



UNIVERSITY OF NAIROBI

College of architecture and engineering

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**TITLE:**

**WASTE MINIMIZATION STRATEGIES FOR SUSTAINABLE INTERIOR DESIGN**

**Masters Project Report**

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THE THESIS PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE  
REQUIREMENT FOR THE DEGREE OF MASTER OF ARTS IN DESIGN TO THE  
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DECLARATION

I **Mike Kemboi Chesaro** do declare that this thesis project report is my original work and has not been submitted for a degree in any other university. The ownership of any academic property privileges which may be described in this project is vested in the University of Nairobi School of The Arts and Design and may not be made available for use by a third party without written permission of the university which will prescribe the terms and conditions of such agreements.

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## DEDICATION

This thesis project report is dedicated to my parents and siblings for the unwavering backing and encouragement for the period of my study.

## ACKNOWLEDGEMENT

This thesis project report is devoted to all who assisted in developing it from the conceptual stage. I value the unequivocal advice and guidance from Dr. Samuel M. Maina my research project supervisor, Mr. Collins Makunda the co-supervisor and the panel of lecturers assessing the master's degree course.

## ABSTRACT

This thesis project report is based on waste minimization strategies for sustainable interior design. Conventionally, interior design was viewed as a one-dimensional practice which was basically to offer beautiful spaces to the clients. Recently, the practice has experienced a dramatic change with the incorporation of strategies which emphasize designing environmentally sustainable and healthy spaces for people to live in, work in and play in. The awareness of environmental accountability is what sparked the necessity for an environmental sustainable interior design practice. Society at large is starting to recognize the link between spaces, people and community. Moreover, consumers of interior design are starting to recognize their role and influence in environmental protection.

This study makes emphasis on a case study of interior design firms within Nairobi County and its environs. The objectives of this study are to establish the most appropriate waste minimization strategy used by interior designers, to determine the current waste minimization strategies used by interior designers in Nairobi and its environs and to propose a waste minimization strategy that can be adopted by interior designers in Nairobi and its environs to attain sustainable interior design. The literature was gathered through document analysis from published online journals and books. The sample size for the study was determined as 11 respondent interior design firms from a population of 110 interior design firms in Nairobi and its environs. Stratified simple random sampling technique was used to get the sample of interior design firms to be studied. The interior design firms in Nairobi will be categorized into stratus of small, medium and large firms. The instruments that will be used in data collection include in-depth interviews, questionnaire survey and observational forms and checklists. This study will create awareness of the existing waste minimization strategies in interior design and also will propose a waste minimization strategy that can be adopted by Kenyan interior designers.

**Keywords;** Interior design, Waste minimization, Waste minimization strategies, Sustainability, Sustainable interior design

## DEFINITION OF TERMS

**Interior design waste** - comprises of unsolicited materials generated directly or indirectly by the interior design activities. This comprises building materials like insulations, tile pieces, electrical wiring, wood, steel etc. (Manohar, 2015).

**Waste minimization** – The process that evades, eradicates or lessens waste creation at its source and permits reusing and reutilizing of the waste materials for other useful usages (Guthrie and Mallett, 1995).

**Sustainable design** – It involves the well-being and protection of the earth so that the present-day generation can be able to meet the needs that they have without interfering with the forthcoming generation ability to meet their needs (WCED - World Commission on Environment and Development, 1987)

**Sustainable interior design** – Interior design practice where every material and system suggested are intended to lessen the negative effects of the practice on users and environment though exploiting affirmative influences on social, on the economic and on the ecological structures (Guerin & Kang, 2009)

**Waste** – All the materials, except the materials from the earth, which needs them be hauled away from the building site or else used on construction site for a different purpose other than the projected purpose in the project (The Building Research Establishment (BRE), 1990)

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## **1.0 CHAPTER ONE**

### **1.1 BACKGROUND**

The United Nation's Sustainable Development Goals (SDGs), released in September 2015, pinpoints on the importance of focusing on the built environment in achieving sustainability (UN, 2015). According to Cargo (2013), traditional interior design occupation was a single-dimensional practice which was to come up with appealing interior spaces for clients. However, Yang, Fenghu and Xiaodong (2011), described this outdated interior design practice as pretty conventional as it simply focuses on extravagance design while overlooking the effect of the practice on the users' health and environmental contamination (Yang, Fenghu, & Xiaodong, 2011). Numerous designers support the campaign towards sustainability in design, however, according to Templeton (2011), the number of interior designers who practice sustainability in their practice is still very few. Furthermore, Kusumarini et al., (2011) and Cargo (2013) concur that even if Environmental Sustainable Interior Design (ESID) is a chief matter of discussion in the practise of interior design, the number of times that interior designers come up with sustainable picks in their practise is precisely limited. Steig (2006) goes ahead and describe this gap as a 'sustainability gap' (Steig, 2006).

The increasing consciousness on the influence of the waste materials on physical environment has led to development of waste management strategies (Shen & Vivian, 2001). According to Mr. Gitura of Chege Interiors, who has been in the industry since the 1980s, interest in interior designers is growing because Kenyans are becoming aware of the benefits of having a nicely done living spaces. Research conclusions done by the University of Loughborough and WRAP (Waste Resources and Action Program) is in agreement that designers have an opportunity and plays a great part in waste minimization (Osmani M. , 2013). Furthermore, there is an opportunity to develop a waste minimization strategy at the designing stage. WRAP in its



research “Designing out waste” went ahead and identified the contributions that designers can make to minimize waste through design (Langdon, 2015). Furthermore, Kibowen (2008), in her research on the identification of waste determining factors in Kenyan construction industry, concluded that the problem of waste which is inherited in most construction processes because of the deficiency of alertness by design experts, specialists and contractors on various sources and types of wastes occurring at different stage of the project.

