid waste cloak and block stormwater drainage systems resulting in urban flooding (Armitage and Rooseboom, 2000, Zurbrugg, 2002).

Urban solid waste may cause increased maximum natural discharges; increased sediment production; and, water quality degradation. If the solid wastes system is not efficient, there will be a greater need for complementary actions (Allison *et al.* 1998).

According to Cheremisinoff (2003) knowing the composition of wastes is a major tool for the effective management of municipal wastes. Thus, water resources monitoring in urban areas is an important technique to seek solutions to improve urban river basin management, with a view to reducing the pollution loads and peak flows. Comprehensive information concerning the components of the urban hydrological cycle and the rainfall-runoff process is required for effective urban planning.

Waste management has been a major focus of several organizers of Olympic Games. Examples include the Beijing 2008 Summer Games where one of the strategies of the organizers was to manage wastes generated as a result of the Games. In the lead up to the Games, municipal authorities began promoting the sorting and recycling of solid

waste. By 2007, more than 50 per cent of Beijing's waste was being sorted by citizens, with 35 per cent being recycled, a threefold increase from the practice before the Games were awarded to Beijing in 2001. Detoxification of household waste also increased, reaching 100 per cent in the city itself, and 85 per cent in suburban areas (International Olympic Committee, 2012)

Duffy (2011) claims that for the entire preparatory process of the Vancouver 2012 Olympic Winter Games, organisers focused on initiatives to reduce waste at source by procuring recycled materials and products, engaging suppliers, Games personnel and spectators in waste management, awareness and education programmes. The International Olympic Committee (2012) observes that as the Vancouver organisers had aimed to divert at least 85 per cent of solid waste generated from landfill for the seven years of the Olympic project. Although only 77 per cent was diverted from landfill, in the end 63 per cent was either recycled or composted.

This section reviewed literature on the growing challenge of waste in rapidly growing urban areas. It looked at the type of waste that is produced in urban centres and how the waste generates environmental problems. The section also provided information on how two Olympic Games Organizers (Beijing 2008 and Vancouver 2010) addressed the issue of waste in their Games. The next section will review literature on transport and the environment.

3.4.4 Transport and the Environment

The issue of transport and the environment is paradoxical in nature due to its two sides of the coin. On one side, transportation activities support mobility demands for passengers and freight, ranging from urban areas to international trade. On the other side, transport activities have resulted in growing levels of congestion and pollution. The economic, social and environmental goals of society intersect more with matters of transport than with any other aspect of life (Chernushenko, 2002). Yet the current pattern of transport that relies mainly on fossil-fuels driven vehicles, generate a range of environmental, social and economic costs (UNEP, 2011). At present transportation consumes more than half of the global fossil fuels, emits around 25 per cent of energy-related carbon dioxide and accounts for over 80 per cent of air pollution in cities in developing countries (IEA, 2008; UNEP, 2011).

In addition to environmental impacts of transport, traffic and modes, economic and industrial processes sustaining the transport system must be considered. These include

the production of fuels, vehicles and construction materials, some of which are very energy intensive (e.g. aluminium), and the disposal of vehicles, parts and infrastructure. They all have a life cycle timing their production, utilization and disposal. Thus, the evaluation of the transport-environment link without the consideration of cycles in the environment and in the product life alike is likely to convey a limited overview of the situation and may even lead to incorrect appraisal and policies (Rodrigue & Comtois, 2011).

The impact of transport on natural resources is significant, including through the consumption of fossil fuels, engine oil and rubber for operating and maintaining vehicles. Also through the manufacture of vehicles or rolling stocks, for example, metals and plastic; and the construction of infrastructure, for example concrete and steel (UNEP, 2011). The most important impacts of transport on the environment relate to climate change, air quality, noise, water quality, soil quality, biodiversity and land take (Rodrigue & Comtois, 2011). The rapid increase in the number of car has contributed to issues such as urban health problems (UNEP, 2012b)

Collins, Flynn et al., 2007 cited in Rydin et al.,(2011) argue that in sport, travel by teams and spectators have a major environmental impact. An assessment of the 2004 FA Cup Finals in Cardiff found that visitors travel left the largest ecological footprint. The 73,000 fans at the match travelled an estimated 43 million kilometres, 47 per cent of the distance was covered by cars (Ibid). Rydin et al. (2011) propose that the sport sector should use its appeal and network to raise awareness on and promote the use sustainable transport.

Establishing environmental policies for transport thus have to take account of the level of contribution and the geographical scale, otherwise some policies may just move the problems elsewhere and have unintended consequences. Examples include local and regional policies that have forced the construction of higher chimneys for coal burning facilities (power plants) and induced the continental diffusion of acid rain. Thus, even if an administrative division in a municipality or region has adequate environmental enforcement policies, the geographical scale of pollutants diffusion (notably air pollutants) obviously goes beyond established jurisdictions (Rodrigue and Comtois, 2011).

This section reviewed literature on the paradoxical role of transportation, both as a key driver of development but also as one of the main greenhouse gas emitters. It described

the impact of transport on the environment and society. The section also reviewed the impact of sport related transport on the environment, indicating how travel by fans and participants is a major component of sports environmental impact. Finally, the section argued that promoting sustainability in sports, including accessibility to public transport from venues and events can be one way that the sport sector uses its profile to promote sustainable development. The next section focuses on green procurement.

3.4.5 Green Procurement

Sustainable development issues continue to gain importance, locally, nationally and globally. Local authorities, governments and other public sector bodies are in a particularly strong position to influence the market place due to their massive collective purchasing power. By using their purchasing power to opt for goods and services that respect the environment, they can make an important contribution towards sustainable development (European Commission, 2005).

Green procurement is an important aspect of sustainability and refers to the acquisition of products or services in a manner that minimizes environmental impact (UNEP, 2011). Green procurement is an approach in which environmental impacts play an important role in purchasing decisions (Ibid). Companies which pride themselves on environmental stewardship and thoughtful care of the environment may use green procurement to ensure that they do business in an environmentally responsible way (European Commission, 2005).

UNEP (2011) sees green purchasing as one of the enabling mechanisms to greening our economy. UNEP (2011) further argues that procurement of goods and services by state agencies take up a large portion of public spending. The International Institute for Sustainable Development (2008) points out that OECD countries use 13 to 20 per cent of their GDP on procuring goods and services. Green procurement is therefore not out of the reach of public institutions (UNEP, 2011).

The public sector for example, has significant leverage over its suppliers: in many industries (such as defence and healthcare) the public sector is the only or the single most important customer, and normally has huge influence over the quality of the supply (New, Green & Morton, 2002). Green procurement can enable companies to seek products made by companies which are committed to environmental stewardship,

demand minimal packaging on the products it orders, look for products moved with biodiesel or products that bear environmental certifications, or indicate to potential vendors that it would prefer products from companies which are committed to minimizing waste and benefiting the environment (European Commission 2005).

To implement its green procurement programme, LOCOG pledged to showcase the best of Britain during the Games and sourced all dairy products, beef, lamb and poultry were sources from Britain or from sources with equivalent environmental standards or fairtrade suppliers outside the UK (UNEP 2012a). LOCOG used its innovative sustainable sourcing code to ensure that strict environmental and social standards were adhered to by its contractors and suppliers. For example, sustainability considerations, including a raft of operational measures designed to optimise efficiency and accessibility and reduce environmental impacts, were central to the procurement of vehicles (LOCOG, 2012).

This section introduced the concept of green procurement as a major component of sustainability. It demonstrated how governments, local authorities, public sector and other organizations are increasingly using their procurement process to force suppliers and contractors to incorporate environmental considerations in their processes. The section also provided a brief summary of London 2012 and sustainability. The next section will look at the impact of behaviour change on the environment.

3.4.6 Behaviour Change

Various environmental problems like global warming, pollution, water shortages, and loss of biodiversity pose a threat to sustainable human development. Many of these problems are rooted in human behaviour and can thus be managed through behaviour change (Gardner & Stern, 2002). Geller (2002) argues that promoting behaviour change is more effective when one carefully selects the behaviours to be changed, examines which factors cause those behaviours, applies well-turned interventions to change behaviours and their antecedents, and systematically evaluates the effects of these interventions on the behaviours, and on environmental quality and quality of human life.

Gardner and Stern (2002) argue that environmental psychologists should focus on behaviours that negatively affect the environment. Such studies should consider the

possibility of various behaviour changes and the consequences to the environment. When the environmental behaviour has been selected and its causal factors identified, intervention strategies can focus on the relevant factors (Ibid). When contextual factors inhibit particular behaviours, one can focus on removing those inhibitions. Various strategies for behaviour change have been identified, each focusing on a different set of behavioural aspects (Geller, 2002). A distinction has been made between antecedent and consequence strategies. Antecedent strategies try to change factors that precede behaviour. Examples are information and education, prompting, modelling, behavioural commitments, and environmental design (Lehman & Geller, 2004; Thøgersen, 2005). Consequence strategies focus on changing the consequences following behaviour. Examples will include feedback, rewards, and penalties (Thøgersen, 2005). Another distinction is that between informational strategies aimed at changing prevalent motivations, perceptions, cognitions and norms; and structural strategies, that seek to change the circumstances under which behavioural choices are made (Ibid).

While many people today may value the environment and promote environmental conservation, this is unfortunately contradicted by everyday behaviours that contribute to increasing environmental degradation and the overconsumption of non-renewable resources. This apparent 'value-action' gap can be attributed to a large extent to the non-reflective nature of everyday practices and behaviours (O'Donoghue & Lotz-Sisitka, 2000). Environmental goals and values are traded-off in the course of everyday activities as a result of uninformed reflection or choice (Von Borgstede& Biel, 2001). Therefore, understanding and targeting everyday practice is essential for achieving behaviour change for environmental sustainability.

Sport is one of the most important vehicles for capturing public attention, and therefore can be instrumental in helping to change public attitude and behaviour (Savery, 2011). The ability of sport to reach the world gives it an inimitable character; it can be a catalyst to spur environmental awareness and actions. The knowledge and experience from one major event can become the minimum standard for future events so that the learning curves become less steep (Roper, 2006; Savery, 2011).

This section described how environmental problems are linked to human behaviour and that this can be managed through behaviour change. The section argued that environmental psychologists should review behaviours that significantly affect the environment and that such studies should be used to promote acceptable behaviours. The section concluded that sport could be an important vehicle for promoting

behavioural change in favour of environmental sustainability. The next section will review environmental sustainability through the London 2012 Olympic Games.

3.5 Environmental Sustainability through the London 2012 Olympic- Games

According to the Communities and Local Governments Department, UK (2010), one of its approaches to sustainable development is supporting the Department of Energy and Climate Change on a green deal for homeowners to fund their energy efficiency improvements, at no upfront cost, that will be paid back through energy bill savings. The Department further claims that approximately 42 per cent of all carbon emissions in the UK come from buildings and that it has introduced measures in England and Wales to improve the energy efficiency of buildings, including introducing Energy Performance Certificates (EPCs) for properties providing A-G efficiency ratings and recommendations for improvement.

Chernushenko (2011) observes that new buildings are subject to increasingly stringent standards and higher expectations in much of the developed world, and yet many uninspiring structures are still build to house sporting activities, with little attention given to environmental concerns and with no thoughts towards the growing scarcity and rising costs of water and energy and the urgency of cutting emissions of greenhouse gases.

The Communities and Local Governments Department, UK (2010) encourages and enables all new homes to be zero carbon from 2016 and considers similar approaches for new non-domestic buildings from 2019. Henson (2011) indicates that implementation of sustainability strategy with London 2012, whereby permanent sporting venues were being constructed only where a comprehensive and coherent legacy use could be established, and the associated supporting infrastructure network scaled to suit legacy requirements. In addition, the two main organizers of the London 2012 Games, the Olympic Delivery Authority (ODA) and the London Organizing Committee of the Olympic Games and Paralympic Games (LOCOG), had complimentary sustainability strategies. The ODA focus was on balancing the embodied impacts of construction with the long-term operational impacts of the permanent sporting venues, as well as the physical integration of the London 2012 Olympic Park into the wider community. Delivery of Combined Cooling, Heating and Power (CCHP) energy and distribution system, improving the operational energy efficiency of venues and construction of large areas of complex, biodiversity habitat, a Park-wide non-potable

water network, and the upgrading of public transport infrastructure all had clear long-term benefits for the community (Ibid).

According to the London Olympic Delivery Authority (ODA) (2007), the vision of the London Games organizers was to transform the physical environment around the Olympic Park by improving the waterways, burying overhead powerlines, enhancing the ecology of the area and creating green spaces. Permanent venues were to achieve an excellent rating of the "Building Research Establishment Environmental Assessment Method for buildings" (BREEAM)[vi] (LOCOG, 2008).

The delivery agencies (LOCOG and the ODA) were committed to achieving the Code for Sustainable Homes Level 4 in Olympic Village, which would target 44 per cent more energy efficiency than required by 2006 Building Regulations (LOCOG, 2008). The delivery agencies also aimed to encourage, through its procurement process, high standards of environmental and social performance among its suppliers and licensees and their supply chain (Ibid). LOCOG established a Sustainable Sourcing Code to set out its expectations of supplies with regards to ethical, social and environmental issues. According to LOCOG (2011), the delivery agencies of the London 2012 Olympics pledged to achieve 15 per cent carbon dioxide reduction for permanent venues, beyond the 2006 Building Regulations. They also pledged to deliver 20 per cent of all energy demands for immediate post-Games legacy using on-site renewable sources.

UNEP (2012a), observe that the organizers aimed to reduce the amount of drinking water used per person per day by 40 per cent in new permanent venues. The delivery agencies also made a commitment to reduce the amount of drinking water used in the 'Olympic Village' homes by 35 per cent, measured against average London consumption of 160 litres per day (LOCOG, 2011). To achieve the above targets, the Olympic venues were fitted with water-efficient fixtures and other water saving technologies that included rainwater harvesting and recycling and use of non-portable water for flushing and irrigation (UNEP, 2012a). A particular example of efficient water management was in one of the landmark venues of the Games – the Velodrome – where use of portable water was reduced from a baseline of 103 mega litres to 28 mega litres total usage through rainwater harvesting and low water sanitary fixtures. Rainwater harvested from the roof of the building could meet approximately 50 per cent of the buildings WC flushing requirements (Epstein, 2011).

According to LOCOG (2011), the ODA made a commitment to reclaim 90 per cent of materials from the Olympic Park demolition work for reuse and recycling and to use 25 per cent (by weight) recycling and secondary aggregate for construction of venues and Park-wide infrastructure. Waste management contractors committed to diverting 90 per cent of construction waste from landfill through reuse, recycling and recovery.

UNEP (2012a) also observes that the Games organizers aimed to reuse and recycle or compost at least 70 per cent of waste – which was everything from packaging and official merchandising to construction materials and to use the rest for energy generation.

LOCOG (2011) concludes that the Games offer a unique platform to promote and disseminate sustainability values and for the host city to showcase good practices of sustainable development. The construction of new sport and accommodation facilities and the investment in sanitation, transport, tourism and telecommunications infrastructure (required for the Games) often act as a catalyst for economic growth, urban regeneration and territorial transformation, leaving the interested area with a positive legacy.

This section reviewed literature on the applicable building standards in the UK at the time that the construction of venues and facilities for the London 2012 Games was being done. It also reviewed the targets of the delivery agencies and briefly touched on the implementation of measures to achieve these targets. The next section will review literature on the greening of construction of venues and facilities of mega-sport events.

3.6 Greening Construction of Venues and Facilities of Mega Sport Events

One of the benefits associated with hosting mega sport events is the enhancement of infrastructure in cities and regions. Long-term changes associated with hosting a mega sport event include the construction or upgrading of sports venues, transport systems and other infrastructures (water treatment, power supply and distribution, etc.)(Essex &Chalkley, 2004). These long-term changes can take various forms: enlarged or new airport, new roads and tram lines, better public transport systems and large event venues which can be used for mega-conventions (Ibid).

Several examples in Olympic history show that hosting the Games became the opportunity to undertake extensive urban renewal. Examples of Olympic Games where greening initiatives were implemented include Sydney 2000, Athens 2004, Torino 2006,

Beijing 2008, Vancouver 2010 and London 2012. During Sydney 2000, various environmentally friendly technologies and processes were incorporated into the planning and operations stages (Balderstone, 2001). For example, by setting clear environmental guidelines, and through careful planning and dialogue with contractors and suppliers, the Sydney Games organizers were able to ensure that no polychlorinated biphenyls (PCBs), a persistent organic pollutant (POP) subsequently banned by the UN Stockholm Convention that came into force in 2004[vii], were used in developments of venues for the Games, while the use of polyvinyl chloride (PVC) was minimised (Ibid). Recycled building materials were extensively used; water was purified and recycled for use in lavatories and for landscape watering; natural light and ventilation were optimised in the buildings to reduce energy consumption and care taken to protect native flora and fauna[viii]. The permanent housing in the Olympic Village became the world's largest solar powered suburb (International Olympic Committee, 2012).

The Athens 2004 Games were used to demonstrate environmental sensitivity and environmental practice in Greece (Kazantzopoulos, 2002). Several new Olympic installations supported the rehabilitation and upgrading of urban and suburban areas. Projects such as the construction of the Olympic Village, the Faliron Coastal Front and the Olympic Sailing Centre are among the best examples of interventions which contributed to a better quality of environment (Ibid).

The Organising Committee for the 2006 Olympic Winter Games in Torino (TOROC) set as one of its goals the need to ensure that sufficient attention and respect was paid towards the environment both in the organizing phase and during the event (TOROC, 2002). TOROC was one of the first mega sport event organizer to ascribe to international certification programmes (ISO and the European Eco-Management and Audit Scheme certifications) (TOROC, 2007).

The Beijing 2008 Games adopted "Green Olympics" theme as one of the three mottos for the Games. An initial Environmental Impact Assessment Framework was submitted during the bidding stage by Beijing. Environmental indicators covered parameters such as energy consumption, water consumption, environmentally-friendly material, etc. Such indicators were integrated at the design and tendering stages. Beijing also launched educational campaigns for sustainable development to raise the nation's environmental awareness (IOC, 2012).

In the case of Vancouver 2010, the Games Organizers aimed to go green in two substantial ways. The first was through extensive application of Canadian green building standards for the new sport venues and the two Athletes villages. The second was around managing the Games' overall carbon footprint (Duffy, 2011). Green building guidelines influenced siting, construction operations, materials and innovations associated with each sport facilities and residential structures (Ibid). In the end, the Games Organizers (VANOC) were recognized by the Globe Foundation and the World Green Building Council for the largest group of simultaneously constructed, single project, low environmental impact facilities in North America. The buildings incorporated practices and technologies that minimize environmental impacts: conserving biodiversity, energy and water (IOC, 2012).The strategies for green construction in Vancouver included a heating bylaw, passive design guidelines, and energy performance requirements for all new buildings. Buildings were integrated with green transport plans through the provision of parking spaces for car-sharing enterprises, bicycle infrastructure, and other requirements (Ibid).

The building of facilities and venues for the London 2012 Olympic Games was done under guidance of UK building regulations (Government of United Kingdom, 2012). Building Regulations apply in England and Wales and promote standards for most aspects of a building's construction, energy efficiency in buildings, the needs of all people, including those with disabilities, in accessing and moving around buildings.

Particularly relevant to this study is Part L of the regulations which sets the standards for energy efficiency within new and refurbished buildings and was applied to facilitate environmental sustainability initiatives. The revised 2010 building regulations legally require buildings to be 15 per cent more efficient than the 2006 equivalent. The London 2012 buildings are still compliant with the most up to date regulations despite being designed way back in 2006 (LOCOG, 2011).

This section presented some of the benefits that hosting of mega sport events can bring to a host city or country including the construction and upgrading of roads and sport facilities. It presented the evolution of the greening of venues and facilities in the Olympic Games from Sydney through Athens, Torino, Beijing to Vancouver as well as efforts by London to green its facilities. The next section focuses on green facility rating systems.

3.6.1 Green Facility Rating Systems

Green facility designers exceed federal, state, and local building codes to improve overall building performance (Gowri, 2004). Currently, there are more than 80 different green building organizations in the world and at least three different national groups promoting what constitutes a green building. The three systems that have emerged to bring about standardization within the green movement are: The Building Research Establishment Environmental Assessment Method (BREEAM), the Green Building Challenge, and Leadership in Energy and Environmental Design (LEED) (Gowri, 2004). BREEAM is the earliest building rating system for environmental performance assessment. This standard was developed by the British Research Establishment (BRE) in 1990. Since that time, BREEAM has evolved from a design checklist to a comprehensive assessment tool that is used in various stages of a building's life cycle (Gowri, 2004). The Green Building Challenge is a collaborative initiative of more than 20 countries committed to developing a global standard for environmental assessment. The first draft of the assessment framework was completed in 1998 and a spreadsheet tool—GBTool—was developed for participating countries to adapt the framework by incorporating the regional energy and environmental priorities (Gowri, 2004).