According to Brebbia and Sandra (2017), an inclusive and effective sustainability solution needs a thorough planning and progressive application. Furthermore, it should have a capability of being reused, recycled, and refurbished or disassembled (Brebbia & Sendra, 2017).

Based on these standpoints, this research will focus on the strategies and techniques by which waste is minimized and propose a waste minimization strategy that can be employed by interior designers in Nairobi and its environs.

## **1.2 Statement of the Problem**

Sustainability has continued to be a major subject matter in the practise of interior design, however, when looking at number of times that designers adopt sustainable strategies in their practices is limited (Templeton, 2011). Moreover, in Kenya, there are no clear waste minimization strategies that interior designers can employ in their practice.

The interior design practice in the accomplishment of sustainability is insufficiently known by interior designers and is not properly emphasized in the present interior design practice (Celadyn, 2019). Steig (2006), describes this gap as a 'sustainability gap'. It is precisely this gap that this study is concerned with.

### **1.3 Objectives of the study**

The overall objective of this study is to establish the most appropriate waste minimization strategy used by interior designers, what waste minimization strategies interior designers currently use and to propose a waste minimization strategy that interior designer in Nairobi and its environs can adopt to achieve sustainable interior design practice.

This study sought to accomplish the succeeding objectives;

- i. To determine waste minimization strategies that are used by interior designers to achieve sustainable interior design practice.
- ii. To investigate the challenges that local interior designers encounter when applying waste minimization strategies in their practice
- iii. To propose a waste minimization strategy that can be adopted by interior designers in Nairobi and its environs.

### **1.4 Research Questions**

The subsequent research questions guided this study;

- i. Which are the waste minimization strategies adopted by the interior designers to achieve sustainable interior design practice?
- ii. What are the challenges that local interior designers encounter when applying waste minimization strategies in their practice?
- iii. Which waste minimization strategy can be adopted by interior designers in Nairobi and its environs?

### **1.5 Scope of this study**

This study targeted interior design firms that are located in Nairobi and its environs. It sought to establish the waste minimization strategies used by interior designers and also to propose a

waste minimization strategy that interior designers in Nairobi and its environs can employ in their practice. The study was based and limited to Nairobi and its environs.



Figure 2: Location of Nairobi (Source: Google maps, 2019)



Figure 1: Map of the scope of the study (Source: Google maps, 2019)

## 1.6 Justification of the study

Considering that interior designers globally are focusing on environmentally responsible interior space designs, the justification of this study cannot be overemphasized. It is of increasing importance for interior design practitioners to have a broad understanding of sustainability in their practices. For clients, the study will serve as their guide in enhancing their knowledge of design practices that contribute to eco-friendly interiors. This study will be an important attempt in promoting good strategies of waste minimization and sustainability to preserve the environment through waste minimization strategies.

## 1.7 Significance of this study

This research purposed to address waste minimization strategies in interior design. The study will contribute to raise awareness on the existing literature on sustainability in interior design practice. Moreover, the findings of the research will contribute to sustainability policymaking

at the industry level. It could also act as a guide and a reference point to interior design clients as they seek sustainable services from the professionals.

### **1.8 Limitations of the study**

Having a slim budget and limited time, the study was restricted to interior design firms that are located in Nairobi and its environs hence the study was not be generalizable to the whole country. Moreover, there were other sustainable interior design strategies but the researcher chose to study waste minimization strategy in interior design as interior design projects generate wastes throughout the interior design process.

## **2.0 CHAPTER TWO**

### **2.1 LITERATURE REVIEW**

#### **2.2 Introduction**

Modern environmentally friendly movement is presently driving and changing the realm of interior design (Center for Sustainable Building Research, 2002). Interior designers are now focusing their attention to green and sustainable practise which involves using of definite resources and also building practices that reduces the environmental harm such as use of low-pollution or sustainable materials and practices (Ryn & Cowan, 1995). This chapter intends to review literature concerning sustainability, waste minimization strategies in interior design and also challenges that faces sustainable interior design with a goal of establishing waste minimization strategies that interior designers can adopt when practicing design so that they can achieve sustainability when practicing interior design.

#### **2.3 Design**

Design has been defined as a method of solving problems. According to Forty (1986), design is a problem-solving activity that encompasses a trial and error process for coming up with meaningful orders. The problem solving is multi-disciplinary and involves examination, information enquiries, and practicability studies up to the obtaining of prototypes ready for production. Design as a method of solving problems may be used in other disciplines such as in sciences and mathematics, art and music, commerce and marketing, in communication and information technology and also in our day to day life (Seymour, 2002). Moreover, design as a basic methodology solves problems in products, services and systems.

Design can further be seen as an activity aimed at inaugurating the faceted abilities of substances, methods used and systems in an entire life sequences (Manzini, 2006). Therefore,

design takes into account matters such as worldwide sustainability and environmental safety. Altogether, design is an activity that comprises a number of professions such as architecture, products, interiors, fashion, services and graphics.

This study is interested in the branch of design which is interior design. It has been demarcated as an occupation whereby imaginative practical answers are practiced in a building to succeed a sustainable constructed interior setting (Moody, 2012). The results are practical, improve the value of life and beliefs of inhabitants, furthermore they are visually pleasing. The designs are generated in reply to and corresponding with the construction shell and accept the physical setting and social environment of the project. Also, the proposals must observe the codes and governing necessities, and hearten the philosophies of eco-friendly sustainability (Vezzoli, 2008).

Interior design contains a range of amenities accomplished by a trained interior design specialist, competent in terms of training, practice and scrutiny, to safeguard and also to improve the health, wellbeing and safety of the community whom are the users of the spaces created by designers. These services include selection of materials, methods and strategies to properly carry out the design thought and to meet socio-psychological, practical, conservation, environmental, and safety requirements (National Council for Interior Design Qualification, 2004). From definitions argued in this section, interior design can be well-defined as the process that solves problems, a multidisciplinary aspect. This study embraces the view that interior design can be seen from the point of reference of selection of processes and strategies that solve interior design problems by encouraging environmental sustainability through waste minimization strategies for sustainable interior design practices.

## **2.4 Interior design process**

The process screens sets of activities that when prudently presumed by interior designers' outcomes in a meticulously deliberated answers that will meet the desires of the clients (Dodsworth & Anderson, 2015). Design can be regarded as a principally direct action with a start-point at which the client makes the first interaction with the designer and an end-point when the project has been executed. Nonetheless, the authenticity is that inside the process, majority of the individual tasks are unified, so, modifications to a single section of a design solution might necessitate that previous parts of the process are reexamined and reviewed. In this perspective, the process is a means to an end. It is not constantly suitable to be rigid about ensuing the process (Salerno, 2015). It offers a configuration, an outline to track, nonetheless it duty stay supple enough so that discernment, exploration, and progresses can altogether be bound as and when they arise to take the concepts onto a new and improved level. Design process is perceived as flexible one where the diverse tasks are adjustable to the distinctive nature of every project.

According to Moore & Rydin (2008), the design process is not a typical "one size fits all" solution, and there is need to grow an understanding of it so that one can see how it can be used to meet the needs of individual projects. One apprehension that ought to be addressed at each and every stage of the design process is that of sustainability. It has become a most important deliberation that leads to the second tranche of analysis, in which the designer is directing to edit, purify, and eventually make logic of all the information that has been gathered (Moore & Rydin, 2008).

### *2.4.1 Analysis*

Analysis is appropriate at two linked but diverse parts of the project sequence. In the earliest stages of the design process, before thorough design exertion proceeds, the designer is required to evaluate the gauge and intricacy of the task work to be assumed (Chapman, 1997). This will permit initial approximations to be prepared of the time and resources required to complete the project. These will in turn offer a basis upon which the designer can base a fee suggestion. Some of the work at this phase will include defining the scope of the project and the probable arrangement and content of the performance as this will control, to a great step, the quantity of drawings and illustrations that are organized. All of this takes time and will require the client to be charged.

Once the client has settled for the suggested design work and reach the initially presentation stage, the designer can take a comprehensive brief from the client. Preliminary inspection of the brief, associated to an overall understanding of the project, tends to give the designer a beginning point for extra research. Wholly, this work will lead to the second tranche of examination, in which the designer is pointing at editing, refining, and eventually make sense of all the information that has been collected. Some information will recount to the practical features of the client's brief, some to the aesthetic facets, while some of it could be conflicting. Over a period of time, the designer will become used to location main concern and accomplishing a comfortable concession with respect to contradictory information. It is very erratic to discover a project that does not require some component of concession to thrive, nevertheless there is never a single method to deal with it. Every project need be observed at its individual advantages, and choices duty be reached that replicate the exclusive nature of the task.



After exploration is done, decisions concerning the flair and content of the whole project can be abridged by generating a concept. Therefore, this will be used to create concepts and initiate the project. Diverse means of investigation and concept flairs are observed in bigger part in the next step, nevertheless, whatsoever method is assumed the concept is crucial to the achievement of the entire project (Guerin, 2009).