Perhaps the best-known group in green construction is the U.S. Green Building Council (USGBC), a non-profit group that developed the LEED point rating system for commercial projects. Many consider the LEED certification as the national benchmark for green construction (Yost, 2002). LEED is a third-party certification, nationally accepted programme for design, operation and construction of high performance green buildings. The programme ensures the buildings are environmentally compatible, provide a healthy work environment and are profitable. LEED New Construction buildings are awarded points for sustainability for things like energy-efficient lighting, low-flow plumbing fixtures and collection of water to name a few (http://www.leed.net/2012).

LEED consists of a suite of rating systems for the design, construction and operation of high performance green buildings, homes and neighbourhoods. Developed by the U.S. Green Building Council (USGBC) in 1998, the programme provides building owners and operators a clear framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions (U.S. Green Building Council, 2006). The benefits of implementing a LEED strategy ranges from

improved air and water quality to reducing solid waste, benefiting owners, occupiers, and society as a whole (Ibid)

This section reviewed literature on the leading green building rating programme, particularly BREEAM and LEED. It provided the benefits that come with implementing any of these green building certification programmes. The next section will review the benefits of green buildings.

3.6.2 Benefits of Green Facilities

The concept of sustainable facilities seeks to optimise the performance of a building and reduce its negative impacts on materials, energy, water, land and the generation of waste and emissions and improve indoor air quality and comfort (UNEP, 2010). Green facilities provide numerous benefits to users and the environment. The following subsections briefly describe some of the benefits of green facilities.

3.6.2.1 Natural Resource Conservation

The efficient use of natural resources is a fundamental tenet of green design. Conventional construction practices consume large quantities of steel, wood, plastic, cardboard, paper, water, and other natural resources that unnecessarily lead to resource depletion (Del Monte, 2006). Design professionals have the option to select environmentally-conscience building materials such as recycled products.

Sustainably constructed products can also include recycled plastics and crushed rock aggregates (U.S. Green Building Council, 2007). The rapidly developing recycled product market is also diverting waste from landfills as mandated by the Integrated Waste Management Act in the US (Journal of Environmental Management, 2007). Reutilization of beams, lumber, flooring, panelling, doors, brick, steel, insulation, and other products often lend quality and durability exceeding conventional materials and most importantly, conserve on the use of resources (del Monte, 2006). Designing adequate space for recycling collection and incorporating a solid waste management programme can reduce waste generation and associated costs over the lifespan of facility (US Green Building Council, 2007).

This section attempted to compare the excessive consumption of materials by conventional buildings with the efficient use of natural resources in green buildings. The section also presented some of the ways in which contractors are reducing resource

consumption through green building practices. The next section will focus on energy efficiency and water conservation.

3.6.2.2 Energy Efficiency and Water Conservation

Energy efficiency and water conservation are cornerstones of any green building project. The generation and use of energy are major contributors to air pollution and greenhouse gas emissions (UNEP, 2011). Improving energy efficiency and using renewable energy are effective ways to reduce the potential of energy supply interruptions, improve air quality, and reduce the impacts of global warming (Ries & Bilec, 2006). Energy efficiency also lowers utility expenses and enables organizations to reap the financial benefits of sustainability on a continual basis. Examples of increased energy efficiency measures include installing top grade insulation, glazed and low-emissive (low-E) double paned windows, and high-efficiency water heaters and other appliances (Ibid). LaRue, Sawyer, and Vivian (2005) describe how the building "envelope" - the windows, doors, walls, floor, foundation, and roof- must balance requirements for ventilation with providing thermal and moisture protection appropriate to a facility's climatic conditions:

An optimal designed building significantly reduces heating and cooling loads, which in turn can allow downsizing of heating, ventilation, and air-conditioning (HVAC) equipment (Loftness, Hakkinen, Ada, & Nevalainen, 2007).

UNEP (2011b) observes that the construction sector is responsible for over a third of global resource consumption, including 12 per cent of freshwater use. Water conservation is therefore an important issue in recreation and sports venues as they consume large quantities of water (Dick, 2007). Designers and owners of sport facilities can make use of a new generation of high-efficiency appliances and landscape water management systems (Ibid). Dual plumbing using recycled water for toilet flushing or a grey water system that recovers rainwater or other non-potable water for site irrigation are efficient methods of water conservation. Wastewater can be minimized by using ultra low-flush toilets, low-flow shower heads, and other water conserving fixtures (LaRue et al., 2005; Dick, 2007). Additional measures such as rainwater harvesting, reminding patrons to turn faucets off completely, repairing drips and leaks, and shutting down water supplies outside of operating hours can go a long way toward conservation and cost reduction (LaRue et al., 2005).

This section argued that energy efficiency and water conservation are important aspects of any green building project. Lowering the use of energy not only saves costs and improves health but also reduces greenhouse gas emissions. The section also argued that water conservation is very important in sport since large volumes of water are often consumed at recreation and sport venues. The next section looks at the potential costs and savings of green buildings.

3.6.2.3 Potential Cost and Savings

Initial costs of greening buildings vary significantly depending on the project goals. While there are many significant benefits requiring no additional cost (e.g. south facing windows), some features will cost more in both design and materials. Some aspects of design have little or no initial investment, including site orientation and window and overhang placement. Other sustainable systems that may cost more in the design phase, such as an insulated shell, can be offset by the reduced cost of a downsized mechanical system (Loftness et al., 2007).

This concept is known as "right sizing" of infrastructure and mechanical systems. Sustainable buildings can be assessed as cost-effective through the life-cycle cost method, a way of assessing total building cost over time. It consists of initial design and construction costs; energy, water and sewage, waste, recycling, and other utilities operating costs; maintenance, repair, and replacement costs; and other environmental or social benefits such as impacts on transportation, solid waste, water, energy, infrastructure, worker productivity, outdoor air emissions, etc.(Dick, 2007).

Deciding how much to green a facility ultimately depends on company vision, as well as time and budgetary limitations (Suttell, 2006). First, the company must establish a vision that embraces the principles of sustainability and an integrated design approach. From the vision, the company develops a project budget that covers green building measures while allocating contingencies for additional research and analysis. Finally, selecting a design and construction team that is committed to the project vision is paramount and facilitates the successful creation of an environmentally sound, sustainable structure (Suttell, 2006).

Savings can only be fully realized when methods are incorporated at the project's conceptual design phase with the assistance of an integrated team of professionals. Currently, major architectural players in sport and recreation facility design are

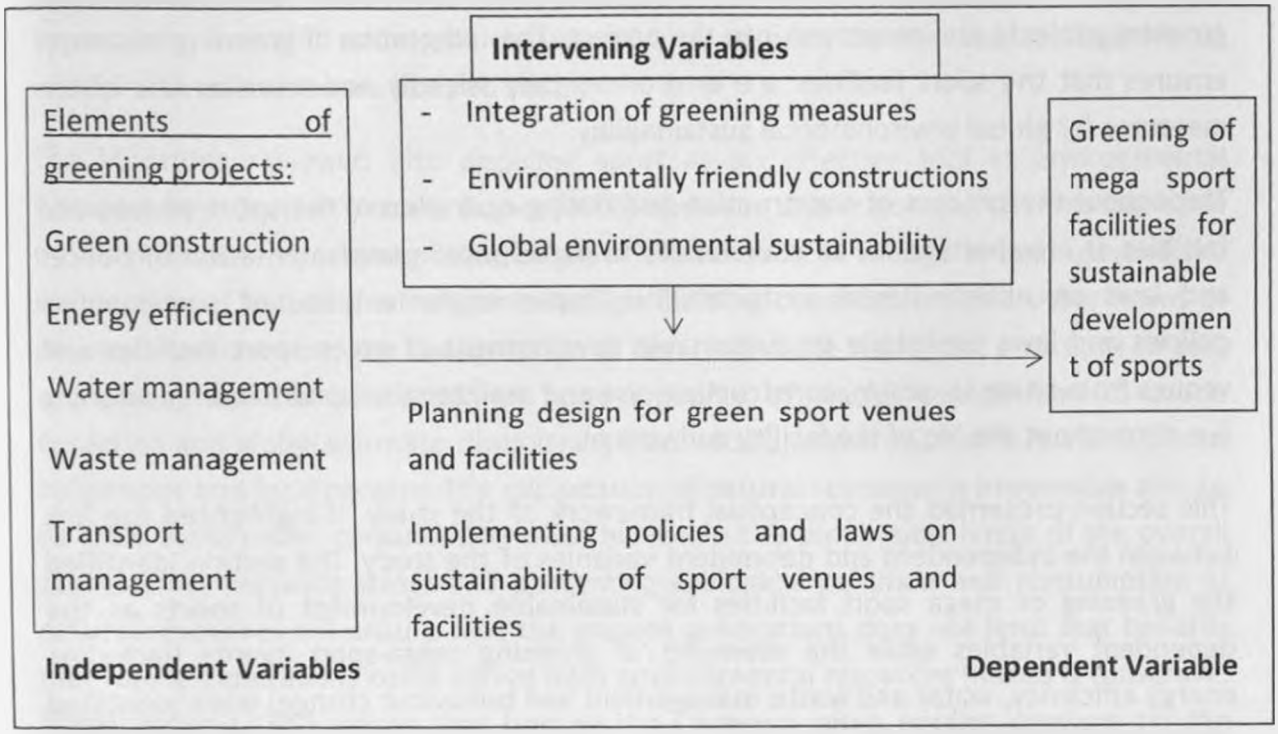
dedicating staff committed to the new design approach of the sustainability movement. This integrated systems approach ensures the building is designed as one system rather than a collection of stand-alone systems (LaRue et al., 2005). Utilizing the holistic approach emphasizes the philosophy that all building systems are interdependent, and that these systems can either adversely or favourably impact their users and surroundings (Monroe, Madsem, Garris, Suttell, Gesener, & Easton, 2004).

The section reviewed the cost involved in integrating green features in buildings. It argued that some features will cost more but that the cost-effectiveness of sustainable buildings should be assessed through life-cycle cost methods. The section also argued that greening a facility as a whole is more practical than having a piecemeal approach and that savings can be fully realised when these measures are incorporated right from the project conception and design phase with the assistance of an integrated team of professional. The next section looks at the conceptual framework of the study.

3.7 Conceptual Framework

A framework is a structure for thinking. A conceptual framework is a diagrammatic presentation of variables in a study (Mugenda and Mugenda, 1999). The variables comprise of independent and dependent variables. In this study, the independent variables were green construction, water management, waste management, transport management, green procurement, energy efficiency and behaviour change. The intervening variables were integration of greening measures, environmentally-friendly construction and global environmental sustainability. The dependent variable was greening of mega sport facilities for sustainable development of sports. The independent and dependent variables are illustrated in the following conceptual framework.

Figure 10: Conceptual Framework



Source: Author (2012)

The conceptual framework presented in figure 10 illustrates the interconnectivity between the independent variables (the elements of greening projects which include green construction, water management, waste management, transport management, green procurement, energy efficiency and behaviour change) and the dependent variable (Greening of mega sport facilities for sustainable development of sports) for the study.

The study intends to establish how each of the independent variables (the elements of greening projects which include green construction, water management, waste management, transport management, green procurement, energy efficiency and behaviour change) was effective in ensuring that the London 2012 Olympic Games delivered on its environmental sustainability agenda. The study reviewed the measures that were implemented to ensure that the London 2012 Olympic Games left a green

legacy that can be replicated in the building and construction industry and in other mega sport events.

The elements of greening projects are prioritized during the planning and design stage of construction of mega sport venues and facilities. During the construction, elements of greening projects are integrated into the project. The integration of greening measures ensures that the sport facilities are environmentally friendly and serve as one of the measures for global environmental sustainability.

Throughout the process of construction and during operation of the sport venues and facilities, it is important for all stakeholder to participate in implementation of polices and laws on environmental sustainability. Proper implementation of sustainability policies and laws contribute to sustainable development of green sport facilities and venues from siting to design, construction, use and maintenance, and decommissioning (i.e. throughout the life of the facility and venue).

This section presented the conceptual framework of the study. It highlighted the link between the independent and dependent variables of the study. The section identified the greening of mega sport facilities for sustainable development of sports as the dependent variables while the elements of greening mega-sport events (including energy efficiency, water and waste management and behaviour change) were identified as the independent variables. The next section will review the critique of the literature.

3.8 Critique of the Reviewed Literature

The literature cited highlighted the importance of sports in sustainable development. In spite of the positive contribution to development, sports also impact negatively on the society and the environment. The literature also highlighted how sport can achieve or facilitate outcomes beyond sport itself. While the view that sport is influencing desirable outcomes such as the development of discipline, confidence, tolerance and respect, evidence for such outcomes tends to be limited both at impacting on individuals and at achieving the desired behavioural outcomes (Coalter 2007).

Donnelly et al (2007) note that sport may have some of the most desirable outcomes such as positive behaviour, tolerance and common understanding, but may also be full of discrimination, racism, divisive and can aid intolerance and misunderstanding. The anticipated positive results of child and youth sport participation and child and youth-based initiatives that use sport for positive social change are therefore not automatic or

linear (Donnelly *et al* 2007, Mwaanga 2003, Kruse 2006, Coalter 2006). A research reviewed by Coakley (2002) concluded that in well-designed sports programmes, participants should feel physically safe, personally valued, socially connected, morally and economically supported, personally and politically empowered and most importantly, hopeful about the future. In the absence of the above, negative or undesirable outcomes are likely to set in.

The literature reviewed also depicted sport as an effective tool in environmental sustainability. On the contrary, Roper (2006) observes that major sport events can harm the environment by, among other negative effects such as change in land-use and the destruction of natural environment through building construction, and other forms of physical development; the consumption of non-renewable resources; emissions to soil, air, water, and the generation of large amounts of waste; contribution to ozone depletion and global warming; diminishing biodiversity; and erosion of cultural values of indigenous and local peoples. The exploitation of natural resources is irreversible and, to be truly sustainable, consumption must be within the biophysical limits of the overall ecosystems. Reducing waste and preventing ecological pollution and consumption of natural resources will ensure that the present generations does not limit that benefits that future generations could derive from environmental resources (Razaq & Musgrave, 2009). Hiller (2000) argues that hosting the Olympics often implies pressure on the environment through increased traffic, water consumption and waste production.

Frey and Iraldo (2009) argue that although it is widely accepted that mega sport events may have a large impact on (and leave an important legacy to) the host city and region, the contribution of the Games to long-term urban and regional development strategies has not received enough attention.

This section presented a critique of the reviewed literature. It argued that the literature presented has mainly highlighted sports mainly as an effective tool for sustainability whereas major sport events are known to have extensive negative impacts on the environment. The section also attempted to highlight some negative impacts of sports that were not covered in the reviewed literature. The literatures reviewed have not looked into how effective the Olympic Games are in promoting environmental sustainability. This study therefore aimed at investigating the effectiveness of the greening measures adopted for the London 2012 Olympic Games. The study findings helped in assessing the role of sports as a mean to facilitate environmental

sustainability. The next chapter will describe the research methodology used for the study.

[iii]Elimu, Michezo na Mazoezi (Education, Sport and Physical Activity) is a community driven non-governmental organization based in Tanzania.

[iv] An ecological footprint is an aggregated indicator of global ecological impact that estimates the area of bio-productive land and sea required to support the resource consumption of the event using prevailing technology (Rydin et al., 2011)

[v] A carbon footprint is the measurement of carbon dioxide equivalent from the range of greenhouse gasses emitted (Rydin *et al.*, 2011)

[vi] BREEAM is a voluntary measurement rating for green buildings that was established in the UK in 1990 by the Building Research Establishment. Since being established, BREEAM has expanded in scope and geography and is used in various countries across the globe. It is the equivalent of LEED in North America (Wikipedia, 2012).

[vii]Stockholm Convention on Persistent Organic Pollutants (POPs), http://chm.pops.int/Convention/tabid/54/Default.aspx

[viii] Olympic Official Report Sydney 2000

CHAPTER FOUR

RESEARCH METHODOLOGY

This chapter presents the research methodology that was adopted for the study. It focuses on the research design, population of study, the sampling methods and sample size, data collection methods and data analysis methods that were used to accomplish the objectives of the study.

4.1 Research Design

A case study research design was adopted for this research project. In a case study, the researcher selects a specific organization or situation to profile because the subjects offer critical, extreme or unusual situations. Also, the researcher has an opportunity to explore the situation from various data sources and use multiple subjects. This enables the issue to be reviewed from multiple perspectives and ensures better and indepth understanding (Baxter & Jack, 2008).

The study aimed to determine the effectiveness of the greening of sports venues and facilities through a case study of the London 2012 Olympic Games[ix]. The 2012 Olympic and Paralympic Games used a mixture of new venues, existing/historic and temporary facilities.

The Olympic Park in London, (the main sporting complex for the 2012 Summer Olympics and Paralympics), situated to the east of the city adjacent to the Stratford City development, contains the Olympic Village and several of the venues and facilities including the Olympic Stadium, the Aquatics Centre, Riverbank Arena, the Basketball Arena, the Copper Box (for handball) and the Velodrome (for cycling events) and was the main focus of the study. The London 2012 Summer Olympic Games was chosen as a case study because it had a strong component of environmental sustainability in the planning, design, construction and operation of venues and facilities.

The objective of a case study is to obtain multiple perspectives of a single organization, situation, event or process at a point or over a period of time (Cooper & Schindler, 2006). In this case study, the London 2012 Summer Olympic Games provided multiple

perspectives of greening of sport venues and facilities. The case study extracted information from organizational brochures, annual reports, journals, newspapers and magazine articles along with direct observation and combined with interview data from various stakeholders. In a case study, participants are invited to tell their experiences with those chosen presenting different levels within the same organization or different perspectives of the same situation or process to ensure depth of perspective (Ibid).

4.2 Target Population

The target population for the study included people from various organizations - the London Organizing Committee for the Olympic Games and Paralympic Games (LOCOG); the Olympic Delivery Authority (ODA); the UK Department of Communities and Local Governments; the International Olympic Committee (IOC); National Olympic Committees (NOCs); Organizing Committees of Olympic Games (OCOGs) for the 2014, 2016 and 2018 Olympic Games; companies and contractors that were involved in the constructions of London 2012 Olympic venues and facilities; non-governmental organizations that were directly or indirectly associated with the preparations of the London 2012 Games; experts on the greening of mega sport events; fans and athletes who participated in or watched test events[x]. Note that for some population groups such as NGOs, NOCs and companies that were involved in the Games preparations, their population was at the corporate not the individual level as their involvement in and appreciation of the greening of the Games was driven more by corporate policy than by individual perspectives. The target population is shown in Table 1.

Table 1: The Target Population

Target group	Population	Data Obtained
International Olympic Committee (IOC)	500	Role in the greening of the Olympic Games and perception on London 2012 greening initiatives
Organizing Committee for the Olympic Games (LOCOG)	300	Measures put in place to ensure effectiveness of greening
Olympic Delivery Authority (ODA)	200	Measures put in place to ensure effectiveness of greening
National Olympic Committees (NOCs)	204	Perception on the greening of the London 2012 Games
UK Department of Communities and Local Governments (staff directly responsible for Olympic related activities)	100	Input into the greening of the London2012 Games
Organizing Committees of Olympic Games (OCOGs) (staff directly responsible for sustainability issues and interaction with LOCOG)	20	Role in and perception on the greening of the London 2012 Games
Companies and contractors directly or indirectly associated with the London 2012 Olympic Games	22	Role in and lessons from the greening of the London 2012 Games
Non-governmental organizations involved in preparation for London 2012 Olympic Games	14	Role in and lessons from the greening of the London 2012 Games
Athletes (who participated in test events)	600	Perception on the greening of the London 2012 Games
Fans (who watched test events)	4000	Perception on the greening of the London 2012 Games
Experts on greening of mega sport events	13	Perception on the greening of the London 2012 Games
Total	5973	

The data presented in Table 1 indicate that the total target population of the study was 5,973. The population comprises key stakeholders of the London 2012 Olympic Games.

4.3 Sampling Method and Sample Size

The study used a combination of various sapling techniques to derive a sample of 110 respondents from the target population. The study used both probability sampling technique (stratified random sampling) and non-probability sampling techniques (purposive sampling and convenience sampling). Albertin and Nair (2004) observe that the combination of random and purposive produces a powerful way of sampling. The use of probability sampling technique ensured that the study was less prone to bias and it allowed for the estimation of magnitude of sampling error hence the determination of statistical significance of study variables. The use of non-probability sampling procedures ensured that the study captured the required information from the key informants. Sampling techniques and the resultant sample sizes are discussed in the following subsections.

4.3.1 Stratified Random Sampling

Stratified random sampling is a probability sampling technique wherein the researcher divides the entire population into different subgroups or strata, then selects the final subjects proportionally from the different strata (Kothari 2004). Respondents were randomly selected from each stratum. Stratified sampling has advantages such as provision of greater precision than a simple random sample of the same size. A stratified sample often requires a smaller sample, saves money and provides greater precision. A stratified sample can guard against an unrepresentative sample and the researcher can ensure that he or she obtains sufficient, reliable and detailed sample points to support a separate analysis of any subgroup (Kothari, 2004).

Stratified random sampling was used to select samples from companies and contractors associated with the construction of venues and facilities for the London 2012 Olympic Games and non-governmental organizations involved in the preparations of the London 2012 Olympic Games and experts on greening of mega sport events. The sample size for the randomly sampled respondents was determined using table for determining sample size from a given population (appendix viii) which was computed by Krejcie, R. V. and Morgan, D. W. (1970). Table 2 shows the sample that was randomly selected.

Table 2: Randomly Selected Sample for the Study

Target group	Population	Sample Size
Companies and contractors associated with the construction of venues for the London 2012 Olympic Games	22	20
Non-governmental organizations involved in the preparations of the London 2012 Olympic Games	14	10
Experts on greening of mega sport events	13	10
Total	49	40

4.3.2 Purposive Sampling

The purposive sampling technique is a type of non-probability sampling that is most effective when one needs to study a certain cultural domain with knowledgeable experts within (Tongco, 2007). Purposive sampling is appropriate when the informants have a specific type of knowledge or skill required in the study (Prance 2004) when the researcher has adopted a case study research design (Dolisca *et al.,* 2007) and when the population is too small for a random sample (Tran & Perry 2003).

Purposive sampling may be used together with the both qualitative and quantitative methods of data collection. For example the researcher may choose samples purposively and then collect data using qualitative method such questionnaires (Zhen *et al.,* 2006) and quantitative methods such as direct observations (Martinez-Romero *et al.,* 2004) and interviews (Li *et al.,* 2006). Statistical analyses such as logistic regression models (Neupane *et al.*, 2002), frequencies, chi-square (Albertin and Nair 2004), analysis of variance (Belcher *et al.,* 2004), and cross tabulation (Bah *et al.,* 2006), among others can be used with purposive sampling.

According to Tongco (2007) the steps involved in purposive sampling include identification of the research problem, determination of the type of information needed (the information sought after in the study is held by only certain members of the community), definition of the qualities that the informants should or should not have, finding the informants based on defined qualities, and use of the appropriate techniques to collect data from the key informants. Bernard (2002) argued that there is

no cap on how many informants should make up a purposive sample, as long as the needed information is obtained.

Purposive sampling was used to select respondents who were directly involved in environmental aspects of preparation for London 2012 Olympic Games. The respondents were chosen because they could provide information on environmental sustainability measure taken to deliver green sport during London 2012 Olympic Games. Therefore the information from the key informants who were purposively selected to participate in the study was valuable for the study whose objective was to determine the effectiveness of the greening of the London 2012 Olympic Games. The Key informants selected purposively were official involved in the implementation of the environmental sustainability agenda of the London Organizing Committee for the 2012 Olympic Games and Paralympic Games (LOCOG), the Olympic Delivery Authority (ODA);the UK Department of Communities and Local Governments; the International Olympic Committee and Organizing Committees of Olympic Games (OCOGs) for 2014, 2016 and 2018. Table 3 shows the informants who were selected using purposive sampling technique.

Table 3: Purposively Selected Sample for the Study

Target group	Population	Sample Size
International Olympic Committee	500	5
London Organizing Committee for the 2012 Olympic Games and Paralympic Games (LOCOG)	300	10
Olympic Delivery Authority (ODA)	200	8
UK Department of Communities and Local Governments (staff directly responsible for Olympic related activities)	100	5
Organizing Committees of Olympic Games (OCOGs) (staff directly responsible for sustainability issues and interaction with LOCOG)	20	6
Total	1120	34

4.3.3 Convenience Sampling

According to Cooper and Schindler (2008) convenience samples are non-probability samples that are not restricted. In convenience sampling the researcher has the freedom to collect data from whomever respondents they find. A sample is drawn on the basis of opportunity, for example, the sample includes any fan who attended a test event. Convenience samples are taken to test an idea or to gain insight about a subject of interest. Cooper and Schindler (2008) argue that the results of a convenience sampling may present evidence that is so overwhelming that a more sophisticated sampling procedure is unnecessary. Convenience Sampling has advantages such as ease of execution, relative cost and time required to carry out a convenience sample are small and it help the researcher to gather useful data and information that would not have been possible using probability sampling techniques. The main disadvantage of convenience sampling is the biasness in selection of samples (Cooper & Schindler, 2008).

Convenience sampling was used in the selection of National Olympic Committee, athletes and fans who participated in and observed test events of the London 2012 Olympic Games. The fan and the athletes were selected using convenience sampling so as to help the researcher gain more insight into their perception on the effectiveness of the greening measure implemented by the deliver agencies the London 2012 Olympic Games. The fans selected did not include volunteers and other employees employed by delivery agencies. This avoided overrepresentation of delivery agencies for 2012 Olympic Games. The information from the fan and athletes was important in identifying whether measures implemented by the delivery agencies had positive impact on the green legacy of the London 2012 Olympic Games.

Table 4: Conveniently Selected Samples for the Study

Target group	Population	Sample Size
National Olympic Committee (NOCs)	204	6
Athletes (who participated in test events)	600	15
Fans (who watched test events)	4000	15
	4804	36

As greening of mega sport events is a new concept for many and since this is a global event with many different stakeholders, getting the appropriate sample for relevant, timely and cost efficient information gathering was not easy. The study focused on a small number for the sample size using the sampling methods that have been described above. The International Olympic Committee has 500 staff and consultants but less than five of them deal with issues related to sustainability. LOCOG and the ODA had around 500 staff but very few staff focused on the sustainability programme. Likewise, very few staff of the UK Department of Communities and Local Governments dealt with issues related to the London Games.

There are 204 NOCs and 3 OCOGs (Sochi 2014, Rio 2016 and Pyeongchang 2018) but only a handful of staff from these OCOGs are linked to sustainability issues and the greening of the London 2012 Games.

Finding athletes and fans from test events proved to be a challenged as they were either very difficult to find or not keen or unwilling to allocate time to participate in the study. Thus the sample size was kept at manageable level. In addition, it was also very challenging to come up with exact numbers of populations for some population groups including, the UK Department of Communities and Local Government, NGOs and companies that were involved in the preparations of the Games, fans and athletes that participated in test events. Based on consultations with the delivery agencies, the ODA and LOCOG, estimates were therefore used for these population groups.

4.4 Data Collection Methods

The study collected data which were both quantitative and qualitative in nature. The quantitative data were collected using questionnaires while qualitative data were be collected using key informant interviews, focus group discussions and direct observations and document review. The following are the details of each of these techniques.

4.4.1 Questionnaires

Questionnaires were used to collect data from athletes, fans, companies and Non-Governmental Organizations involved in the preparations of the London 2012 Olympic Games and experts on greening of mega sport events. The questionnaire consisted of three sections: section A, covering demographic information; section B, capturing the greening measures undertaken for the London 2012 Games; and section C, focusing on

the significance of the greening measures undertaken within the context of the London 2012 Games. The questionnaires were self-administered through e-mails. The respondents were given time to fill out the questionnaire and e-mail the questionnaires back to the researcher. This reduced the chances of biasness which may have been as a result of the researcher involvement. The results of the questionnaires can usually be quickly and easily quantified either manually by a researcher or electronically through the use of a software package. Questionnaires can be analysed more 'scientifically' and objectively than other data collection instruments. When data has been quantified, it can be used to compare and contrast other research and may be used to measure change. Questionnaire data can be used to create new theories and or test existing hypotheses. Questionnaires reduce bias as there is uniform question presentation and no middle-man bias

4.4.2 Key Informant Interviews

Interviews were used to collect data from the key informants. The key informants included officials in charge of environmental initiatives in LOCOG; the ODA; the UK Department of Communities and Local Governments; the IOC, NOCs and OCOGs.

The IOC was expected to give information concerning their role and perspective on the greening of the London 2012 Games, whether they had any role in enforcing the implementation of the greening measures and why they felt it was important for the Games to leave an environmental legacy.

Respondents from LOCOG and the ODA were expected to shed light on how the greening measures were conceived, implemented and monitored, the benefits that they felt these measures would bring to the communities and the extent to which they felt that these measures had positive impacts beyond the Games. Respondents from the UK Department of Communities and Local Governments were expected to provide information on how their greening standards apply to events such as the Olympic Games and if these standards contributed to the greening of the London 2012 Olympic Games. Respondents from OCOGs were expected to provide information on the greening of the Olympic Games and their perspectives on the greening of the London 2012 Games and what they felt were the successes and challenges encountered by the organisers.

Interviews have several advantages. The respondents are given time and opportunities to develop their answers. The respondents have the opportunity to take control, to define properties and direct the interview into areas which they see as interesting and significant. This can lead to new and important insights for the researcher. If respondent feels at ease in the interview, they are more likely to open up and say what they really mean. They are more likely to provide valid data. The researcher has more chance to pursue a topic, to explore with any further questions, and ask the respondent to qualify and develop their answers. Interview data therefore can have a lot more depth than the information obtained from questionnaires (Muganda and Muganda, 1999; Kothari, 2004).

4.4.3 Focus Group Discussion

Focus group discussion was used to collect data from some experts on greening of mega sport events[xi]. The information obtained from experts on greening of mega sport events focused on their overall perspectives of the benefit of greening mega sports event in general and whether they could link these general perspectives to the London 2012 Games. The experts were organized into a small group and presented with discussion topics on greening of mega-sport facilities.

The face-to-face involvement of a qualified moderator ensured that the conversation was on track, and encouraged participants' engagement without one individual dominating the meeting. Carey (1994) observes that when focus group participants are stimulated to discuss, group dynamics brings fresh thinking about a topic and results in a much more in-depth discussion. Due to the dynamic environment, the moderator can modify the topics, which are prepared before the session to make the topic more suitable for the purpose (Ibid). In traditional focus groups, it is possible for the client personnel to watch the whole discussion behind a one-way mirror.

4.4.4 Direct Observations

Direct observations were carried out to assess the green initiatives undertaken in London 2012 Olympics Games. The instruments used included a checklist, camera and a plan for the Olympic Park. The observations focused on green facilities available at the Olympic Park, the sporting complex for the London 2012 Summer Olympics and Paralympics which included waste management efforts (labelling and use of bins by spectators during Games time); visible energy and water fixtures; integration of green

spaces in the Olympic Park; and, the look and feel of the Olympic Park (whether it conveyed any visual sustainability features/messages).

The venues of interest were the Olympic Stadium, Aquatics Centre, Riverbank Arena, Basketball Arena, Copper Box, the Velodrome and the Black Water Recycling Plant. The main advantage of observational research is the noninterventionist approach as the researcher does not manipulate or stimulate the subject or situation. It is a very direct and flexible way of collecting data and simply allows behaviours and interactions to continue as they would if the researcher was not there (Adler and Adler, 1994).

4.4.5 Document Review

The study reviewed available documents on environmental sustainability through greening of sport venues and facilities for Olympic Games to complement the information obtained through questionnaires, interviews, focus group discussion and direct observations. This was done through reviewing documentaries posted on the internet, journals and magazines.

The study reviewed available print and electronic documents with different perspectives on the greening of the London 2012 Olympic Games in particular, and the greening of mega sport events in general. Documents were also reviewed on the basis of the findings and conclusions of this study. Document review has a number of advantages. The information contained in document is independently verifiable. The document review process can be done independently, without needing to solicit extensive input from other sources. Document review is typically less expensive than collecting the data on your own.

4.5 Data Analysis Methods

The following is the outline of data analysis:

4.5.1 Data Organization

Data collected using questionnaires were edited, coded and entered into the Statistical Package for Social Sciences (SPSS) system. During the editing of the raw data, questionnaires were checked for errors and any missing data and corrected. Responses from open-ended questions, interview guides, direct observations and, recordings from focus group discussion were analysed through content analysis. Content analysis is a

methodology in social sciences for studying the content of communication. As observed by Baxter and Jack (2008), as in any other qualitative study, collection and analysis occur simultaneously. Data collected using the interviews and focus group discussion were analysed for common patterns directly during and after the interviews and discussion and used for findings and to draw conclusions. Content analysis is also a research tool used to determine the presence of certain words on concepts within texts or sets of texts. Researchers quantify and analyse the presence, meaning and relationships of such word and concepts, then make inference about the messages within the text.

4.5.2 Exploratory Data Analysis (EDA)

Exploratory data analysis (EDA) is an approach to analysing data sets to summarize their main characteristics in easy-to-understand form, often with visual graphs, without using a statistical model or having formulated a hypothesis. Exploratory data analysis (EDA) was used to generate measures of central tendency (mean), measure of dispersion (standard deviation), frequencies, percentages and graphics for data visualization. The descriptive statistic (frequencies, percentages, mean and standard deviations) were generated from SPSS.

The Pearson product-moment correlation coefficient[xii] was used to analyse the association between the independent variables (green construction, water management, waste management, energy efficiency, transport management, green procurement and behaviour change) and the dependent variable (the greening of mega sport facilities for sustainable development of sports).

The researcher performed a regression analysis to establish the association between the independent variables (measures taken by delivery agencies for the London 2012 Olympic Games) with the dependent variable (greening of mega sport facilities for sustainable development of sports) of the study.

The following regression model was adopted for the study:

$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + e$

Where:

y = greening of mega sport facilities for sustainable development of sports

β_0 = Constant Term

β_1= Beta coefficients

X_1= Green construction

X_2= Water management

X_3= Waste management

X_4= Transport management

X_5= Green procurement

X_6= Behaviour change

X_7= Energy efficiency

e= the standard error

The quantitative data was supplemented by qualitative data collected through the key informant interviews, focus group discussion, direct observations and document review. The qualitative data was analysed using content analysis as discussed in section 4.5.1.

4.5.3 Hypothesis Testing

The study used the Chi-Square Test[xiii] on statistics generated by SPSS to test the null hypothesis for the study. Chi Square is much easier to compute than other statistical hypothesis test methods. Another unique value of Chi Square is that it can be used to treat data, which have been measured on ordinal scale as is the case of Likert scale questions in the questionnaire used in this study. Chi Square also test hypotheses that do not require normal distribution or variance assumptions about the populations from which the samples were drawn and are designed for ordinal or nominal data (non-

parametric test). The Analysis of Variance (ANOVA) results was also used in testing the hypothesis. In the Analysis of Variance the F statistics are used in rejecting or adopting the null hypothesis. The null hypothesis is adopted if the calculated F value is less than the value of F critical read from statistical tables.

[ix]The 2012 Summer Olympic Games took place in London, United Kingdom from 27 July to 12 August 2012 and the Paralympic Games were held from 29 August to 12 September 2012. The 2012 Summer Olympic programme featured 26 sports and a total of 39 disciplines. The 2012 Paralympic Games programme had 20 sports and 21 disciplines.

[x] Test events are events that were organized prior to the Olympic Games to test the viability of the venues and facilities.

[xi] Note that experts on green sports facilities were divided into 2 groups and different data collection methods used for each of the groups. Data from experts who were familiar with the London 2012 Games (5 in total) was collected through the questionnaire while data from general experts on greening of sport facilities not closely linked to the London 2012 Games (5 in total) was collected through a focused group discussion on the margins of the IOC Sport and Environment Commission meeting in Lausanne, Switzerland on 11 May 2012.

[xii] The Pearson product-moment correlation coefficient (Pearson correlation coefficient) is a measure of the strength of a linear association between two variables and is denoted by *r*. The Pearson correlation coefficient, *r*, can take a range of values from +1 to -1. A value of 0 indicates that there is no association between the two variables. A value greater than 0 indicates a positive association, that is, as the value of one variable increases so does the value of the other variable. A value less than 0 indicates a negative association, that is, as the value of one variable increases the value of the other variable decreases.

[xiii] Chi-square is a statistical test commonly used to compare observed data with data we would expect to obtain according to a specific hypothesis. From Chi-Square Tests the probability (P) values less than the significant level of 0.05 lead to rejection of null hypotheses. P values more than the significance level of 0.05 led to acceptance of null hypotheses.

The Chi Square test is the most important and most used member of the nonparametric family of statistical tests. Chi Square is employed to test the difference between an actual sample and another hypothetical or previously established distribution such as that which may be expected due to chance or probability. Chi Square can also be used to test differences between two or more actual samples.

CHAPTER FIVE

RESULTS AND DISCUSSIONS

5.1 Introduction

This chapter presents the results of the study whose main objective was to determine the effectiveness of the greening of the London 2012 Olympic Games. The study specifically sought to: determine whether the Games provided alternative perspectives for reviewing the potential for hosting mega sport events beyond the strict cost-benefit analysis; identify measures taken by the delivery agencies to ensure that the London 2012 Olympic Games leave a green legacy; analyse how the green building measures were designed, executed, monitored and evaluated for success, including handling of challenges; and, analyse the extent to which the measures taken by delivery agencies influenced greening of the building industry with respect to construction of venues and facilities. This chapter presents the findings, discusses them and draws conclusions from the findings.

5.2 Response Rate and Reliability of Research Instruments

The response rate and the reliability of questionnaire were determined using the spearman rank order correlation (r). The findings are presented in subsections 5.2.1 and 5.2.2.

5.2.1 Response Rate

Table 5 shows the response rate for the study.

Table 5: Respondents

Target group	Targeted	Respondents	%
International Olympic Committee (IOC)	5	2	40.0
Organizing Committee for the Olympic Games (LOCOG)	10	6	60.0
Olympic Delivery Authority (ODA)	8	5	62.5
UK Department of Communities and Local Governments (staff directly responsible for Olympic related activities)	5	5	100
Organizing Committees of Olympic Games (OCOGs) (staff directly responsible for sustainability issues and interaction with LOCOG)	6	5	83.3
Non-governmental organizations involved in preparation for London 2012 Olympic Games	10	10	85.7
Companies and contractors directly or indirectly associated with the London 2012 Olympic Games	20	16	80.0
National Olympic Committees (NOCs)	6	3	50.0
Athletes	15	15	100
Fans	15	15	100
Experts on greening mega sport events	10	8[xiv]	61.5
Total	110	90	81.8

Table 5 above shows that out of the sample size of 110 respondents, the study managed to collect data from 90 respondents. This constituted a response rate of 81.8 per cent. The response rate is within Mugenda and Mugenda's (2003) prescription of significant response rate for statistical analysis which they established at a minimal value of 50 per cent. Table 5 also show that the study gathered information from 11 major stakeholder groups of London 2012 Olympic Games. Coverage of major stakeholders during data collection ensured that external validity was achieved. The attainment of external validity ensures that the study findings can be generalized to other mega sport events.

Questionnaires were used to collect data from 61 respondents who included 15 athletes, 15 fans, 10 officials from the each of the 10 Non-Governmental Organizations involved in preparation for London 2012 Olympic Games and 5 experts on greening of

mega sport events who were familiar with the London 2012 Games, and 16 officials from companies that were associated with the London 2012 Games preparations. Interview guides were administered to a total of 26 respondents who included 2 officials from International Olympic Committee (IOC), 6 officials from Organizing Committee for the Olympic Games (LOCOG), 5 officials from Olympic Delivery Authority (ODA), 5 officials from UK Department of Communities and Local Governments, 5 officials from Organizing Committees of Olympic Games (OCOGs) and 3 officials from National Olympic Committees. Focus group discussion involved 3 environmental experts who were not closely linked to the London 2012 Olympic.

5.2.2 Reliability of Research Instruments

The reliability of the questionnaire was determined and Spearman rank order correlation (r) was used to compute the correlation co-efficient to establish the degree to which there was consistency in eliciting similar response every time the questionnaire was administered. Spearman rank order correlation (r) was 0.7 which was within the acceptable range of reliability (0.6-0.9) indicating that questionnaires used were reliable.

5.3 Preparatory Measures Taken to Deliver a Green Legacy for the London 2012 Olympic Games

The study examined the preparatory measures taken to deliver a green legacy for the London 2012 Olympic Games. The respondents were asked to indicate the extent to which preparatory measures influenced the delivery of a green legacy for the London 2012 Olympic Games. Table 6 shows the study findings.

Table 6: The Extent to Which Preparatory Measures Influenced Delivery of a Green Legacy for the London 2012 Olympic Games

Effect	Frequency	Percentage
Moderate extent	11	12.6
Great extent	62	70.9
Very great extent	14	16.5
Total	87	100

From the study findings in Table 6, the majority of the respondents (70.9%) indicated that the preparatory measures taken for the London 2012 Olympic Games greatly influenced the delivery of a green legacy for the Games. The study established that the successful delivery of green games was greatly attributed to the environmental sustainability strategies developed at the very beginning of the preparations of the Games.

The International Olympic Committee (IOC) has been working on environmental sustainability since 1994. Environmental concerns are part of Olympic Games candidature procedure documentation. Sustainability references are found in the Olympic Charter[xv].