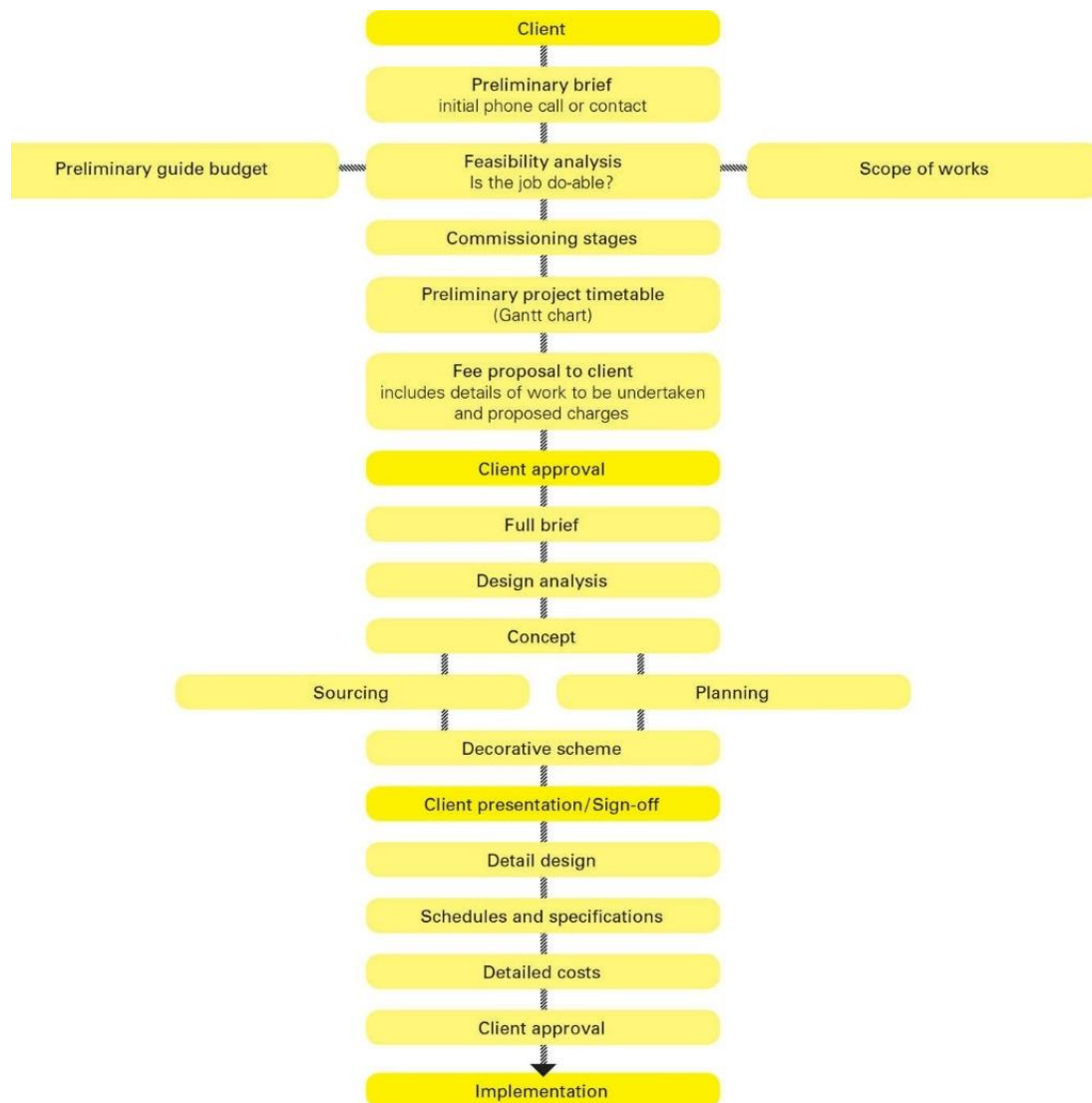


Figure 3: interior design process stages (Source: Bluysen, 2013)

#### 2.4.2 Development

This advance phase of the project is one of the great fascinating for the designer. This is where the ordinary talent of most designer get their communicative passage and somewhere the

individual can actually brand a mark on the project (Dodsworth & Anderson, 2015). This is the phase where the requirements of the client are taken and altered into a practical and appealing design results. It is also where concepts are created and assumed life, where “journeys of fancy” are apprehended and revolved into practicable and spectacular realism. The detection of a hint and the understanding that it can be used and made into somewhat distinct is thrilling. It is an involvement that designers live for. It stimulates and aids outgrow the designer on to learning further of what the project grasps. Interior design is a problem solving activity on a great and compound scale, nevertheless aesthetic touches are also added, the civilizing fundamentals that make interiors attractive and practical on a passionate level. Progressive work can occasionally be challenging, necessitating an unlimited transaction of thought and reworking till the outcome is as flawless as is realistic, but the desire and immodesty that the designer proficiencies when it goes well are worth the struggle.

How far development work wants to be assumed hinge on very much upon precisely what the client needs from the designers. If the client supposes to see “idea sketches” for a project, then merely negligible design work might need to be assumed. Just sufficient straightforward space arrangement and the growth of a few ornamental thoughts and ideas, e.g., to permit the designer to produce sketch graphics of the suggestions. However, if the client needs to see a completely resolved design explanation, then a great deal of progressive work will be assumed; space arrangement, ornamental specifics, and modified objects will all need to be worked on, and this will produce a much greater quantity of drawings and backup work.

Throughout this phase, numerous diverse components of the completed designs will be composed together. Space arrangement will be of key significance. Taking account of ergonomic requirements, the designer will pursue to generate a composed and effective equipment plan that meets the practical requirements of the user. The designer will be obtaining equipment, gilts, and materials that will be selected for their artistic and practical fit with the

idea, with space-planning restraints also notifying furniture selections. As the decorative scheme arises to take shape, the assortment of textures will be advanced and amended. The design is probable to be fairly unsolidified, altering and developing while heading towards a completely determined ending. Being exposed to alteration is one of the best qualities a designer can and should have.

### *2.4.3 Design stage*

It is not sufficient to attempt to reason things through and then generate a sketch to record an end idea, as nearly no one is skilled adequate to be able to predict a fully resolute and expressed design (Daly, 1992). Alternatively, it is over the act of drawing itself that concerns are recognized and resolved. This is such an essential idea for the beginner designer to hold. Drawings are not made merely to record an idea or detail that has already been formulated in the designer's mind. Instead, making drawings is a process of "thinking on paper." Drawing is crucial to the development of a design, an extremely powerful tool in the designer's arsenal. Sketching and hand drawing play a part in the lives of almost all designers; even those who use computers on a daily basis turn their ideas into the drawings used for construction purposes.