The findings revealed that greening of venues and facilities for the London 2012 Olympic Games involved various organizations. The main delivery agencies were the London Organizing Committee for the Olympic Games and Paralympic Games (LOCOG), and the Olympic Delivery Authority (ODA). The ensuing "One Planet Living" concept became the basis for the sustainability programme for the London 2012 Games. At a strategic level, therefore, all decisions around venues and facilities were informed by this concept and resulted in a Sustainable Development Strategy 'Towards a One Planet 2012' published in 2007.

The ODA released the Sustainability Development Strategy in January 2007. The strategy set out 12 objective areas[xvi] (six environmental and six sustainability objectives areas). Specific environmental target in the Sustainable Development Strategy included 40 per cent reduction in use of portable water, 50 per cent reduction in operational carbon footprint, recycling and reuse (90 per cent in land clearance, 90 per cent for construction and overlay and 70 per cent during Olympic Games i.e. operational waste),

zero waste to landfill, and the enhancement and preservation of biodiversity. In addition, the ODA allocated funds amounting to 10 million Pounds for environmental sustainability and also ensured that much more was spent on sustainability as sustainability was fully integrated in all project budgets.

LOCOG on the other hand, had a sustainability and venue infrastructure plan for delivering sustainability through overlay work. LOCOG also had a sustainability management plan for the venue with key aims - leave no trace, zero waste to landfills, zero harm and positive legacy. The objectives derived from the key aims included: minimization of carbon emissions; reduction of water use; conservation of biodiversity; minimization of environmental impact; minimization of waste; minimization of carbon emission, conservation of energy, and prevention of environmental incidents.

The Worldwide Fund for Nature (WWF), and BioRegional – a UK based social enterprise and development group organization - signed a Memorandum of Understanding (MoU) with the London 2012 Bid Committee in 2004 to work with the Committee to develop the sustainability strategy for the London bid. This strategy was based on WWF and BioRegional's "One Planet Living" concept. WWF and BioRegional also worked closely with the sustainability staff of the ODA and LOCOG, particularly over the period from 2005 – 2009 to provide constructive advice and technical input, and to lobby for the delivery of green options. As the programme accelerated and the number of staff grew rapidly, it is fair to say that their influence diminished.

The findings revealed that the concept of sustainability was enshrined in the London 2012 Olympic Games from the bid phase into the Games preparations. After winning the bid, the delivery agencies both developed strategies to ensure that the bid commitments were implemented. They used the strategies to set key targets that included actual percentage reductions expected in each area. This approach is clearly linked to the Theory of Sustainability which as described by Norton (2005) in section 3.1.1 of this report, is the ability to ensure that the outcome of a process is maintained over time. The measures undertaken by the Games delivery agencies ensured that the Games leave a green legacy. This is in line with the statement by Dodouras and James (2004) that any kind of development programme has to be designed to achieve sustainable development. It also a practical application of the assertion by Gibberd (2002) that one of the most important steps in developing sustainable venues is to ensure that elements of sustainability are incorporated as early as possible in the conceptualization of the project.

We can conclude that the approach by the London 2012 delivery agencies and key players including the Bid Committee ensured sustainable development around the London 2012 Games, particularly in the design and construction of venues and facilities. The conclusion is in line with the commitment in the Olympic Charter (2011) that the Olympic Movement will encourage and support responsible concern for the environment and promote sustainable development in its activities.

Stakeholders' engagement is crucial for any project of this scale and the findings revealed that stakeholders including NGOs such as the Worldwide Fund for Nature (WWF) and BioRegional were involved in the process right from the bid campaign. The findings also revealed that local communities and other special interest groups such as disability access groups and representatives of athletes were involved through until the final stages of construction. This can be linked to Social Capital Theory described in section 3.1.2 of this report and viewed by Banik (2006) as the time and energy that community organizations spend on community development, civic engagement and responsibility, recreation and other activities that create social bonds and cohesion between individuals and groups for attainment of a common goal. The importance of working together with stakeholders, particularly NGOs in the preparations of mega sport events is supported by UNEP (2009) and Riddlestone (2011) who observe that NGOs and community groups can bring unique perspectives to the creation of sustainable sports and that their motivation is for the greater good of society.

We can conclude that the involvement of various stakeholders in the London 2012 Games preparations ensured as wide a perspective as possible and enriched the greening of the Games. It also ensured that there was oversight from interest groups for the full implementation of the greening objectives. This was clearly evident by the independent assurance role that the Commission for Sustainable London played throughout the Games preparations.

5.4 Greening initiatives for London 2012 Olympic Games

There was a clear push to integrate environmental sustainability in the London 2012 Olympic Games. Some of the reasons for this included: the fact that sustainability issues had become mandatory in Olympic Games with the environment becoming the third pillar of Olympism in 1994; sustainability was increasingly becoming part of the agenda for many processes around the world; and, also the fact that the London 2012 Games were conceived with the objectives of regenerating a highly neglected and depressed area of East London and to showcase the area as a model for sustainable development.

The greening initiatives for the London 2012 Olympic Games covered the following areas: selection of sites for venues and facilities; design of venues and facilities; construction of venues and facilities; water management; minimizing air, noise and water pollution; use of environmentally friendly energy sources during construction and operation of the venues and facilities; maintenance of natural vegetation and development of new green spaces around venues and facilities; waste management, and; institution of building management systems including monitoring and evaluation of venues and facilities. The next sub-sections will present the findings around these issues, discuss the findings and draw conclusions from the findings.

5.4.1 Selection of Sites for Venues and Facilities

The study explored the extent to which the site selection promoted the delivery of environmentally sustainable mega sport. The respondents were requested to indicate the extent to which the site selection of the London 2012 Olympic Games effectively enabled environmentally sustainable of the Games. The responses were rated on a five-point Likert scale on which 1=no extent at all; 2= little extent; 3=moderate extent; 4= great extent; and, 5=very great extent. Table 7 shows the study findings.

Table 7: The Extent to which the Site Selection Promoted Environmentally Sustainability in the London 2012 Games

Effect	Frequency	Percentage
Moderate extent	13	15.1
Great extent	63	72.6
Very great extent	11	12.3
Total	87	100.0

From the study findings in Table 7, majority of the respondents (72.6%) indicated that the site selected for the London 2012 Olympic Games greatly contributed to the delivery of environmentally sustainable Games. The study findings reveal that site selection for the London 2012 Olympic Games served as an impetus to the environmental sustainability agenda for the Games.

The qualitative data collected from the delivery agencies revealed a number of considerations made during site selection for the London 2012 Olympic Games and how the considerations lead to greening of the sports. The Olympic Park is located close to the Stratford (rail, underground and bus) station which is served by several different lines that connect to the rest of London as well as Essex. The site for the Olympic Park was a degraded area of London, both environmentally, economically and socially. The siting of the Olympic Park on a brownfield; a former industrial land, with high levels of dereliction, within communities suffering from widespread deprivation including low literacy, high crime rates and high unemployment offered strong opportunities for regeneration. Reconnection of this area, both physically and socially through investment spanning a timeframe far beyond the end of the Olympic Games was central to the promise of delivering a sustainability legacy from the Games. The remediation of the contaminated and highly depressed part of the host city into an environmental showpiece echoes an approach that has been implemented by previous Olympic Games organisers, notably the Sydney 2000 Olympic Games and the rehabilitation of the Homebush Bay into the landmark Sydney Olympic Park described in section 3.2 (History and Legacy of the Olympic Games) of this report.

The compact nature of the London Olympic Park and the level of integration supported the legacy objective of the Games. Mixing residential housing (through the Olympic Village with over 5,000 homes after the Games) with commercial properties and

sporting facilities will provide a post-Games environment in which a vibrant new community would be created. The concept of legacy was behind the selection of venues for the Games.

The rivers that run through the Park were assessed from a holistic perspective. The banks of the rivers were cleaned and a design for long term use of the rivers was put in place. The improvement of the river and the creation of new parkland in a spine running down the centre of the Olympic Park were of great environmental importance as they connected existing biodiversity areas from the north to the south of the Park. This mirrors the view of the United States Environment Protection Agency (2012) that developing a compact community or what it calls a "smart growth" options with techniques such as mixing land uses (e.g. homes, offices and shops) and transit accessibility lessens the environmental impacts of development. The selection of the site also took into account the good transport connections to various parts of London and concurs with Lallanilla (2012) that structures that are sited near major transport hubs encourage the use of public transit and minimize emissions.

In conclusion, the selection of the sites for the Olympic Park was in line with the "One Planet Living" concept of the London 2012 Games and ensured that the compact nature of the Park provided everything that would be necessary to sustain a community and minimized the need for people residing in the Park area to look elsewhere for their basic needs. The selection of the site for the Games also triggered the redevelopment of the region confirming the claim by McCarthy (2011) that the main objective for sustainable London 2012 was to act as a catalyst for the redevelopment of East London.

5.4.2 Design of Venues and Facilities

The study investigated the extent to which the design of the venues and facilities of the London 2012 Olympic Games contributed to the greening of the Games. The respondents were requested to indicate the extent to which the design process facilitated the greening of the London 2012 Games. Table 8 shows the study findings.

Table 8: The Extent to which the Design of Venues and Facilities for the London 2012 Olympic Games Contributed to the Greening of the London 2012 Games

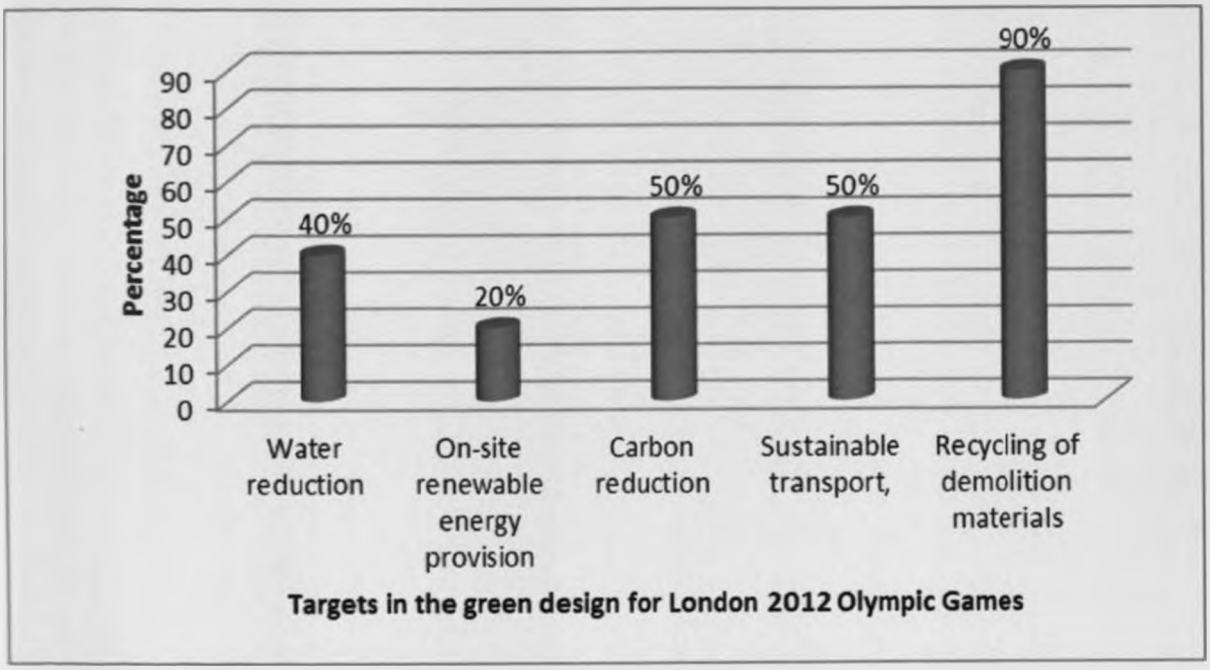
Effect	Frequency	Percentage
Moderate extent	6	6.8
Great extent	74	84.6
Very great extent	7	8.6
Total	87	100.0

From the study findings in Table 8, the majority of the respondents (84.6%) indicated that the design of venues and facilities greatly contributed to the greening of the venues and facilities of the London 2012 Olympic Games. The study findings revealed that facility design and construction for London 2012 Olympic Games was a major factor that led to delivery of environmentally sustainable Games.

The qualitative data revealed that the London 2012 Olympic Games delivery agencies promoted creativity in design. The Sustainable Development Strategy (SDS) published in early 2007 gave details of the targets and became part of the planning documentation.

Targets in the SDS were engrained into design of venues and facilities through conditions set on the planning consent. Figure 11 below illustrates various targets in the green design for the London 2012 Olympic Games.

Figure 11: Greening Targets for London 2012 Olympic Games



The targets of the Sustainable Development Strategy shown in Figure 11 were translated into project briefs (Implementation Guides to Project Teams) and supported by design and reporting guidelines. Contractors were not allowed to progress from one level to another if reporting requirements have not been met.

There is strong evidence that the development of a strong green code at the bid stage resulted in a strong sustainability framework being applied to the master plan and then the development of design codes and requirements for venues and facilities. The design of venues and facilities reflects in practice, the assertion by the Environmental Building News (1999) in section 1.1.1 of this report, that green venues are those buildings that are designed to use resources such as energy, water and construction materials more efficiently. The evidence of this is found in the lightweight Olympic Stadium, the Velodrome and with facilities such as the Combined Cooling, Heat and Power (CCHP) plant. The Velodrome makes use of exterior features such as FSC certified wood and green walls. The Aquatics Centre likewise has a green walls and the Olympic Stadium makes extensive use of recycled gas pipes.

Figure12: External View of the Lightweight Olympic Park with Recycled Gas Pipes

Source: Author (2012)

Figure 13: **External View of Velodrome**

Source: Author (2012)

The findings revealed that the clear guidance, technical support and assurance function by the ODA contributed to almost all the targets being achieved. This is in line with the argument by Gibson, Lloyd, Bain and Hottell (2008) that promoting sustainability thinking in the design process encourages designers to explore various options of selecting environmentally-friendly building materials such and recycled products.

In conclusion, the fact that sustainability and legacy were key elements of the London 2012 bid ensured that these two elements were fully incorporated in the design and execution of all projects related to the Games as well as ensured the success of the greening of the Games. This conclusion is in line with UNEP (2011) observation that the greatest opportunity to attain higher environmental performance in buildings is in the early stages of their design.

5.4.3 Construction of Venues and Facilities

Various green construction practices were applied in the construction of venues and facilities for London 2012 Olympic Games. Greening measures such as use of recycled concrete (for gabion baskets) as well as concrete using secondary aggregates and cement and FSC certified timber were used for construction. The most prominent

measures included the green procurement for construction materials and soil remediation practice.

Each contractor was obliged to procure timber from a central supply panel that was set up by the delivery agencies or justify why this was not viable. The rail head was centrally managed, and a central waste management hub for construction was established through competitive tender with all contractors required by contracts to use this facility. This ensured ease of monitoring and reporting for key targets around sustainable timber, sustainable transport, and recycled content (particularly in concrete – a bulk building material) and of course targets around the recycling and reuse of demolition and construction waste. This clearly aligns with the conceptual framework of the study as organizers ensured that greening measures were fully integrated in the construction of venues and facilities and as stipulated in the framework, this integration serves as one of the measures for global environmental sustainability.

Tenders to build contained specific sustainability questions and experts within the Sustainability Teams of the delivery agencies evaluated the responses. Commitments were written into contracts of contractors and workshops and training opportunities provided to contractors to raise the awareness on expectations, reporting requirements and the technical support available. This ensured that partnerships were built with contractors and designers, and that support was provided to them on the construction sites rather than trying to control delivery of sustainability remotely.

The use of the railhead ensured the transportation of most of the bulk materials (construction materials and waste) on and off the site. This approach is likely to have a significant impact on how the construction sector does business.

The findings demonstrated that an integrated management process was adopted by the delivery agencies to ensure that sustainability was fully incorporated during the construction process. The findings also revealed that procurement was centrally coordinated and that there were guides for procurement of items such as timbers and other construction materials and that green procurement and sustainability clauses were included in all contracts. There were strict monitoring and reporting requirements ensuring that contractors took the issue of sustainability very serious but collaborative partnerships and ensuring that contractors were informed were also critical to delivery.

The findings revealed that workshops and capacity building programmes were organized by the sustainability teams to train contractors on sustainability issues. This ensured

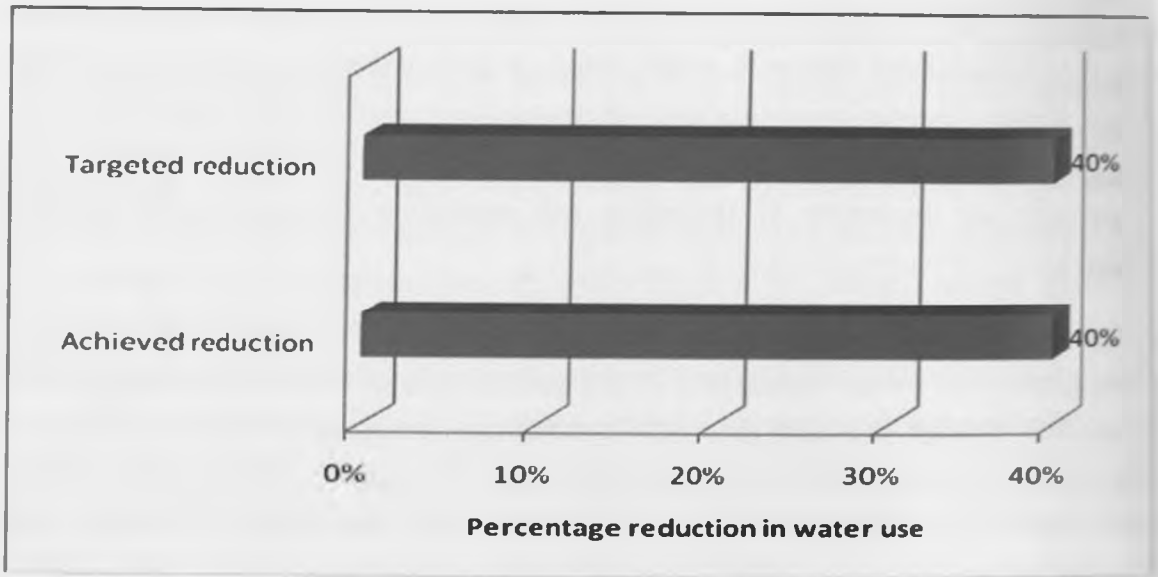
that contractors were more appreciative of and comfortable with integrating sustainability dimension into their work on Olympic projects, but also the importance of integrating sustainability aspects in other projects that they were involved in beyond the Olympic Games, thereby promoting the transformative aspect of the Games. It is in line with the observation from UNEP (2011) that training and skills enhancement programmes are important in preparing the workforce for implementing green measures.

We can conclude that processes were put in place by the delivery agency to ensure that greening measures were incorporated in the construction of venues and facilities. This was evident through the contracts with contractors, the centralised coordination of issues such as procurement and the organisation of capacity building and training programmes for contractors as well as through clear reporting, monitoring and evaluation processes.

5.4.4 Water Management

The London 2012 Olympic Games were to be held in summer - a period when drought was expected in the United Kingdom. A team was therefore constituted to oversee water conservation during the Games. Figure 14 shows the target for reduction in water use and the achieved reduction in water use.

Figure 14: Targets for Water Use at the Olympic Park



The target to reduce water use by 40 per cent was achieved through water efficient fixtures and fittings and potable water substitution. Water needs for different venues were considered.

The findings revealed that measures implemented included the use of low flush fixtures and fittings, the use of a non-portable water systems and rainwater harvesting and use for flushing of toilets in venues such as the Copper Box. The ODA developed the largest non-portable water network and distribution system in the UK. These measures ensured that the targets were met and is a practical reflection of the observation by Brown et al. (2009) in section 3.4.2 of this report, that a viable transition to a more sustainable water management system is one that employs pollution prevention at source, captures and makes use of multiple water sources (rivers, ground, rain, storm and recycled water). It is also in line with the statement by Lallanilla (2012) that smart water efficient features of green buildings include low flush toilets, sinks and showers as wells as the reuse of grey water and taking advantage of rainwater.

The site remediation has reduced the level of contaminants picked up when rain water sips into the ground and improved surface water quality. To maintain water quality, cut off walls and localized water treatment facilities were erected in areas where residual ground or ground water pollution remain high.

A black water treatment plant was set in the Olympic Park. In addition, the surface water and foul water (sewage) networks were separated across the Olympic Park

reducing the load on local sewage treatment works. The approach extended beyond the traditional approach of having the most advanced water saving features in the venues to having legacy impacts that will benefit communities beyond the confines of the Olympic Park. This included the development of a flood control feature at the wetland bowl in the Park that helps to ensure that at least 200 households downstream are not at risk of flooding. In addition, the remediation of contaminated land improved surface water quality.

From these findings, we can conclude that an integrated approach to water management was adopted by the London 2012 Games organizers. This is evident in the use of low flow water fixtures in venues and facilities as well as the water treatment processes and the extensive use of non-potable water in venues. These measures ensured that the Games achieved the envisaged target of 40 per cent.

Beyond the measures to reduce the use of water in venues, we can conclude that the Games contributed to improving water quality in the Olympic Park through the remediation measures. The Games organizers also contributed to addressing other long-term issues related to water management such as the flood control feature around the wetland bowl of the Olympic Park.

Figure 15: Wetland Bowl

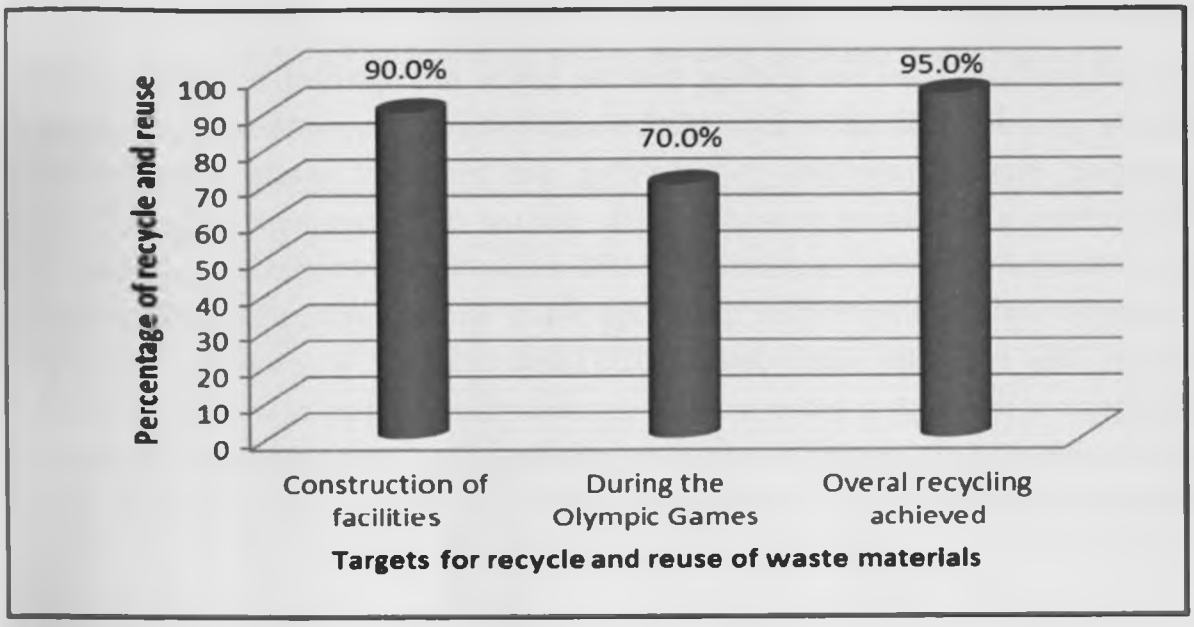
Source: Author (2012)

5.4.5 Waste Management

Waste minimization was a key priority for the London 2012 organizers. They had a waste management plan with a zero waste to landfill target for the Games. The waste streams for the Games were classified in three categories: recyclable waste; non-recyclable waste; and combustible waste. To meet the target of zero waste, two companies – MSX and SOITA - were contracted to oversee waste management during construction and at Games time respectively. During construction, waste was segregated on the site and recycling/reuse of materials was maximized.

Figure 16 illustrates various targets for recycle and reuse of waste materials during the London 2012 Olympic Games. Different targets were set for construction of venues and facilities and during the events.

Figure 16: Targets for Recycling and Reuse of Waste at the Olympic Park



There was a 90 per cent target for recycle and reuse of waste materials during construction (Figure 16). The remaining 10 per cent was energy from the waste. A 70 per cent target for recycle and reuse was set for the Games time with the remaining 30 per cent being energy. The findings revealed that 95 per cent of construction waste was recycled. The zero waste to landfill commitment was a positive driver for how the events industry thinks about waste through procurement of materials that are not environmentally harmful.

The use of low embodied impact materials (those with high recycled content and healthy materials) were pursued. For example on the Horse Guards Parade site, there were compostable cups for the workers on site and a biodegradable mesh was installed to clad the seating stands rather than the conventional polypropylene mesh used. This approach echoes Macozoma (2002) who said that the prevention and management of waste on construction sites reduces cost of raw materials and the disposal of construction and decommissioning waste also ensures that avoidable waste is reduced.

The findings revealed that there was a clear policy of incorporating bins in the venues. However, from observations at the Olympic Park during the Olympic Games, the bins were not enough and the signage was confusing as in some cases, visitors were observed to be putting waste in the wrong bins. This might have resulted partly from

the three and four bin systems which might have confused spectators on where to put the waste.

We can conclude from the findings that the waste management programme of the delivery agencies included all aspects of the greening of the waste sector. The use of embodied impact materials, the recycling and reuse of waste materials from construction, a zero waste to landfill policy, the use of procurement process to avoid environmentally harmful materials and the centralized management of waste by companies that were contracted to manage waste during construction and during the Games. This is in line with UNEP (2011) description of a comprehensive waste management approach in which material use and the generation of waste is minimized, unavoidable waste is recycled or remanufactured and any remaining waste is treated to become least harmful to the environmental and health or to generate new value such as energy.

From observation we can conclude that waste management during the Games was a challenge as spectators were observed putting waste in the wrong bins.

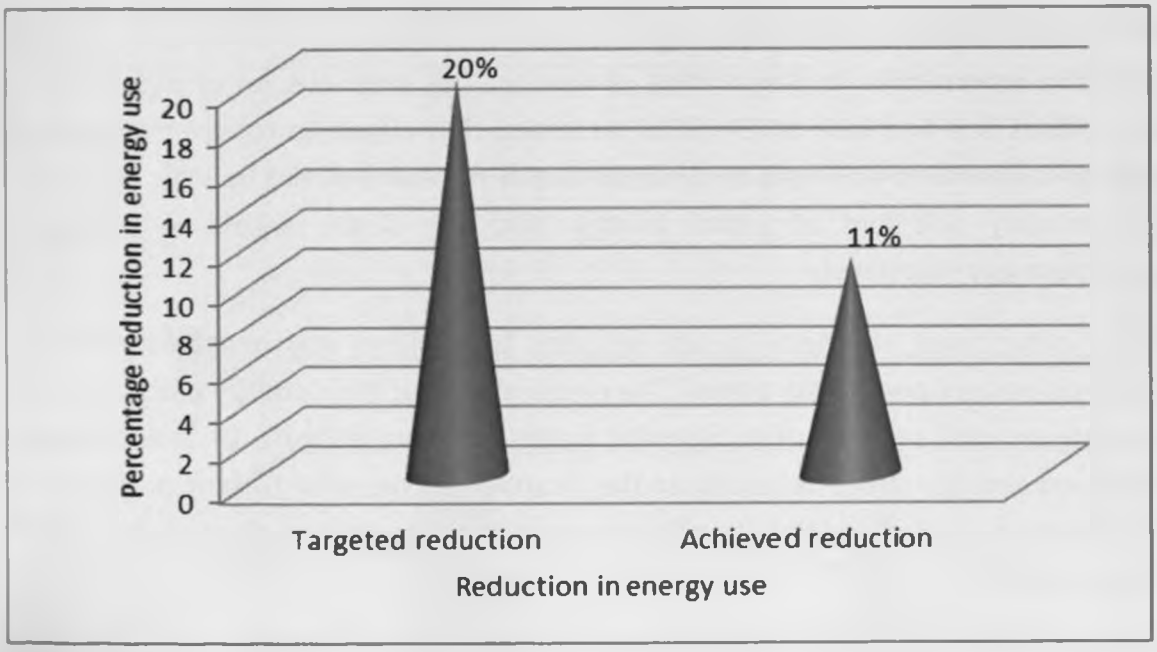
Figure 18: Bins at the Olympic Park

Figure 17: Bins at the Olympic Park

5.4.6 Energy Management

Management of energy was also a priority for the London 2012 Olympic Games. The energy target and the achieved reduction in energy use are illustrated in Figure 19.

Figure 19: Reduction in Energy Use through Renewable Energy



Source: Author (2012)

Figure 19 shows that from a target of 20 per cent reduction of energy through the use renewables, 11 per cent reduction was eventually achieved. The energy philosophy of the organizers from the design stage was always mean, lean and green and the findings revealed that the mean, lean and green philosophy yielded 50 per cent reduction in energy sources. The mean approach focused on reduction of energy demands as much as possible through improved insulation, extensive use of natural lighting and exploitation of natural ventilation, and high efficiency monitoring and evaluation systems.

A Combined Cooling and Heat Power (CCHP) system ensured the lean aspect of the design. During operation, CCHP provides power and hot water to all the venues and in the summer, the system provides cooling for the Copper Box and Media Centre. The system operates predominantly with high efficiency gas turbines but also has a biomass boiler which is further being considered for the Legacy phase of the project. Ammonia chillers rather than HFC chillers are provided at the Energy Centre offering a lower total

Environmental Warming Impact for these cooling systems. These measures reflect the position of the IEA (2010) referred to in section 3.4.1 of this report, that greening the energy sector will also require improvement in energy efficiency, which alongside a much greater supply of renewable energy will lead to reducing greenhouse gas emissions as well as other types of pollution.

The Games organizers attributed a high importance to reducing the demand for energy during the construction and operation of venues. This emphasis on energy in venues and facilities is in line with UNEP (2011) assertion that efforts to reduce energy use in buildings is central to attempts to minimise use of resources as the building sector uses approximately one-third of global energy (and the single largest contributor of greenhouse gas emissions).

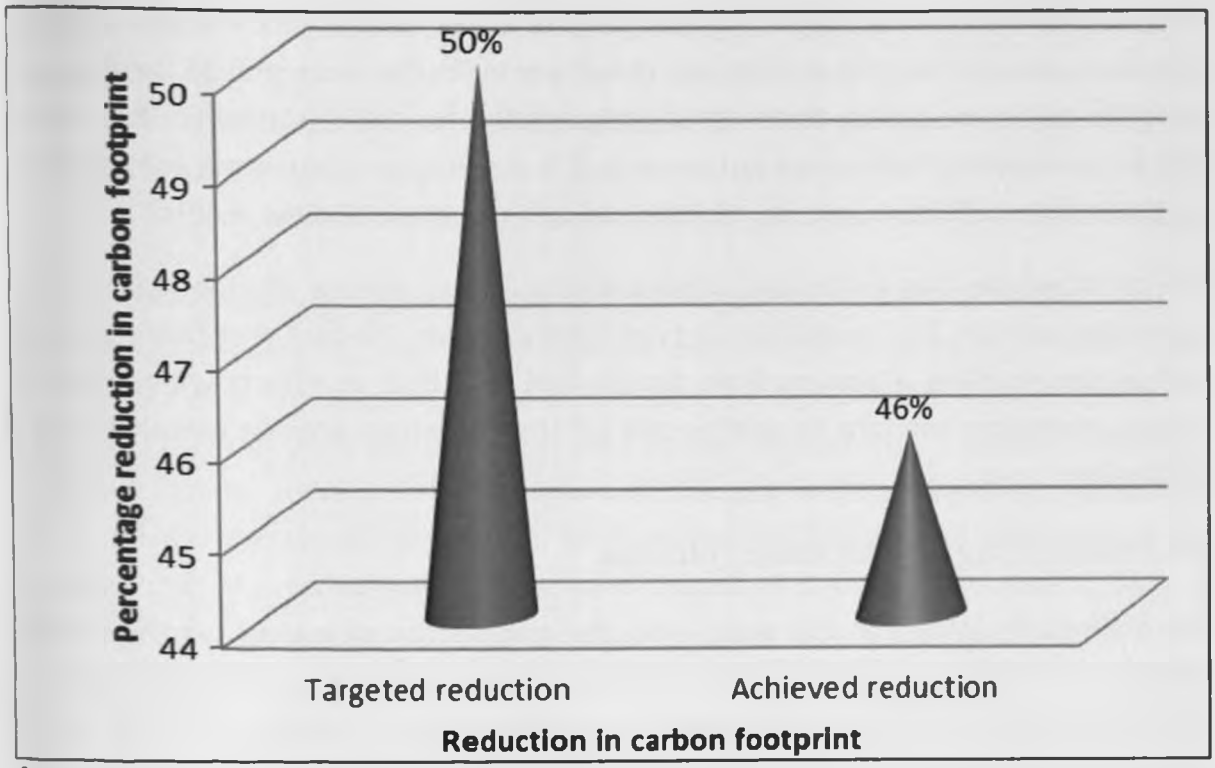
On the other hand, the findings also revealed that energy was one area where the Games organizers performed poorly. The green aspect of their energy philosophy only achieved about 50 per cent of its intended target as shown in Figure 19. In addition, the design and security issues necessitated the scrapping of the wind turbine project which was meant to account for the shortfall. It was too late to recover the lost opportunity through other measures.

The study concludes that, overall, the opportunity for a holistic, truly innovative approach around the green aspect of the energy philosophy for the Olympic Park, was missed. However, the pragmatic and ad hoc approach that the organizers adopted for reduction in energy use had many significant benefits which included having low embodied carbon in the design of venues and facilities and establishment of a district CCHP plant that is expected to extend into legacy.

5.4.7 Minimization of Carbon Footprint

Figure 20 below illustrates the target reduction of carbon footprint and the achieved reduction in the carbon footprint for the London 2012 Olympic Games.

Figure 20: Minimization of Carbon Footprint



Source: Author (2012)

The findings revealed that at a strategic level, the London 2012 organizers estimated their carbon footprint and used carbon management processes to reduce their climate impact. However, it is worth noting that some of this work took place well after the design phase for venues and facilities and was too late to influence some of the designs. A target was set to achieve a 50 per cent reduction of carbon emissions in the venue and 46 per cent reduction was eventually achieved as illustrated in Figure 20. With the growing importance of climate change and discussions around the climate footprint of mega-sport events, one would have expected a more ambitious target from London 2012 that focused on avoidance, mitigation and compensation. As Gibson et al (2008) observe, to create structures that are more sustainable, it is crucial to explore all

relevant environmentally-friendly options alongside economical options, right from the design phase of any project.

The findings also revealed that there were little or no discussions around compensation or offset measures which was again not a positive lesson from the Games. Even though Olympic tickets and accreditation allowed holders to use public transport for free, there was no plan to directly engage stakeholders, particularly teams and spectators to compensate their emissions. This is contrary to UNEP (2009) which states that the emissions released into the atmosphere directly or indirectly as a result of the Games is what has to be measured, curtailed or compensated for. UNEP (2009) further argues that for an event to claim to be carbon neutral it should also compensate for travels, in particular international travels by athletes, officials spectators and the media.

We can conclude that unlike the other greening issues, climate change was an area where the London 2012 organizers did not achieve much. The fact that there were no policies for handling emissions from travels and also that no efforts were made to engage spectators and fans to compensate for their emissions provide evidence to this conclusion.

5.4.8 Minimizing Air and Noise Pollution

The findings revealed that the design and the construction of venues for the London 2012 Games incorporated sufficient ventilation for good air quality. Natural ventilation was maximised to eliminate the need for air conditioning in venues. The noise from Olympic venues such as Lord's Cricket Ground was greatly minimised.

The findings also revealed that the Code of Construction Practice was a strong driver for achieving sound environmental practices including sound air quality in Olympic venues. All contractors were required to sign up to the Considerate Constructers Scheme which required them to minimise disturbances or negative impacts such as noise, air pollution and other inconveniences. The ODA informed owners of nearby properties in advance of the work that would take place, including the duration and likely noise and vibration impact.

The ODA /CLM[xvii] invited regulatory authorities such as the Environment Agency (EA) to sit with the project management team on site. This proactive and collaborative approach with the regulatory authorities ensured openness and that best practice on noise and air quality and other environmental issues such as water quality, biodiversity,

flood management and land pollution were implemented. This in a way pointed to the level of transparency that the London 2012 Games organizers adopted in the development of their venues and facilities.

We can conclude from the findings that the delivery agencies adopted a proactive approach towards reducing pollution in addition to ensuring that the regulations were adhered to. The delivery agencies ensured that contractors met mandatory requirements for the reduction of pollution during construction but also proactively engaged the Environment Agency in the construction process to minimise incidences of pollution. This approach was in line with Sustainable Build (2008) which observes that the UK Environment Agency and other governmental bodies are keen to ensure that construction companies incorporate pollution reduction measures in their processes.

5.4.9 Development of Green Spaces and Conservation of Biodiversity

The findings revealed that new soil and overlay materials for planting trees, flowers and grass were used to develop the new landscape of the Olympic Park. Prior to the commencement of work on sites, areas with mature habitat were retained as much as possible, habitat surveys and relocation of species were undertaken. Indigenous vegetation was protected and damage to the landscape was avoided. The findings also revealed that the remediation of the land helped to promote the regeneration of vegetation and green spaces, and of course the integration of people with the newly created habitats. Birds resettled in the Park as a result of the new vegetation. A large green space on the north end of the Park was developed to enhance the river valley with native plants and promote biodiversity conservation on the Park. Green spaces were also created on some roofs including the media centre, the primary substation, and the deep foul pumping station.

The findings revealed that a permit to clear system was instituted to prevent the deliberate or accidental removal of vegetation. This system required an ecologist to approve the removal of any vegetation or trees from the Park. Various teams working on the Park were informed of ecological composition in the surrounding. The local communities were also made aware of the need to conserve the environment in the Park. Legislation on environmental issues such as spillages, waste management, impact on land and water quality guided the delivery agencies in their efforts to adhere to environmental best practices.

The importance that the delivery agencies attributed to green spaces is a manifestation of the statement by Sandstrom (2009) that green spaces are a multifunctional system with high importance to our efforts to achieve sustainable development including for recreational purposes and human well-being.

We can conclude from the findings that integration of green spaces and the regeneration and conservation of biodiversity were among the most successful greening measures for the London 2012 Games. Venues and facilities were not only interwoven into a green urban garden, but the green spaces served as recreational venues during the Games. This is evident from the extent of the green spaces observed in the Olympic Park and the way in which these green spaces were integrated into the venues and facilities at the Park (see images below).

Figure 21: **Green Space at the Olympic Park**

Source: Author (2012)

Figure 22: Green Space at the Olympic Park

Source: Author (2012)

5.4.10 Management of Green Venues and Facilities

The respondents to the questionnaire were asked to rate the extent to which the delivery agencies prioritize the following aspects of management to ensure that the greening of the London 2012 Olympic Games positively and sustainably transform the neighbouring communities and their economies. The response was rated on a Likert scale using mean on which 1=no extent at all; 2= little extent; 3=moderate extent; 4=great extent; and, 5=very great extent. Table 9 illustrates the findings.

Table 9: Management of Green Venues and Facilities

	Mean	Standard Deviation
Effective Management	4.265	0.1786
Formulation of management strategies for the greening of venues and facilities	4.187	0.0894
Training on greening facilities for contractors	4.196	0.0925
Outsourcing of services for the greening of venues and facilities to local businesses	3.462	0.2432
Providing training on green building to local communities and businesses	4.191	0.2155
Providing opportunities for local businesses to be involved in venues and facilities development	4.015	0.9865
Adherence to legal standards on green buildings	4.374	0.2041

The study findings in Table 9 above indicate that delivery agencies greatly prioritized adherence to legal standards on green buildings in order to ensure that the greening of the London 2012 Olympic Games positively and sustainably transform the neighbouring communities and their economies (M=4.374). The delivery agency also greatly prioritized effective management (M=4.265), formulation of management strategies for the greening of venues and facilities (M=4.187) and training of contractors on the greening of facilities (M=4.196). The study findings indicate that provision of training on green building to local communities and businesses was carried out by delivery agencies (M=4.191). Similarly, the provision of opportunities for local businesses to be involved in venues and facilities development was also a priority (M=4.015). The findings also revealed that there was moderate outsourcing of services for the greening of venues and facilities to local businesses (M=3.462).

The findings revealed that the delivery agencies placed much emphasis on capacity building and training of contractors and communities around the Olympic Park on green issues. This is in line with the Theory of Reasoned Action (TRA) where the delivery agencies made deliberate efforts to promote attitudes and behaviours among contractors and communities that will enable them to adopt responsible sustainability

approaches. Fishbein and Ajzen (1980) in section 3.1.3 of this report explain TRA as a theory that explains and predict human behaviour. UNEP (2011) also support the approach of the Games delivery partners by acknowledging that investing in capacity building and training is essential to support the widespread application and realization of a concept. This was an important management approach of the London 2012 delivery agencies – one that is likely to ensure that green building practices are implemented in future projects of the contractors and businesses that were involved in the Games.