Quick sketches and formal technical drawings are used in conjunction to conceive new ideas and examine their impact on the scheme. Plans are usually the first technical drawings to be made, but as soon as the first planning options are being explored, the designer should be thinking in three dimensions, so elevations, sections, or perspective sketches will follow to show other aspects of the space. Drawing is an excellent way of comparing alternatives, of seeing different options side by side.

After the project has been presented to the client, and the client has approved the work to date, further drawings will be needed to move the project forward. These drawings, done in more detail than those for the presentation, will be sent out to tender to allow accurate quotes to be

given by potential contractors. They will highlight what work needs to be done to the space and, where necessary, will show constructional details, thus ensuring that the designer's vision for the project is realized by the contractors as intended.

While the designer is continuously pointing to deliver the best answer imaginable, the solution is virtually certainly going to include negotiations. At the very least, there will be opposing, if not contradictory, needs and wants in nearly every design brief. It is the job of the designer to make decisions and to highlight. In some circumstances, it will be the applied solution that is the most suitable; in others, the beautiful will win.

#### *2.4.4 Implementation*

After all the design work has been settled on and signed off by the client, implementation can start. Once contractors have been engaged to carry out the work, the involvement of the designer could be minimal, with a number of site visits to check that work is being accomplished as intended. The designer could, on the other hand, be involved in a very hands-on supervisory role. In some countries, depending on the depth of training that the designer has undertaken, legislation may limit their involvement with the implementation process. The term "project management" is sometimes restricted to those who have undertaken specific training in that subject, so the designer may find legal limitations on what they are able to contribute to this part of the process.

The designer's struggle is essential to decide some of the matters that are sure to rise as the execution continues. A good association with contractors and other people involved in the project will be of boundless help. It can in portion be attained by demonstrating understanding to some of the difficulties that might arise during the application stage. Knowledge of building practice, materials and their limitations, and local building regulations, will all give the designer credibility with those in the building trade. Neat, legible, and complete drawings are

vital in communicating with the construction team. As part of the development stage, it will have tried to anticipate all the drawings that will be required for the various trades involved with the project to interpret your instructions accurately. This may well be a much greater number of drawings than was needed to communicate your design proposals to the client. Even at the implementation stage it may be necessary to create new drawings to deal with some of the unexpected and unforeseen situations that arise. Long-term professional relationships with tradespeople are often forged by designers, with the same contractors being used time and time again for their projects.

The trust that is built up in this way can be very helpful to the easy running of the project, allowing for a more efficient workflow because of the familiarity that exists with the designer's ways of working. Good workmen will trust and respect the designer's judgment, even if this means working outside of their experience, but this trust can take time to mature. If contractors are not known to the designer, then it is especially important that the designer maintains a professional attitude at all times. All drawings must be thorough and complete. Decisions made and changes agreed need to be fully documented and recorded, as disagreements could be costly and cause friction between the parties involved.

#### *2.4.5 Evaluation*

It is healthy for a designer to constantly question the chain of decisions that have been taken to that point and to maintain a self-critical attitude toward everything throughout the life of a project. Before reaching the implementation stage, revising work that has already been done can be a healthy way to work. From the client's point of view, the design process is usually considered complete after the implementation stage, but the designer should also evaluate the project in an effort to learn from it. A time of reflection will be valuable immediately after the design has been delivered, as lessons learned during the process will still be fresh in the mind,

and it is good practice to revisit the project after an appropriate period has elapsed (say six months or a year), as lessons might be learned which become apparent only after a space has been occupied and is functional. While it may or may not be possible to rectify any shortcomings that are identified on an individual project at this stage, the knowledge acquired can be fed into subsequent projects.

Whatever the extent of the work undertaken to try to visualize the finished outcome of the project during the design development, there will be some instances where you can only properly judge some of your aesthetic decisions during implementation. Although it may be possible to make changes at this stage, there are likely to be cost implications. It may be more appropriate to simply learn the lesson for next time but take no action on-site.

#### *2.4.6 The collection of data*

The data is collected from a medium –small size construction company. The data is collected both from the site directly and also from the design process where the wastage is factored into the quantity surveying process. The data is gathered by estimating the quantity of the waste generated at the construction site with naked eyes. The reason that the data is collected by estimation is because the construction waste that are generated on site are not being separated and hard to categorize into their types.

### **2.5 Sustainability**

From the early 1960s conservation campaigners decreed that the globe is the mutual obligation of every human beings and that everybody must be involved in fighting misuse and negligence (Margolin, 2007). These revelations urged people across the globe to embrace a paradigm shift which shifts human beings from being environmentally irresponsible to environmentally responsible (Jones, 2008). Furthermore, he maintained that this model move is “the acceptance

by the majority of people in a changed belief, attitude, or way of doing things, a fundamental change in people's worldview".