We can conclude that the delivery agencies made a tremendous effort to ensure effective management and transparency around the implementation of the greening measures and that contractor were technically competent, knowledgeable and motivated to meet the sustainability targets. This is evident in the rating given by respondents to the management and training related aspects of the work of the London 2012 Games organizers.

We can also conclude that the delivery agencies ensured that their work either met or surpassed applicable standards in the UK. Although organizers prioritized adherence to legal standards, their targets were set at a much higher level than what was normally required by legal standards. This was a clear sign of the transformative intention of the organizers and is likely to influence the construction industry in the UK.

5.5 The Benefits of Greening the London 2012 Olympic Games

The study sought to establish from the respondents to the questionnaire, the benefits of the greening measures undertaken by the organizers of the London 2012 Olympic Games. The respondents were requested to indicate the extent to which the greening measures undertaken in venues and facilities benefitted the community. The responses were rated on a Likert scale on which 1=no extent at all; 2= little extent; 3=moderate extent; 4= great extent; and, 5=very great extent. Mean and Standard Deviations were computed and the study findings are shown in Table 10.

Table 10: The Benefits of Greening the London 2012 Olympic Games

	Mean	Standard Deviation
Efficient management of water	4.282	0.1813
Reduced generation of waste products	4.145	0.251
Efficient waste management	4.128	0.2177
Improved awareness on the importance of environmental sustainability	4.068	0.1227
Facilitate implementation of environmental sustainability policies	4.031	0.1548
Facilitate adoption of environmentally friendly technology	4.026	0.1674
Conservation of energy	4.015	0.2652
Improved air quality	3.364	0.3211
Reduced noise	3.176	0.3948

The study findings in Table 10 show that greening measures undertaken in the London 2012 Olympic Games have largely brought benefits such as efficient management of water (m=4.282), reduced generation of waste products (m=4.145), efficient waste management (m=4.128), and improved awareness on the importance of environmental sustainability (m=4.068). The measures facilitated the implementation of environmental sustainability policies (m=4.031), the adoption of environmentally friendly technology (4.026), and the conservation of energy (m=4.015). The findings indicate that greening measures undertaken in the London 2012 Olympic Games have moderately improved air quality (m=3.364) and reduced noise (m=3.176).

The respondents were further requested to rate the extent to which construction of venues and facilities for the London 2012 Olympic Games resulted in the benefits illustrated in the Table 11.

Table 11: Benefits of Green Construction

	Mean	Standard Deviation
Regeneration of wasteland	4.071	0.3483
Promotion of tourism and related sectors of the country	4.016	0.4216
Facilitate recognition of the country's culture all over the world	3.787	0.2013
Strengthening of social bonds by promoting common values and the interdependence of social groups	3.769	0.2004
Provision of adequate training facilities for future Mega sport events	3.483	0.4647
Creation of employment opportunities	3.472	0.3645
Boost the economy through the rise of trade and advertisement	3.465	0.4436

From Table 11, the construction of venues and facilities for the London 2012 Olympic Games resulted in the benefits such as the regeneration of wasteland (m=4.071), the promotion of tourism and related sectors of the country (m=4.016), the facilitation of recognition of the country's culture all over the world (m=3.787), the strengthening of social bonds by promoting common values and the interdependence of social groups (m=3.769), the provision of adequate training facilities for future mega sport events (m=3.483), the creation of employment opportunities (m=3.472), and the boosting of the economy through the increase in trade and advertisement (m=3.465).

The findings revealed that the greening of the venues and facilities provided environmental, social and economic benefits to the city. The environmental benefits included the regeneration of wastelands, efficient waste and water management, improved awareness on the importance of environmental sustainability and the adoption and implementation of environmental technologies and standards. The social benefits included the strengthening of social bonds and interdependence of social groups, the provision of training facilities for the communities and for future mega events.

The economic benefits included the promotion of tourism and job creation. This is a clear signal of the practical implementation of the Theory of Sustainability described in section 3.1.1 of this report and the realisation of the position by Dodouras and James (2004) who encourage much more integrated approach in sports that ensures the

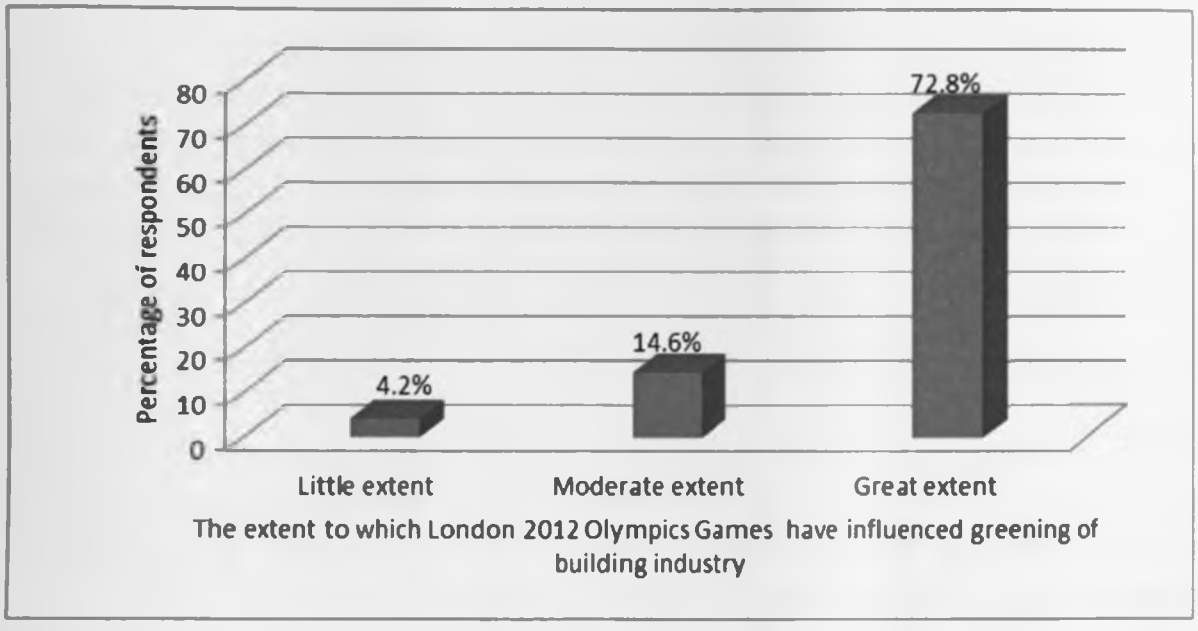
linkages between the environmental, social and economic strands to provide long-term sustainability benefits to communities and countries hosting mega sport events.

We can therefore conclude the greening of venues and facilities for the London 2012 Olympic Games brought environmental, social and economic benefits to the host communities and that several of the environmental and social benefits such as the regeneration of wastelands and improved awareness as well as social benefits such as the strengthening of social bonds provide an alternative perspective of viewing the organizations of mega events beyond the traditional cost-benefit analysis.

5.6 The impact of the London 2012 Olympic Games on greening of the building industry

The respondents of the questionnaire were asked to rate the extent to which the measures taken by delivery agencies of the London 2012 Olympic Games influence greening of the building industry. The response is illustrated in Figure 23.

Figure 23: Impact of the London Games on the Greening of the Construction Industry



The study findings in Figure 23 show that measures taken by delivery agencies of the London 2012 Olympic Games influenced greening of the building industry to a large extent. The greening measures for the Games serve as best practices for construction of green buildings and showcased green designs.

From the findings in this section, one can conclude that the London 2012 Games left an impact on the building industry. Delivery agencies and contractors were challenged to deliver efficiencies in water, waste and energy use in the venues and facilities that were well above those required by the applicable building regulations in the UK. They had to think "outside the box" to meet these targets which have now become reference points for best practices in green buildings in mega sport events. This is evident from the overwhelming response from the respondents that the Games greatly influenced the building industry.

5.7 Satisfaction with greening measures incorporated in venues and facilities for the London 2012 Olympic Games

The respondents of the questionnaire were requested to indicate their level of satisfaction with the greening measures incorporated in venues and facilities for the

London 2012 Olympic Games. The response was rated on a Likert scale using mean on which 1=not satisfactory; 2=less satisfactory; 3= moderately satisfactory; 4=satisfactory; 5=very satisfactory. The study findings are shown in the Table 12.

Table 12: Satisfaction with Greening Initiatives in the London 2012 Olympic Games

	Mean	Standard Deviation
The selection of site for venues and facilities	4.582	0.1025
Water conservation	4.517	0.1245
Energy conservation	4.491	0.2641
General green building standards	4.365	0.3438
Adherence to building regulation on the environment	4.354	0.1076
Construction materials (reuse and recycling of materials	4.238	0.3258
Air quality	3.416	0.9893

The study findings in Table 12 revealed that majority of the respondents were very satisfied by the selection of site for venues and facilities (m=4.582), water conservation (m=4.517) and energy conservation (m=4.491). The respondents were also satisfied with general green building standards (m=4.365), adherence to building regulation on the environment (m=4.354), and construction materials (reuse and recycling of materials) (m=4.238). The findings also revealed that the respondents were moderately satisfied with air quality measures (m=3.416). The study findings revealed that the respondents were generally satisfied with the greening measures incorporated in venues and facilities for The London 2012 Olympic Games.

In conclusion, there was a high level of satisfaction with the greening of the London 2012 Games from the respondents of the questionnaire. It means that the greening measures were inclusively and transparently implemented and that delivery agencies clearly communicated the importance of these measures to various stakeholders who fully understood the depth of the greening of the Games. This is evident in the highly

positive satisfaction that respondents gave to various greening issues. It is also evident from the capacity-building workshops and training programmes that were organized by the delivery agencies.

5.8 Inferential Statistics

The researcher used inferential statistics to establish the relationship between the dependents and the independent variables of the study hence generalize the study findings to the target population. The inferential statistics used in the study include regression analysis, analysis of variance, Pearson product-moment correlation and Chi-Square Test.

The Pearson product-moment correlation coefficient was used to analyse the association between the independent and the dependent variables. Two variable are said to be correlated if their coefficient of correlations is greater than 0.5. If two independent variables are correlated one of the variables must be dropped from the analysis. As shown in Table 13 below none of the independent variables had coefficient of correlation between themselves less than 0.5 hence all of them were included in the model. The Pearson correlation coefficients above 0.5 in the matrix indicated great correlation between the dependent variable (greening of mega sport facilities for sustainable development of sports) and the independent variables (green construction, water management, waste management, transport management, green procurement, energy efficiency and behaviour change).

Table 13: Pearson Correlation Correlations

	Greening of mega sport facilities	Green construction	Water management	Waste management	Transport management	Green procurement	Behaviour change	Energy efficiency
Greening of mega sport facilities	1.000							
Green construction	0.812	1.000						
Water management	0.655	0.168	1.000					
Waste management	0.621	0.124	0.135	1.000				
Transport management	0.513	0.116	0.154	0.24	1.000			
Green procurement	0.638	0.261	0.217	0.162	0.178	1.000		
Behaviour change	0.784	0.243	0.154	0.215	0.265	0.134	1.000	
Energy efficiency	0.795	0.147	0.184	0.218	0.209	0.211	0.225	1.000

The researcher performed a regression analysis to establish the association between the independent variables (measures taken by delivery agencies for the London 2012 Olympic Games) with the dependent variable of the study (greening of mega sport facilities for sustainable development of sports).

The following regression model was adopted for the study:

$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + e$

Where:

y = Greening of mega sport facilities for sustainable development of sports

β_0 = Constant Term

β_1= Beta coefficients

X_1= Green construction

X_2= Water management

X_3= Waste management

X_4= Transport management

X_5= Green procurement

X_6= Behaviour change

X_7= Energy efficiency

e= the standard error

Table 14: Shows the Summary of the Regression Model.

Table 14: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.9978	.9957	.9956	.4428

a. Predictors: (Constant), Green construction, Water management, Waste management, Transport management, Green procurement, Behaviour change, and Energy efficiency

b. Dependent Variable: greening of mega sport facilities for sustainable development of

sports

The coefficient of determination (R Square) is used to test the goodness-of-fit of the model. That is, R Square measures the proportion or percentage of the total variation in the dependent variable explained by the independent variable. The value of R Square lie between 0 and 1 and if R Square value is 1 the there is a perfect fit while R Square value 0 indicates that there is no relationship between dependent and independent variables. From the study findings in Table 14, the R Square value was 0.9957 indicating that there was a variation of 99.57% in the greening of mega sport facilities for sustainable development of sports as a result of the measures instituted by the delivery agencies for the London 2012 Olympic Games.

Table 15: Coefficients of Regression Equation

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	T	Sig.
1 (Constant)	.923	.118		7.835	.035
Green construction	.374	.074	.063	5.021	.016
Water management	.358	.086	.074	4.115	.032
Waste management	.355	.085	.071	4.157	.036
Transport management	.353	.088	.078	3.994	.038
Green procurement	.357	.086	.075	4.124	.027
Behaviour change	.362	.086	.075	4.186	.024
Energy efficiency	.366	.070	.061	5.193	.019

a. Dependent Variable: Greening of mega sport facilities for sustainable development of sports

The level of confidence for the analysis was set at 95% (0.05). Therefore, the P- value less than 0.05 imply that the independent variables significantly influence the dependent variable. The regression results show that greening of mega sport facilities

for sustainable development of sports is influenced by green construction, water management, waste management, transport management, green procurement, behaviour change, and energy efficiency because all had P values less than 0.05 (Table 15).

The established multiple linear regression equation becomes:

$Y = 0.923 + 0.374X_1 + 0.358X_2 + 0.355X_3 + 0.353X_4 + 0.357X_5 + 0.362X_6 + 0.366X_7 + 0.118$

Constant = 0.923, shows that if all the independent variables (green construction, water management, waste management, transport management, green procurement, behaviour change, and energy efficiency) all rated as zero, greening of mega sport facilities for sustainable development of sports would be 0.923.

$0.374X_1$ denotes that if all other independent variables are rated as zero, a change of magnitude 0.374 in X_1 (green construction) lead to a unit change in Y (greening of mega sport facilities for sustainable development of sports). Similarly, the corresponding magnitudes of the coefficients of regression for the independent variables ($0.358X_2$, $0.355X_3$, $0.353X_4$, $0.357X_5$, $0.362X_6$, and $0.366X_7$) leads to a unit change in the dependent variable Y (greening of mega sport facilities for sustainable development of sports).

The magnitudes of the coefficients of regression also show the strength of the influence that the independent variables have on the dependent variable. Therefore, greening of mega sport facilities for sustainable development of sports was strongly influenced by green construction (0.374) followed by energy efficiency (0.366), behaviour changes (0.362), water management (0.358), green procurement (0.357), waste management (0.355), and transport management (0.353).

The sign of the coefficients of regression indicate the nature of relationship that is, the positive coefficient denotes a direct relationship in which an increase in the independent variable leads to an increase in the dependent variable and the vice versa. The negative coefficients of regression indicate an inverse relationship in which an increase in the independent variable leads to a decrease in the dependent variable. From the study findings in Table 15, all the independent variables (green construction, water management, waste management, transport management, green procurement, behaviour change, and energy efficiency) had positive coefficients of regression. Therefore, increase in the independent variables (green construction, water management, waste management, transport management, green procurement,

behaviour change, and energy efficiency) lead to increase in the dependent variable (greening of mega sport facilities for sustainable development of sports).

5.8.1 Hypothesis of the Study

Chi-Square Test was done using SPSS to test the null hypothesis (H_0) of the study which was "measures instituted by the delivery agencies for the London 2012 Olympic Games did not lead to effective greening of the mega sport facilities for sustainable development." The data used for the Chi-square test are the data generated from the questionnaire that was administered to NGOs, experts on greening of mega sports and companies that were involved in the construction of venues and facilities for the London 2012 Games. It had three sections focusing on demographics information, green measures taken by the London 2012 Olympic Games organizers and on the significance of the greening of mega-sports events. A total of 31 of the randomly selected respondents completed the questionnaire which were used to test the hypothesis of the study. Chi-Square test results are illustrated in Table 16.

Table 16: Chi-Square Tests for Null Hypothesis (H_0)

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.215[a]	7	0.031

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 25.4.

The findings in Table 16 shows that P value = 0.031 < 0.05. Therefore, the study rejects the null hypothesis and therefore adopts the alternative hypothesis leading to the conclusion that measures instituted by the delivery agencies for the London 2012 Olympic Games lead to effective greening of the mega sport facilities for sustainable development.

The Chi square test results were in line with the Analysis of Variance results in Table 17. In Analysis of Variance, if the computed F value exceeds F Critical at 95% (0.05) level of confidence the null hypothesis is rejected. Table 17 shows the Analysis of Variance results.

Table 17: Analysis of Variance(ANOVA) Results

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	0.468	6	0.78	2.864	.035[a]
	Residual	1.465	24	2.105		
	Total	1.927	30			

From the results for analysis of variance shown in Table 17, F calculated was 2.864 and the F critical was 2.140. Therefore, the study rejects the null hypothesis (H_0) which stated that measures instituted by the delivery agencies for the London 2012 Olympic Games did not lead to effective greening of the mega sport facilities for sustainable development. The ANOVA results lead to adoption of the alternative hypothesis (H_1) which stated that the measures instituted by the delivery agencies for the London 2012 Olympic Games led to effective greening of the mega sport facilities for sustainable development.

We can conclude that the delivery agencies staged Games that achieved more than just the environmental targets that were contained in the London 2012 Sustainable Development Strategy. They not only raised environmental awareness and increased the prominence of environmental issues in mega sport events but positively influenced the mainstreaming of green building measures in the building industry. Concrete signals to these were the new mandatory targets for renewable energy in buildings which was revised upward to 15 per cent by the UK in 2010 compared to the 2006 regulations.

This is also evident in the use of motivation and rewards to encourage contractors to implement green measures, the use of the railhead to ensure an environmentally-friendly and cost-effective transportation of bulk materials and the extensive recycling and reuse of construction materials (up to 90 per cent) which was bound to reduce cost for raw materials. These and many other measures provided the construction industry more cost-effective and environmentally-friendly alternatives for construction.

5.9 Challenges and Corrective Measures during Greening of the London 2012 Olympic Games

The following are challenges encountered during The London 2012 Olympic Games preparations and the measure taken to overcome them.

5.9.1 Challenges in Greening of the London 2012 Olympic Games

It is very clear that the bid vision was considered too radical by the contractors and the targets were also very high. Convincing the delivery bodies and various stakeholders that they could deliver such radical vision and high target on time and on budget and also guarantee the best standards was a major challenge.

From the findings, it was also clear that an integrated management approach was adopted taken for delivering the greening programme for the Games. There was a great demand of managerial inputs on logistics during the Games preparations. Managing hundreds different functional areas, different teams, different agendas and tight time schedule required a lot of logistical input and resources. This was a major challenge for the Games preparations.

There was also a major challenge over the fuel source for the Energy Centre of the Olympic Park. The Energy sponsor EDF and the organizers were heavily criticised for not being able to meet the 20 per cent reduction in energy use. EDF had problems[xviii] of its own and even though these problems were not directly related to the Games, they cast a negative image over the selection of EDF as the Games energy partner and reinforced the negative publicity over the organizer's inability to meet the energy target. This created a massive publicity backlash for the Games organizers.

Other challenges include concerns regarding the emissions of the Olympic flame, concerns around the fuel source of the Energy Centre, the need to clean up the territory for the Olympic venues to be built, the resettlement of homeless domestic animals that were in the Park's territory prior to the Olympic project.

5.9.2 Measures to overcome in Greening of the London 2012 Olympic Games

Measures were put in place to deal with challenges encountered during implementation of greening measures in the construction of venues and facilities for Games. The organizers ensured that skilled and knowledgeable people were recruited to strategic positions during design and construction as well as the operation of the venues for the

Games. Experts were involved in decision making on various sustainability deliverables for the Games.

Delivery agencies had efficient communication channels and terms of reference were clearly developed. Detailed procedures and deliverables were stipulated during tendering of contracts for the Games. Before any of the contractors started their work, they had to present documents outlining their approach on delivering the targets for the events. Each contractor was required to have someone responsible for environmental sustainability and technical support on communication was provided to all parties involved in preparation and operation of the Games.

The organisers made a deliberate effort to make sustainability practical and realistic. They used real life issues such as reduced health and safety risk to profile the concept of environmental sustainability to ensure that people easily understood the concept. Besides, sustainability ambassadors were appointed to drive the sustainability programmes. These were people who were respected for their knowledge not just on sustainability but also on project delivery.

Other measures that were implemented to enhance the greening of Games include reward and recognition to motivate contractors to deliver the green Games, involving experts in project management, training on various environmental issues such biodiversity conservation and waste management as well as on the implementation of green building measures. Many industry awards in the UK now require sustainability to be part and parcel of any project recognition scheme. It is no longer enough to simply deliver on time and to budget. The Games were therefore showcased as an opportunity for companies to strengthen their green credentials and vie for such awards.