Literally, sustainability means the ability to retain some unit, product or procedure over a period of time (Basiago, 1999). Nevertheless, in literature, majority of scholars, investigators and practitioners apply the concept to connote improving and sustaining a healthy economic, ecological and social system for human development (Thomas, 2015; Gray & Milne, 2013; Tjarv, & ZemītE, 2016; Mensah & Enu-Kwese, 2018). Stoddart (2011) explains sustainability as the effective and impartial supply of resources intra-generationally and inter-generationally with the process of socio-economic doings inside the boundaries of a limited environment. Also, Ben-Eli (2015), perceives sustainability as a vibrant balance in the process of collaboration between the people and the carrying capability of the environment such a way that the inhabitants advances to express their full potential minus creating irrevocable adverse effects on the carrying capacity of the environment upon which they depend on. From this viewpoint (Thomas, 2015) highlighted that sustainability brings into emphasis the human activities and their capability to gratify human needs and wants without exhausting the prolific resources at their discarding.

The world has experienced constant population growth for centuries. Also, the resources available are inadequate (Bluyssen, 2013). The state of global warming and waste pollution paints an undesirable future for our environmental resources; therefore, an awareness of the importance of sustainable practices is required (Tucker, 2014). Moreover, the impact of human activities in the environment over some period of time is progressively becoming clear. From the contamination of oceans and aquatic life by oil spills to the damage of human health initiated by unsafe processes, materials and constructions (Braganca & Cuchi, 2007). From all the resources consumed throughout the globe, fifty per cent is used in building and construction. This makes construction one of the least sustainable activities in the universe.

Nevertheless, modern human civilization depends on building structures for its continuous sheltering and survival though our world cannot sustain the present level of resource consumption (Edwards, 2005) .

It is projected that by the year 2056, the world economic activities will have amplified five times, worldwide population increased by more than 50%, worldwide energy consumption will have amplified approximately three times, and global industrial activities will increase at least three times (Matthews, et al., 2000). The design field and its subordinate occupations, that is, industrial design, engineering, architecture, etc. is the main focal point for sustainability. This is not astonishing since poorly designed products, processes and structures can significantly add to social and environmental dilapidation. “Sustainability,” and “green” have become a slogan in virtually all design discipline (Stegall, 2006). Sustainability turned out to be a significant international commissions’ problem. Particularly, Bruntland Commission in 1987 professed a report on the primary substances in sustainable development. The report stated that sustainable development is first about guaranteeing that every person, that is, in poor and rich republics, and now as well as the forthcoming generations can have their basic needs meet(Ayalp, n.d.). This ought to be acquired without endangering nature in which life on the globe is reliant on (Ness, 2001). Moreover, the World Summit (1992) and United Nations Conference on Environment and Development (UNCED) encompassed environmental contamination and resource exhaustion in their programmes. The dissertation was widened in “Agenda 21” and “Rio Declaration” whereby the ideologies of sustainable development was discoursed. Also, the “Declaration of Interdependence for a sustainable future” at the Chicago Assembly of the International Union of Architects (IUA) in 1993, architecture was also united in the movement and numerous states and foundations began creating energy and



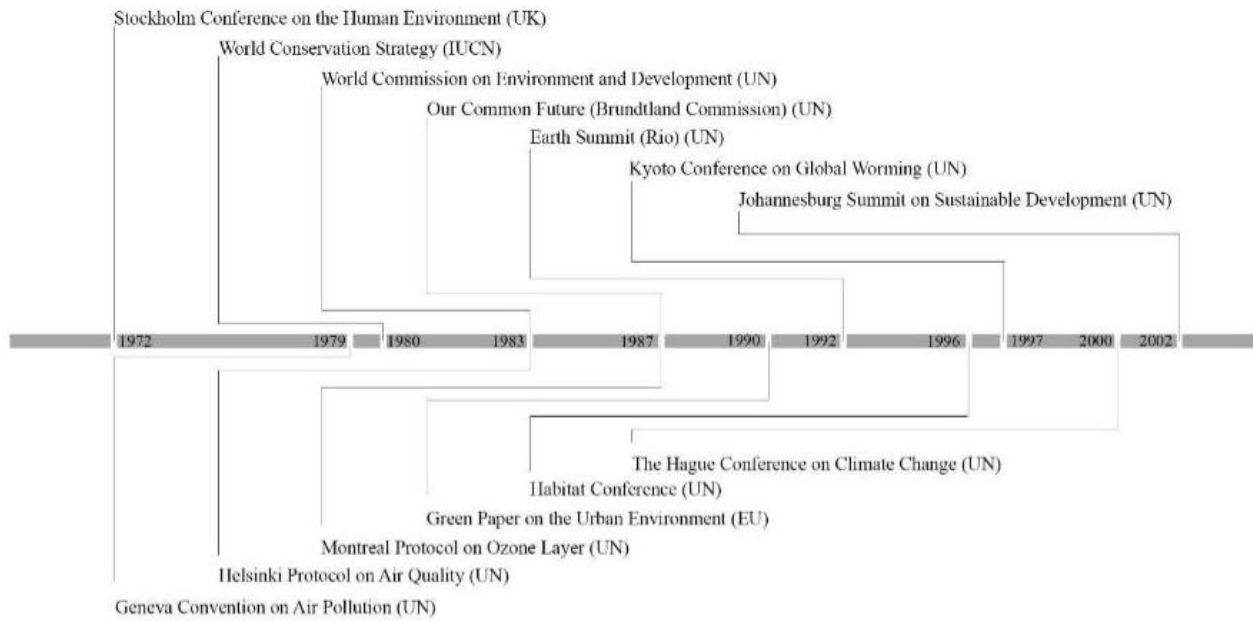


Figure 4: key global environmental treaties (source: Edwards, 2005)

environmental conservation policies (Szokolay, 2004). Below the timelines of key conservational treaties is briefly shown.