We can conclude that like any other mega sport event or mass spectator event, the London 2012 Games organisers encountered several challenges including the issue of the bid vision and high sustainability targets as well as the complexity of managing all functional areas that had to deliver the sustainability targets. However, we can also conclude that measures were put in place from the bid campaign through the preparations to anticipate and ensure that most of these challenges were addressed. Timely planning, effective management, clear targets, clear processes and contracts, centralised monitoring and evaluation as well as rewards, motivation and training opportunities were some of the measures that the delivery agencies used to address

some of these challenges. The successful greening of the Games was as a result, to a large extent, to these measures.

[xx] All of the 5 sport and the environment experts linked to the London 2012 Games responded to the questionnaire, while 3 of the experts who were not closely linked to the Games participated in a focus group discussion.

[xxi] The Olympic Charter, Published by the International Olympic Committee in July 2011

[xxii] The 12 objective areas for sustainability of the ODA included: (environmental) - carbon; water; waste; materials; biodiversity and ecology; land, air, water and noise; (sustainability) - supporting communities; transport and mobility; access; employment and skills; health and wellbeing; and inclusion.

[xxiii] CLM is a consortium made up of CH2M HILL, Laing O'Rourke and Mace which was appointed the ODA's delivery partner.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

6.1.1Introduction

This chapter presents a summary of findings, conclusion and recommendations of the study. The main objective of the study was to determine the effectiveness of the greening of the London 2012 Olympic Games. The specific objectives were to: provide alternative perspectives for reviewing the potential of hosting mega-sport events beyond the strict cost-benefit analysis; identify measures taken by the delivery agencies to ensure that the London 2012 Olympic Games left a green legacy; analyse how the green building measures were designed, executed, monitored and evaluated for success, including handling of challenges; and, analyse the extent to which the measures taken by delivery agencies influenced greening of the building industry with respect to construction of venues and facilities. To achieve the objectives, the study undertook a review of existing literature on the subject, conducted a survey and interviews as well as field observations to determine how the greening measures were conceived and executed in the construction of venues and facilities for the London 2012 Olympic Games. The next section will review the key findings of the study.

6.1.2Summary of Key Findings

The Chi-Square Test and the ANOVA results lead to the adoption of the alternative hypothesis for the study which stated that the measures instituted by the delivery agencies for the London 2012 Olympic Games led to effective greening of the mega sport facilities for sustainable development. The regression analysis was also performed to establish the association between the independent variables (measures taken by delivery agencies for the London 2012 Olympic Games) with the dependent variable (greening of mega sport facilities for sustainable development of sports) of the study. The study findings revealed that greening of mega sport facilities for sustainable development of sports is influenced by measures such as green construction, energy efficiency, behaviour changes, water management, green procurement, waste management and transport management. The implementation of the measures led to effective greening of the London 2012 Olympic Games.

The findings revealed that environmental sustainability was integrated into the London 2012 Olympic Games right from the bid phase and was part of the bid commitments. This led to the development of a Sustainable Development Strategy and a Sustainability Plan by the two delivery agencies – the ODA and LOCOG– prior to the actual commencement of construction. The Strategy and Plan were used to set and measure key targets for greening the construction of venues and facilities. These measures ensured that the London 2012 Olympic Games leave a green legacy.

The findings revealed that the site that was selected for the Olympic Park was a highly contaminated and depressed part of East London. The Games led to the remediation of this contaminated and depressed part of the city into a vibrant centre that would showcase urban green gardens, promote the regeneration and conservation of biodiversity, healthy communities and also compete with the rest of the city for business and social opportunities. The site selection and the remediation and revitalisation measures provided an alternative perspective on the case for the city of London hosting the 2012 Olympic Games beyond the strict cost-benefit analysis.

The findings revealed that the efforts of the organizers extended beyond the traditional water management approach with the flood control feature at the wetland bowl in the Olympic Park designed to help ensure that at least 200 households downstream are not at risk of flooding. This measure demonstrated how the benefit of the Games extended beyond the strictly cost-benefit analysis. The measure also provided a legacy benefit for the communities in and around the Park.

The findings revealed that green spaces were extensively integrated into the Olympic Park and that as much of the natural vegetation, biodiversity and landscape as possible was conserved. The findings also demonstrated that as a result of the remediation of land, biodiversity began to flourish in the Park. This is clearly in line with the objective of leaving a green legacy from the Games but also in line with the benefits beyond the strict cost-benefit analysis.

The findings revealed that the Sustainable Development Strategy was translated into project briefs which were supported by design and reporting guidance documents for the design teams. The findings also revealed that workshops and training programmes were organised for the design teams, contractors and neighbouring communities to raise their awareness on the importance of the greening of the venues and facilities.

This shows that green building measures were well designed, executed, monitored and evaluated to ensure sustainable development of sports.

The findings revealed that an integrated management process was adopted by the delivery agencies to implement environmental sustainability in the construction of venues and facilities. For example, procurement was not only centrally coordinated but there were guidelines and centralised teams overseeing the procurement of timber and other construction materials. Management of waste was also centralised and outsourced to ensure that there was a clear overview of how waste from construction and at Games time were being managed. This approach ensured that the delivery agencies were in control of the execution of the greening measures and that they were also able to fully monitor and evaluate attainment of the sustainability targets.

The findings revealed that there was good communications around the value of the ecological composition of the Park and the importance of maintaining this and that organisers used the Games to organize capacity-building workshops and training programmes for contractors and communities around the Park.

The findings revealed that the London 2012 Olympic Games had a positive and transformative impact on the building industry in the UK. The companies that were involved in the Games were subjected to rigorous contracts that ensured that the sustainability targets were achieved. However, delivery agencies provided rewards and motivation to encourage them to implement these measures and also organized training programmes for them to be comfortable with implementing green measures.

The findings also revealed that the Games organizers were not as successful with their energy programme as with the other environmental issues. They missed the target for renewable energy by almost 50 per cent mainly as a result of the scrapping of the wind turbine project. The findings also revealed that the programme to minimize carbon footprint was not very ambitious. There were no concrete plans to offset the emissions that could not be avoided and there was no clear communications programme to encourage teams and spectators to offset their emissions. This is contrary to the objectives of leaving a positive legacy from the Games and will not encourage organizers of future mega sport events to also focus on carbon offsetting and compensation.

6.2 Conclusion

The following subsections present conclusions drawn from the study findings:

6.2.1 The Environmental Sustainability Measures Instituted By the Delivery Agencies for the London 2012 Olympic Games Led to Effective Greening of the Mega Sport Facilities for Sustainable Development

The inferential statistics applied in the analysis of relationship between the dependent and independent variables and to test the hypothesis led to the conclusion that environmental sustainability measures instituted by the delivery agencies for the London 2012 Olympic Games led to effective greening of the mega sport facilities for sustainable development. The Pearson product-moment correlation coefficients indicated great correlation between the dependent variable (greening of mega sport facilities for sustainable development of sports) and the independent variables (green construction, water management, waste management, transport management, green procurement, and behaviour change and energy efficiency).

The regression results show that greening of mega sport facilities for sustainable development of sports is significantly influenced by green construction, water management, waste management, transport management, green procurement, behaviour change, and energy efficiency. The regression analysis revealed that that greening measure implemented during the London 2012 Olympic Games led to successful achievement of the targets in the environmental sustainability plan for the Games. For instance the greening measure resulted in reduction in water use and in demand for energy, conservation of biodiversity and effective waste management.

The inferential statistics provide a basis on which the study finding can be generalized to the practice of environmental sustainability in mega sport events. The greening measures implemented during the London 2012 Olympic Games also serve as a mean to enhance environmental sustainability in construction industries. The following conclusion are drawn from the study findings

6.2.2 The London 2012 Games Provided Alternative Perspectives for Reviewing the Potential for Hosting Mega Sport Events beyond the Strict Cost-Benefit Analysis

Cost benefit analysis is an important aspect in every mega sporting event. The delivery agencies in mega sport events always come up with financial plan for the games which include the cost of constructing sport facilities, the cost incurred in transport and security, the cost of labour and the revenue collected. The cost of hosting mega sport is

analysed against the resultant qualitative and quantitative benefits. Examples of qualitative benefits are increased national pride and community spirit and enhanced reputation which may lead to hosting of future events. The quantitative benefits include increased number of tourist for the current and future mega sport event, welfare gains to the host nation as a result of funds used to organize the events, the funding of communication and broadcasting by world sport governing bodies, improvements of infrastructure.

However, the study explored alternative perspective for reviewing the potential for hosting mega-sport events beyond the strict cost-benefit analysis. The study specifically investigated the benefits that environmental sustainability measures implemented in a mega sport event present to a host nation. London 2012 Olympic Games serve as a good example of the effectiveness of mega sport events in promoting environmental sustainability. The Games presented a number of benefits which included efficient management of water, reduced generation of waste products, efficient waste management, and improved awareness on the importance of environmental sustainability. The greening measures for the London 2012 Olympic Games facilitated the implementation of environmental sustainability policies, the adoption of environmentally friendly technology and the conservation of energy. Moreover there was promotion of tourism and related sectors, the strengthening of social bonds by promoting common values and the interdependence of social groups, the provision of training facilities for the communities and for future sport events and the creation of employment opportunities. The selection of sites for the games was done strategically to allow for greening and legacy impacts. The Olympic Park is located in a previously depraved area of East London.

The area was a heavily contaminated industrial wasteland and the community was riddled by low literacy, high crime and high unemployment rates. Measures such as the remediation of the land and extensive clean-up of the rivers, renewal of overlay materials, planting of new vegetation, and implementation of measures to promote biodiversity were undertaken.

The communities around the Olympic Park were fully involved in implementation of these measures. The area now assures a host of environmental, health, social and economic benefits for the communities and for London. The remediation of the land and the development of green spaces will enhance health benefits for the communities for years to come.

The flood control feature at the Olympic Park's wetland bowl will prevent about 200 houses downstream from risks of flooding in the event of heavy rainfall. The Olympic Park now has the largest non-potable water network and distribution system in the UK which will help to ensure a reduced demand for potable water in the area. It will provide sport facilities that will be used for exercises and for social interactions by the communities. We can conclude that this will help increase social harmony and reduce crime that the area was riddled with prior to the Olympic project. As Donnelly *et al* (2007) confirm sport offers an important resource for reducing delinquency and crime among youth, promoting community safety, contributing to educational commitment and attainment among children and youth, as well as acting as a vehicle for promoting character-building and moral development. Economically, the findings revealed that the Games promoted skills development, new innovations and business development as well as touristic opportunities for the region.

From the above, we can clearly conclude that the London 2012 Olympic Games provided alternative perspectives for reviewing the potentials for hosting mega-sport events beyond the strict cost-benefits analysis. As pointed out by Epstein (2011), it brought forward plans for the revitalization of a contaminated site by 20 years or more. It led to the revitalization of a highly contaminated and depressed part of London into a vibrant centre whose legacy was meant to promote a healthy community and compete with the rest of the city for business and social opportunities.

6.2.3 Measures Taken by the Delivery Agencies Ensure that the Mega Sport Events Leave a Green Legacy

Countries all over the world encounter serious environmental challenges especially in urban areas. The environmental degradation presents a host of negative social and economic effect in both developing and developed countries. The world has been recently battling with the devastating effects of global warming whose effects have been witnessed in storms, hurricanes, wild fires and increased heat waves. The destruction of natural vegetation has led to imbalance in the ecosystem and reduction in the number of rare plant and animal species. Besides environmental degradation presents social and health challenges through destruction of recreational sites, poor air, water and soil quality.

The study examined the role of mega sport in environmental sustainability by focusing on the green legacy that was left by environmental sustainability measures taken during London 2012 Olympic Games. The study findings led to a conclusion that environmental measures implemented during London 2012 Olympic Games was successful in leaving a green legacy that serve as a model and a benchmark for best practice in environmental sustainability in mass spectator events. From the London 2012 Olympic Games, it was evident that environmental sustainability is attainable in mega sport events if the organizers fully embrace the concept of sustainability and legacy and mainstream them in their agenda.

The green legacy of a mega sport event should be integrated from an early stage in the bid to host the event. We noted that sustainability and legacy were fully engrained in the London 2012 Olympic Games bid process and that they were part of the bid commitments and as shown by the study, they involved both political and executive leadership throughout the bid and preparatory campaigns.

The study established some of the key factors that contributed to successful greening of the London 2012 Olympic Games. The factors include extensive consultations on environmental sustainability, setting and instituting performance measurement and performance appraisal on various deliverables for greening of the event, training all personnel involved in greening of the event, involving major stakeholders and local communities in the greening initiatives, adhering to environmental standards and

regulations in the host country, creating awareness on environmental sustainability, and adhering to best practices in green procurement.

The study emphasized the role of community involvement in establishing the green legacy of the Games. For environmental sustainability programme to be successful, the local community must be made aware of the value of different environmental initiatives being undertaken by delivery agencies. During the London 2012 Olympic Games, the local community around the Olympic Part were involved in the greening initiatives. The delivery agencies undertook a number of schools programmes in order to ensure that the Olympic Games positively and sustainably transform neighbouring communities and economies. Local volunteers and employees were trained on management and conservation of environment in the Park.

Structures must be constituted to effectively manage the implementation of green legacy that accompany major sporting events. The Olympic Park Legacy Company (now LLDC) was established to ensure that the objectives around the Games legacy are achieved. The master plan of Olympic Park and proposed legacy development ensured that there was thriving, connected and green communities where sustainable lifestyles are possible.

6.2.4 The Successful Greening of Mega Sporting Events Depend on Effectiveness of Greening Measures Adopted during Preparation, Planning/Designing, Implementation, Monitoring and Evaluation Stages as well as Measures Designed to handle the Challenges that were encountered

The study examined the importance of formulating strategic environmental sustainability plans at every stage in the mega sporting events from bidding and preparations for the events to sustaining the environmental aspects during and after the events. From the findings, the study concludes that the London 2012 Olympic Games experience provide an excellent example of a well-planned, executed and monitored greening programme for a mega-sport event. A strong code at the bid stage resulted in a strong sustainability framework being applied in the construction of venues and facilities.

The Sustainable Development Strategy and Sustainability Plan were translated into project briefs which were supported by design and reporting guideline documents for the design teams.

Training programmes were organized to ensure that everyone was on the same page and understood clearly what the expectations were. Commitments on expectations were written into contracts of designers with clear reporting requirements and technical support was provided by the delivery agencies. Contractors were required to have a sustainability focal point and they were not allowed to progress to the next level if the delivery agencies were not happy with what they had achieved.

The findings also revealed that the delivery agencies adopted an integrated and centralised system of managing various aspects of the greening of the Games such as waste management and green procurement. This ensured that the delivery agencies were tracking the implementation of the greening programme very closely and were able to provide needed support in areas where delivery was falling behind target.

The design and construction of venues and facilities for the Games had higher standards than the applicable construction standards in the United Kingdom and strict adherence to environmental best practices was a strong basis to effective greening of the Games.

The incorporation of green elements in sport facilities is a great undertaking and prone to a number of challenges. From the findings, the greening of the London 2012 Olympic Games encountered challenges such as difficulties in harmonizing the activities of construction industry and the event industry, difficulties in making the ambitious targets realistic and selling these fairly high targets to the designers and contractors.

The findings revealed that measures were put in place to deal with challenges encountered during construction of venues and facilities for the Games. These measures included ensuring that skilled and knowledgeable people were hired for the implementation of green initiatives, involving experts in decision making on various deliverables for the Games, adopting efficient communication channels, creating awareness on environmental sustainability, ensuring transparency within management bodies, instituting reward and recognition programmes for contractors, involving experts in project management, and training of personnel involved in implementation of green initiatives.

6.2.5The Greening Measures Implemented by Delivery Agencies for Mega Sport Events Greatly Influence Adoption of Greening within the Building and Construction Industry

The London 2012 Olympic Games achieved more than just the environmental targets that were contained in the London 2012 Sustainable Development Strategy. They not only raised environmental awareness and increased the prominence of environmental issues in mega sport events but positively influenced the mainstreaming of green building measures in the building industry. Concrete signals to these were the new mandatory targets for renewable energy in buildings which was revised upward to 15 per cent by the UK Government in 2010.

This is also evident in the use of motivation and rewards to encourage contractors to implement green measures, the use of the railhead to ensure an environmentally-friendly and cost-effective transportation of bulk materials. In addition, the various positive measures that were implemented for the Games such as the use of embodied materials, recycling and reuse of construction materials and their cost benefits are likely to provide new ideas for constructing environmentally-friendly buildings. These measures also provided the construction industry more cost-effective and environmentally-friendly alternatives for construction.

The findings revealed that the organizers worked with the British Standard Institute to develop a building management system which included monitoring and evaluation of venues (BS 8901), and that this standard was later adopted by the International Organization of Standardization (ISO 20121) for Sustainable Management of Major Events.

Based on the findings, particularly the response from the survey, we can conclude that the London 2012 Olympic Games influenced the greening of the building industry with respect to the construction of venues and facilities to an extent.

6.3 The London 2012 Games on Presented Important Lessons and Experiences which can be used to Facilitate Environmental Sustainability in Future Mega-Sports Events

An important lesson from the London 2012 Olympic Games experience is that full integration of environmental sustainability considerations from an early stage of a mega event process is crucial for the successful greening of the event. From the findings, it is clear that one of the main reasons why the Games organizers were successful was the fact that sustainability was fully engrained in the process right from the bid campaign.

We also noted from the findings that issues such as the minimisation of carbon footprint were not as successful as the other issues (water management for example) because they were not integrated into the environmental portfolio at an early stage of the Games preparations.

Another important lesson from the London 2012 Olympic Games experience is the need for political and executive leadership to drive the sustainability agenda. In the case of London, it was noted that the Mayor of London was fully involved from the bid campaign. The Secretary of Sports and Culture and other senior UK Government Officials were also involved in the process. This ensured the seriousness around the greening and legacy aspects of the Games.

Sustainable games require a comprehensive approach. The Games demonstrated a more comprehensive approach to sustainability which included targets such as minimisation of carbon emission, reduction of water use, enhancement and conservation of biodiversity, minimisation of energy use, minimisation of waste generation and noise and air pollution.

The zero waste to landfill strategy and the ability of London 2012 organizers to translate high level commitments and ambitious plans into tangible deliverables is a great lesson for others planning to host mega-sport events. The planning and delivery of the London 2012 sustainability programme was a model for future Games to emulate.

Effective communication is a key to success of any major event and undertaking such as environmental sustainability. Various objectives were communicated through print and electronic media which ensured that all stakeholders were informed of the overall

expectations for the Games. The delivery agencies had clear policies and goals on environmental sustainability before commencement of preparations.

The Commission for Sustainable London, as the oversight body for assurance and reporting, ensured that all delivery partners of the Games incorporated elements of environmental sustainability in their activities. The Commission for Sustainable London provided a shared forum and platform to assess and report on sustainability from the perspective of all the hosting bodies.

The best practices observed in green procurement are a great lesson to all sectors of the economy. The delivery agencies of the London 2012 Olympic Games adhered to green procurement of materials for the construction of venues and facilities. The focus on embedded carbon and waste reduction in sourcing specifications are good lessons for the building industry. The London 2012 Olympic Games showcased great innovation and application of environmental standards in the venues and facilities.

6.4 Recommendations

Several recommendations are drawn from the study findings. The recommendations are grouped into recommendation to aspiring host cities and countries, recommendations for policy considerations and recommendations for further research.

6.4.1 Recommendations to Aspiring Host Cities and Countries

All aspects of sustainability should be integrated into the process from a very early stage of the campaign. This should be part of the bid process and eventually the bid commitment. As has been demonstrated in the study, this was a very important aspect of the successful implementation of the greening of the London 2012 Olympic Games.

It is also important for aspiring host cities and countries to also strive to involve all relevant stakeholders. From the London 2012 Games experience, it was clear that the "One Planet Living" concept had a strong influence on the sustainability and legacy aspects of the Games. This concept was the result of the collaboration between the Games organizers and non-governmental organizations (WWF and BioRegional in this case). In addition, the Commission for Sustainable London – an independent third party assurance body – was created at a very early stage to provide third party independent inputs into the Games greening. This ensured that there was transparency and inclusivity around the greening of the Games.

Aspiring host cities should come up with a plan on environmental sustainability that is relevant to the communities living around the venues. The sustainability plan for major events should ensure that the green legacy is relevant to current and future generations of the host communities. The sustainability plan should be very comprehensive and anticipated benefits clearly researched and communicated.

The delivery agencies for major sport events should have clear and concise terms of reference. This is important because the supply chains for delivery of major events involve many stakeholders and a mistake by one stakeholder can hinder timely and effective delivery of the greening agenda. From the London 2012 experience, it is clear that contractors were bound by very clear terms of reference.

Future host cities should perceive the concept of green games beyond cost-benefit analysis. There is a need to look into other aspects of the Game such as the environmental, social and health benefits. Highlighting such benefits will be important in rallying support for hosting the event.

6.4.2Recommendations for Policy Considerations

More attention should be given to sustainability and legacy in other major events and processes. From existing literature, it is clear that the extent to which these measures are incorporated in major events is not consistent and some organizers of major events do not pay serious attention to environmental and sustainability issues.

The example of the London 2012 Olympic Games has demonstrated that focusing on these issues does not constitute an increase in the cost or time schedule for staging the event. In fact it makes economic sense as fewer resources are required for providing infrastructures on a size and needs basis for the event and for future use.

The study recommends that policy makers in the event industry use the example of the London 2012 Olympic Games as a benchmark for future events and widely disseminate the lessons of the London Games to organizers of their respective Games.

The study also recommends that owners of mega sport events such as the International Olympic Committee (IOC) and FIFA become more involved in overseeing the implementation of the sustainability and legacy elements of these events. This will ensure that all future host cities fully embrace and implement sustainability

programmes around their events. The success of the London 2012 Olympic Games might be replicated by all future hosts if this high level involvement is assured.

6.4.3Recommendations for Further Research

Further studies should be done on the legacy impact of the London 2012 Games, particularly as the Olympic Park has now been handed over to the legacy company. This will provide information on the extent to which the legacy of the Games is positively affecting the region and communities around the Park.

As this research focused on the impact of the greening of construction of venues and facilities, it is important for further research to be undertaken on the extent to which the lessons learnt from the Games are concretely influencing the work of contractors that were directly or indirectly involved in the Games. Finally, further studies should be undertaken on the effectiveness of other aspects of the greening the Games such as transport. This will assist in provided the comprehensive picture of the impact of the greening of the London 2012 Olympic Games.

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APPENDICES

Appendix I: Questionnaire

Section A: Demographic information

1. Name of the organization

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2. Position in the organization

.....

3. Duration of service in the committee

Less than 5 years [ ] 5-10 years [ ] 11-15 years [ ] 16-20 years [ ] Over 20 years [ ]

Section B: The green measures taken in The London 2012 Olympic Games

4. From your perspective, which measure was implemented in the following areas to ensure a green legacy for the London 2012 Olympic Games?

(a) Site selection

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(b) Facility Design and Construction

(i) Ventilation and air quality

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(ii) Energy Efficiency

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(iii) Water saving technologies and water use

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(iv) Interior Systems

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(v) Exterior features

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(vi) Space management

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(vii) Establishment and usefulness of green spaces around venues and facilities

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(c) Building Management Systems (Monitoring and evaluation)

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.....

.....

.....

(d) Other measures for greening of venues and facilities

.....

.....

.....

.....

5. Indicate the extent to which the following measures lead to delivery of green games during London 2012 Olympic games

	No extent at all	Little extent	Moderate extent	Great extent	Very great extent
Incorporation of greening measure during preparatory stages of the games					
The criteria for Site Selection					
Facility Design and Construction					
Building Management Systems (Monitoring and evaluation)					

6.

7. To what extent did the delivery agencies prioritize the following to ensure that the greening of the London 2012 Olympic Games positively and sustainably transform the neighbouring communities and their economies? Rate your response on a scale where 1=No extent at all, 2= Little extent, 3=Moderate extent, 4= Great extent and 5=Very great extent.

	No extent at all	Little extent	Moderate extent	Great extent	Very great extent
Management					
Installation of Computer-Aided Facility Management					
Formulation of management strategies for greening of venues and facilities					
Training on green facilities for contractors					
Outsourcing of services for the greening of venues and facilities to local businesses					
Providing training on green building to local communities and businesses					
Providing opportunities for local businesses to be involved in venues and facilities development					
Adherence to legal standards on green buildings					
Adopting a plan for incorporation of green features and management of the existing green facilities					

8. Are you aware of any other measures that were adopted by the delivery agencies to ensure that green measures in The London 2012 Olympic Games positively and sustainably transform neighbouring communities and economies?

(i).....

(ii).....

(iii).....

(iv).....

9. Rate your level of satisfaction with the greening measures incorporated in venues and facilities for The London 2012 Olympic Games? Rate your response on a scale where 1=Not satisfactory, 2=Less satisfactory, 3=Moderately satisfactory, 4=Satisfactory, 5=Very satisfactory

	Not satisfactory	Less satisfactory	Moderate satisfactory	Satisfactory	Very satisfactory
The selection of site for venues and facilities					
Water conservation					
Energy conservation					
Air quality					
General green building standards					
Construction materials (reuse and recycling of materials					
Adherence to building regulation on the environment					

Section C: Significance of mega sport events

10. To what extent do the green measures undertaken in venues and facilities for The London 2012 Olympic Games present the following benefits? Rate your response on a scale where 1=No extent at all, 2= Little extent, 3=Moderate extent, 4= Great extent and 5=Very great extent

	No extent at all	Little extent	Moderate extent	Great extent	Very great extent
Reduced generation of waste products					
Efficient waste management					
Conservation of energy					
Improved air quality					
Reduced noise					
Efficient management of water					
Improved awareness on the importance of environmental sustainability					
Facilitate implementation of environmental sustainability policies					
Facilitate adoption of environmentally friendly technology					

11. Rate the extent to which construction of venues and facilities for the London 2012 Olympic Games resulted in the following benefits? Rate your response on a

scale where 1=No extent at all, 2= Little extent, 3=Moderate extent, 4= Great extent and 5=Very great extent

	No extent at all	Little extent	Moderate extent	Great extent	Very great extent
Regeneration of wasteland					
Boost the economy through the rise of trade and advertisement					
Creation of employment opportunities					
Provision of adequate training facilities for future Mega sport events					
Promotion of tourism and related sectors of the country					
Strengthening of social bonds by promoting common values and the interdependence of social groups					
Facilitate recognition of the country's culture all over the world					

12. Rate the extent to which the measures taken by delivery agencies for The London 2012 Olympic Games influence greening of the building industry

(i) No extent at all [ ]

(ii) Little extent [ ]

(iii) Moderate extent [ ]

(iv) Great extent [ ]

(v) Very great extent [ ]

13. What lessons have been learnt from the London 2012 Olympic Games experience on greening of mega-sports events?

(i).....

(ii).....

(iii).....

(iv).....

(v).....

14. Are you aware of any challenges were encountered when implementing greening measures in construction of venues and facilities for London 2012 Olympic?

(i).....

(ii).....

(iii).....

(iv).....

(v).....

15. Are you aware of how can the challenges be overcome?

(i).....

(ii).....

(iii).....

(iv).....

(v).....

Appendix II: Interview guide for International Olympic Committee (IOC)

1. What was the role of International Olympic Committee (IOC) in the greening of venues and facilities for The London 2012 Olympic Games?
2. Could you highlight from your perspective how greening initiatives were handled in the following areas during construction of venues and facilities for The London 2012 Olympic Games.

   (i) Selection of sites for venues and facilities

   (ii) Design of venues and facilities

   (iii) Construction of venues and facilities

   (iv) Water management during construction and water features incorporated in venues and facilities

   (v) Minimizing air, noise and water pollution

   (vi) Use of environmentally friendly energy sources during construction and in the venues and facilities

   (Vii) Maintenance of natural vegetation and development of green spaces around venues and facilities

   (viii)Use of biodegradable materials

   (ix) Building (environmental) management systems incorporated in venues and facilities

3. Were measures put in place by the IOC to ensure that the London 2012 Olympic Games leave a green legacy?
4. Why were these measures put in place?
5. Highlight various ways in which these measures by the IOC contributed to the greening of venues and facilities for The London 2012 Olympic Games.

6. From your perspective, which challenges were encountered when designing the venues and facilities for The London 2012 Olympic Games?

7. From your perspective how did the organizers overcome these challenges?

8. What are the health and environmental benefits of **green venues and facilities** for The London 2012 Olympic Games?

   (i) Health benefits

   (ii) Environmental benefits

9. What are some of the economic and social benefits of **hosting the** Olympic Games in London?

   (i) Economic benefits

   (ii) Social benefits

10. Based on your experience so far with the London Games, which other measures can be implemented to enhance the greening of mega-sports events?

11. What can aspiring and future host cities and countries undertake to ensure that mega-sports events positively and sustainably transform their societies and economies but also leave a green legacy?

12. Are there any lessons that the IOC has learnt from the London 2012 Olympic Games experience?

13. To what extent were you satisfied with the budget and resources that were allocated to the greening of the facilities;

14. To what extent are you satisfied with the budget and resources that was allocated to the Sustainability Department of both LOCOG and the ODA

15. Would you say that the standards implemented by the delivery partners in the venues and facilities influence greening standards of buildings outside of the Olympic Games?

16. If so, can you give a few examples?

17. Would you say that the green building standards of the London 2012 Olympic Games influenced standards in the UK and abroad?

18. If so, please list those standards?

19. What would you consider as your 5 top winners in the London 2012 green building initiative

Appendix III: Interview guide for Organizing Committee for the Olympic Games and Paralympic Games (LOCOG)

1. What was the role of the Organizing Committee for The London 2012 Olympic Games (LOCOG) in the greening of the London 2012 Games?
2. What was the role of LOCOG in greening of venues and facilities for The London 2012 Olympic Games?
3. Highlight from your perspective, how greening initiatives were observed in the following areas during construction of venues and facilities for The London 2012 Olympic Games.

   (i) Selection of sites for venues and facilities

   (ii) Conception and design of venues and facilities

   (iii) Construction of venues and facilities

   (iv) Water management

   (v) Minimizing air, noise and water pollution

   (vi)Use of environmentally friendly energy sources and technologies during construction and operation

   (vii) Maintenance of natural vegetation and development of green spaces

   (viii) Biodiversity conservation

   (ix)Use of biodegradable and recycle/recyclable materials

   (x) Waste management during construction

   (xi) Transportation of construction materials

   (ix) Institution of building (environmental) management systems including clear monitoring and evaluation plans for venues and facilities

4. Which other measures were put in place to ensure that the London 2012 Olympic Games leave a green legacy?

5. Highlight various ways in which measures taken contributed to the greening of venues and facilities for The London 2012 Olympic Games.

6. In your view, why do you think that these measures were put in place? Were they fulfilling legislative or building standard requirement?

7. Which challenges were encountered during the designing and construction as well as during the operational phases with regards to meeting the green objectives of these venues and facilities?

8. How were challenges overcome?

9. What are the health and environmental benefits of **green venues and facilities**?

(i) Health benefits

(ii) Environmental benefits

10. What are the economic and social benefits of **hosting mega-sport events** like The London 2012 Olympic Games?

(i) Economic benefits

(ii) Social benefits

11. Which other measures can be implemented to enhance the greening of mega-sports events?

12. What can aspiring and future host cities and countries undertake to ensure that mega-sports events positively and sustainably transform their societies and economies and leave a green legacy?

13. What lessons have you learnt from your e London 2012 Olympic Games experience?

14. To what extent were you satisfied with the budget and resources that were allocated to the greening of the facilities;

15. To what extent are you satisfied with the budget and resources that was allocated to the Sustainability Department of the ODA

16. Would you say that the standards implemented by the delivery partners in the venues and facilities are influencing greening standards of buildings outside of the Olympic Games?

17. If so, can you give a few examples?

18. Would you say that the green building standards of the London 2012 Olympic Games influenced standards in the UK and abroad?

19. If so, please list those standards?

20. What would you consider as your 5 top winners in the London 2012 green building initiative

Appendix IV: Interview guide for Olympic Delivery Authority (ODA)

1. What was the role of Olympic Delivery Authority (ODA) in greening of venues and facilities for The London 2012 Olympic Games?

2. Highlight how greening initiatives were conceived and implemented in the following areas during construction of venues and facilities for the London 2012 Olympic Games.

   (i) Selection of sites for venues and facilities

   (ii) Conception and design of venues and facilities

   (iii) Construction of venues and facilities

   (iv) Water management

   (v) Minimizing air, noise and water pollution

   (vi) Use of environmentally friendly energy sources and technologies during construction and operations

   (vii) Maintenance of natural vegetation and development of green spaces

   (viii)Use of biodegradable materials

   (ix) Monitoring and evaluation of green venues and facilities

3. Which other measures were put in place by your organization to ensure that the London 2012 Olympic Games leave a green legacy?

4. Why were all these measures initiated and implemented?

5. Highlight various ways in which measures taken by your organization contributed to the greening of venues and facilities for The London 2012 Olympic Games.

6. Were measures put in place by your organization to ensure that the London 2012 Olympic Games leave a green legacy effective? Explain

7. Which challenges were encountered when designing green venues and facilities for The London 2012 Olympic Games?

8. How were challenges overcome?

9. What are the health and environmental benefits of **green venues and facilities** for The London 2012 Olympic Games?

   (i) Health benefits

   (ii) Environmental benefits

10. What are the economic and social benefits of **hosting mega-sport events** like The London 2012 Olympic Games?

    (i) Economic benefits

    (ii) Social benefits

11. Which other measures can be implemented to enhance the influence of greening of mega-sports events on environmental sustainability?

12. What can aspiring and actual host cities and countries undertake to ensure that mega-sports events positively and sustainably transform their societies and economies?

13. What lessons were learnt from the London 2012 Olympic Games experience?

14. Were the measures around the greening of venues and facilities in line with the applicable standards for building in the UK?

15. Did the London 2012 Games surpass those standards? How?

16. Has this had an impact on the overall building standard in the UK? How?

17. In your view, have these standards influenced industry-wide changes in favour of more stringent green standards? How?

18. Can you give a few examples?

19. Were the measures around the greening of venues and facilities in line with the applicable standards for building in the UK?

20. Did the London 2012 Games surpass those standards? How?

21. Has this had an impact on the overall building standard in the UK? How?

Appendix IV: Interview guide for Olympic Delivery Authority (ODA)

1. What was the role of Olympic Delivery Authority (ODA) in greening of venues and facilities for The London 2012 Olympic Games?
2. Highlight how greening initiatives were conceived and implemented in the following areas during construction of venues and facilities for the London 2012 Olympic Games.

   (i) Selection of sites for venues and facilities

   (ii) Conception and design of venues and facilities

   (iii) Construction of venues and facilities

   (iv) Water management

   (v) Minimizing air, noise and water pollution

   (vi) Use of environmentally friendly energy sources and technologies during construction and operations

   (vii) Maintenance of natural vegetation and development of green spaces

   (viii)Use of biodegradable materials

   (ix) Monitoring and evaluation of green venues and facilities
3. Which other measures were put in place by your organization to ensure that the London 2012 Olympic Games leave a green legacy?
4. Why were all these measures initiated and implemented?
5. Highlight various ways in which measures taken by your organization contributed to the greening of venues and facilities for The London 2012 Olympic Games.
6. Were measures put in place by your organization to ensure that the London 2012 Olympic Games leave a green legacy effective? Explain
7. Which challenges were encountered when designing green venues and facilities for The London 2012 Olympic Games?
8. How were challenges overcome?

9. What are the health and environmental benefits of **green venues and facilities** for The London 2012 Olympic Games?

   (i) Health benefits

   (ii) Environmental benefits

10. What are the economic and social benefits of **hosting mega-sport events** like The London 2012 Olympic Games?

    (i) Economic benefits

    (ii) Social benefits

11. Which other measures can be implemented to enhance the influence of greening of mega-sports events on environmental sustainability?

12. What can aspiring and actual host cities and countries undertake to ensure that mega-sports events positively and sustainably transform their societies and economies?

13. What lessons were learnt from the London 2012 Olympic Games experience?

14. Were the measures around the greening of venues and facilities in line with the applicable standards for building in the UK?

15. Did the London 2012 Games surpass those standards? How?

16. Has this had an impact on the overall building standard in the UK? How?

17. In your view, have these standards influenced industry-wide changes in favour of more stringent green standards? How?

18. Can you give a few examples?

19. Were the measures around the greening of venues and facilities in line with the applicable standards for building in the UK?

20. Did the London 2012 Games surpass those standards? How?

21. Has this had an impact on the overall building standard in the UK? How?

22. In your view, have these standards influenced industry-wide changes in favour of more stringent green standards? How?

23. Can you give a few examples?

24. What are the 5 top things that you are most proud of as achievements from the sustainability perspective? Try to have 1 or 2 that relate to venues and facilities

Appendix V: Interview guide for UK Department of Communities and Local Governments

1. What was the role of UK Department of Communities and Local Governments in greening of venues and facilities for The London 2012 Olympic Games?
2. How are the green standards of your Department applicable to mega-sport events like the London 2012 Olympic Games?
3. Why are these standards important for small and big development?
4. Highlight how greening initiatives were observed in the following areas during construction of venues and facilities for The London 2012 Olympic Games.

   (i) Selection of sites for venues and facilities

   (ii) Conception and design of venues and facilities

   (iii) Construction of green venues and facilities

   (iv) Water management

   (v) Minimizing air pollution

   (vi) Use of environmentally friendly energy sources

   (vii) Maintenance of natural vegetation

   (viii) Use of biodegradable materials

   (ix) Use of recycled materials

   (x) Building/Environmental Management Systems (including monitoring and evaluation) of venues and facilities
5. Which other measures were put in place by your Department to ensure that the London 2012 Olympic Games leave a green legacy?
6. Highlight various ways in which measures taken by your Department contributed to the greening of venues and facilities for The London 2012 Olympic Games.

7. Do you think that the measures put in place by your Department helped to ensure that the London 2012 Olympic Games leave a green legacy effective?

8. Why?

9. In your view, which challenges were encountered when designing the venues and facilities for The London 2012 Olympic Games?

10. In your view, how were challenges overcome?

11. In your view, what are the health and environmental benefits of **green venues and facilities** for The London 2012 Olympic Games?

    (i) Health benefits

    (ii) Environmental benefits

12. In your view, what ere the economic and social benefits of **hosting mega-sport events** like The London 2012 Olympic Games?

    (i) Economic benefits

    (ii) Social benefits

13. Which other measures can be implemented to enhance the influence of greening of mega-sports events on environmental sustainability?

14. What can aspiring and actual host cities and countries undertake to ensure that mega-sports events positively and sustainably transform their societies and economies?

15. From your perspective, what lessons were learnt from the London 2012 Olympic Games experience?

16. Did the greening initiatives for venues and facilities meet or surpass your regulations?

17. How and to what extent?

18. Did this have an influence in your revised guidelines that were published in 2010? How?

Appendix VI: Focus Group Discussion Schedule for Experts not Familiar/Worked Closely with Games Delivery Agencies

	Topic	Areas Discussion
1	Greening measures for mega sports (The London 2012 Olympic Games)	i. Types of building materials ii. Various natural vegetation in venues and facilities iii. Measures for water conservation iv. Measures to prevent air, noise and water pollution v. Use of energy sources vi. Transportation of materials for construction vii. Efficiency in land management viii. Use of biodegradable materials
2	Significance of green initiatives for mega sports (The London 2012 Olympic Games)	i. Advantages and disadvantages of green venues and facilities ii. Advantages and disadvantages of mega sport events with respect environmental sustainability
3	Effectiveness of green initiatives for mega sports (The London 2012 Olympic Games)	i. Discuss how effective greening initiatives for The London 2012 Olympic Games are ii. Challenges encountered in implementing greening initiative for mega sports. How can these challenges be identified and resolved iii. Environmental benefits of green venues and

			facilities
		iv.	Health and social benefits of green venues and facilities and mega sport events
		v.	Economic benefits of green venues and facilities and mega sport events
		vi.	Measures to enhance environmental sustainability through mega sport events such as Olympics
		vii.	Your top 5 achievements
		viii.	Why are these achievements among you top achievement?
		ix.	What can be done better?

Appendix VII: Direct Observation Guide

General Observations

1. Visible presence of information on green measures in the Olympic Park
2. Knowledge of Volunteers on the greening measures for the Games

Waste Management

3. Availability of Bins in the Olympic Park
4. How many bin system is being used?
5. Signage on bids (texts, drawings or photos)
6. Is the signage easily understood?
7. Are the bins distributed in a way that fans can easily get to them?
8. Are spectators throwing waste outside the bins?
9. Are spectators putting the waste in the right bins?

Renewable Energy

10. Visible fixtures in the Olympic Park and within the venues
11. Energy sensors in toilets and washrooms
12. Information / signage of energy efficient behaviour by spectators
13. Use of natural lighting in venues and facilities
14. Any signs of consciousness of spectators of the energy implications of the Games

Water

15. Visible low flow water fixtures in venues

16. State of rivers and canals at the Olympic Park

17. Integration of wetland bowl in Olympic Park

Green Spaces

18. Extent of integration of green spaces in and around venues

19. Special features of green spaces

20. Signage on importance of green spaces, wetlands and biodiversity conservation

21. Biodiversity conservation and any visible impact by spectators during the Games

Venues

22. External features of venues

23. Green design features

24. Photos of venues

25. Compact nature of the Olympic Park

26. Integration of temporary venues in the Olympic Park

Other Issues

27. Information on climate impact of the Games

28. Organized tours for spectators to brief on the environmental features of the Olympic Park