For many years humans have been making buildings that, out of need, have been precise to a given area and its environment. They were naturally "sustainable" in their indigenous landscapes. In the modern century, growths in technology have allowed a shift from this model, permitting nature to be overwhelmed. As extensive concern is raised over the limitations of natural resources, as well as the planet's limited capability to absorb waste products, the processes that we are used to needs to be reconsidered. So what does it mean to design according to "sustainable" principles? One universally recognized definition was coined in 1987 by the World Commission on Environment and Development (WCED), which defined sustainable development as that *"Which meets the needs of the present without compromising the ability of future generations to meet their own needs"* (Brown & DeKay, 2001)

The first generation of sustainable design was grounded on little experiments (Der Ryn; S. Cowan, 1995). Energy efficacy, other building materials, preservation, and salvaging have been extensively accepted in disconnected fashion. The second generation of sustainable design began to comprehend that the incorporation of all the aspects can yield the best results for sustainable design. This comprises of the combination of all the numerous concepts and strategies of the past into a whole and extensive sustainable design theories and practices.

The term sustainable design for the built environment is used interchangeably with green design (Otegbulu, 2011). Nevertheless, there is an understated variance. The Green Design Education Initiative (GDEI) (2003) stated that green design frequently suggests an awareness in design that shields people's health and welfare whereas sustainable design similarly defends the worldwide environment and ecologies for the future generations to use them as well. The two terms are often used interchangeably and replicate the notion of generating structures that can be built and operated in ways that improve the influence of the buildings on the environment and inhabitants (Bilec, 2007). The U.S.A Green Building Council (2003) terms "*green design*" as design and building practices that significantly decreases or eradicates the negative effect of structures on the environment and its inhabitants

Sustainable design developed from a range of concerns, experiences, and needs: energy proficiency grew its importance during the 1970s oil crisis, recycling efforts in the U.S.A in the 1970s became ordinary and came to the attention of the building industry, in the 1980s, the "*sick building syndrome*" notion appeared and apprehension for workers health and output became a concern. The apprehension for lethal material emissions also became an issue that needed to be addressed; and projects in water-scarce areas began to focus on water conservation (U.S. Green Building Council, 2003). Usual buildings devour more resources than required, this harmfully impact the environment, and produces a large amount of waste. The contest is to build wisely, using ideal processes and strategies, so that buildings use a

least of nonrenewable energy, produce least of pollution and wastes, and also cost a least of energy money, but increasing the health, protection, and wellbeing of the people who live and work in the spaces. Basically, these are the apparatuses of sustainable design.

## **2.6 Interior design and sustainability**

Bonda (2003) proposed that designers of the built environment need to make the personal decision to take moral responsibility for what they do (Bonda, 2020). Additionally, Stieg (2006) argued that designers should also understand the impact of their activities and take responsibility for their actions. According to Pidcock (2005) there is much evidence to show that if the design industry embraces the future with openness to new models of thinking and doing, there are many exciting opportunities to be realized. She believes that the design profession plays an integral part in creating a future that maintains a healthy economy and attempts to save the world. Pidcock (2005) argues that “The design industry is well placed to take a fresh look at problems and create design solutions that are both creative and desirable”.

The word of sustainability is not just an abstract course, but it is also a very technical term in the face of problem solution. As Sassi defined “Sustainability is not an academic pursuit or even a professional activity: it is a way of life affecting everything an individual does. Knowing what kind of a relationship we want to have with the global and local environment is the first consideration. Then, we should address how to achieve this relationship. To move from theory into practice, it is necessary to understand the impacts associated with our work and life related activities” (Sassi P. , Strategies for Sustainable Architecture, 2006 )

Interior designers, establishments, institutions, companies and the governments recognize the significance of sustainability in interior design, hitherto they don't constantly apply sustainability in their practices. Moreover, inadequate campaign of sustainable facets and effective barricades are held responsible when employing sustainability (Khaleel, 2013).

Sustainability has appeared as an appeal for design field in which can encourage a new conservational invention because of its effects on most parts of life (Osha, 2011). Interior spaces, where we spend 90% of our time in, henceforth, they have the mainstream of environmental effect (Moxon, 2011). Consequently, there is urgent need for sustainable practices by designers who are in a perfect point to offer sustainable solutions (Cain, 2007). Experts in the construction industry, like interior designers, play fundamental roles in sustainable growth that needs to lead in all construction practices. The sustainable interior design approach deliberates the entire project categories be it temporary or long-term projects, in spite of them having diverse requirements. Temporary/Short-term projects/pop-up projects such as exhibitions are well-known for generating a marketing stunt whereas long-term interior design projects falls under domestic, leisure, learning institutions, healthcare and commercial projects (Cain, 2007, Omen, 2008).

It is neither an educational quest nor a professional movement: it is a mode of life touching entirety on what an individual does. Understanding the kind of a connection we want to have with the worldwide and local environment is the foremost deliberation. Secondly, we ought to talk about how to accomplish this association. Moving from theory into practice, it is essential to appreciate the influences allied with our work and life linked activities (Sassi P. , 2006). It is a wide and multifaceted concept that has developed to be one of the key subject in the built environment. The idea involves improving the quality of life, therefore permitting people to live in a healthy environment with enhanced social, economic and environmental conditions(Akadiri et al., 2012). Additionally, a sustainable project is designed, constructed, refurbished, operated or re-claimed in an environmental and resource proficient way (Ortiz, Pasqualino, & Castells, 2009).

Current sustainability strategies and methods stress on broader global goals and strategic objectives hence they are conspicuously feeble in addressing project specific level decision-

making (Ugwu, 2006). Ironically, it is exactly at micro-levels that the goals of sustainability needs to be transformed into actual practical actions. This is done by using an all-inclusive approach to enable decision making.

Interior design is a vital part of any construction structure or repair project. Structures, their supportive substructure and their related maintenance signify a massive amount of human's direct and indirect impact upon the environment. Buildings and their interiors are also accountable for extensive reduction of natural resources, including raw materials and water. The construction, operation, maintenance and renovation of buildings and interiors generate waste and pollution in many forms, creating local and global changes. Sustainable design is a way of thinking that considers the impact of these issues on the environment and on human health in the context of building and construction. By taking an informed approach to the way design decisions are made, beginning with an understanding of how every choice affects the environment; designers can begin to help mitigate these impacts. Interior design is a key aspect of any green building process. It is the design discipline that is most explicitly concerned with how people will experience their built environments and therefore has huge implications for human health, well-being and productivity, all central tenets of sustainable design.

Sustainable interior design practices can be defined as the balance among interior design practices and the use of Earth's resources that benefit humans and the earth now and in the future (Guerin, 2009). Examples of sustainable design practices include: specifying locally manufactured materials, rapidly renewable materials, and/ or durable, long lasting materials. Winchip (2007) explored sustainable strategies of commercial and residential interiors. Solutions for commercial interiors included designing spaces that can easily adapt to the changes in a spaces activities, employees, and technology while conserving resources, giving occupants access to thermal comfort controls and outdoor views, day lighting, designing for minimal heat gain or loss, including centralized energy management units and energy-

efficient light systems, efficiently using space to conserve energy and materials, and specifying low-flow fixtures to conserve water. The numerous approaches to sustainable interior design are evident, and will be unique to each project's criteria. A successful project will blend sustainability into each phase of the design process, its execution and post-occupancy (Winchip, 2007) .An Interior designer juggles client concerns, cost factors, process used, time restraints, and technology among other things.

Ecological sustainability is becoming a key concern within the interior design arena due to the extensive resources required for interior use (Ruff, 2009). Sustainable interior design practices are actions that diminish ecological effect due to site selection, water use, processes used, energy use, and material selection (Rider, 2005). Overall, environmentally sustainable interior design minimizes negative effects and maximizes positive effects on environmental systems over the life cycle of a building (Kang & Guerin, 2008), by blending solutions of the past with new technology of today (Loftness, 2007). Pilatowicz (1995) defined sustainable interiors as interiors designed in such a manner that they sensibly address the impact of all their functions, parts and elements on the global environment. Pilatowicz (1995) also defined environmentally conscious interior design as professional practice that attempts to create indoor spaces that are environmentally sustainable and healthy for the occupants.

Sustainability can only be affective phenomenon when it's considered as a multifaceted problem. After the Brundthland Commission report was publish in 1987, there produced large amount of knowledge in the field of social and positive sciences. The field of environmental design is a different field of study from positive and social sciences. The environmental design deals with both theoretical and practical knowledge produced in the field of social and positive sciences.

In the field of design, the sustainability concept is considered to be in studies with an extensive term as environmental sustainability. This study focuses on the dimensions of sustainability in interior environments. According to Yaldiz and Magdi "Sustainability is a multi-dimensional concept that has environmental, social, political, economic, cultural, and spiritual dimensions". Therefore, sustainability can be described as a system or, in other words, an ecosystem within which various parts/elements interact". They considered these social, cultural and environmental dimensions in the field of interior design (Yaldiz & Magni, 2011). Designers have a responsibility in creating sustainable environments. That is, interior environment is the first and the closer place to fulfill human needs in all of these dimensions (Ayalp, 2013).

When considering the limitedness of the world's resources we realize the need to priorities sustainability when shaping the built environment. As the portent of negative environmental changes has started to dawn on us, vigilance in sustainable practices has become more prevalent around the globe. Furthermore, the concept has reached a certain degree of maturity that has evoked critical outlooks in defining and applying sustainable design. Recognizing the impact of the built environment in ecological and social problems and the accountability of architects and designers in responding to these, many professional organizations and academic programmes, especially those in more developed geographies, have initiated sustainable design education. This has brought up the question of how best to incorporate environmentally responsible design into the educational structure.

It is well acknowledged that our planet is susceptible to catastrophic environmental events and that everybody should do their share of preventing environmental and social degradation. Designers/architects can do much to prevent negative environmental consequences by adopting sustainable design practices (Williamson, 2003). In this context, designers have a responsibility in creating sustainable environments. That is, interior environment is the first

and the closer place to fulfill human needs in all of these dimensions. This study aims to focus on the interior design practice as a multifaceted problem and develops a context with the bilateral relationship between sustainability, social sustainability, and sustainability in design elements.

## **2.7 Sustainable design strategies**

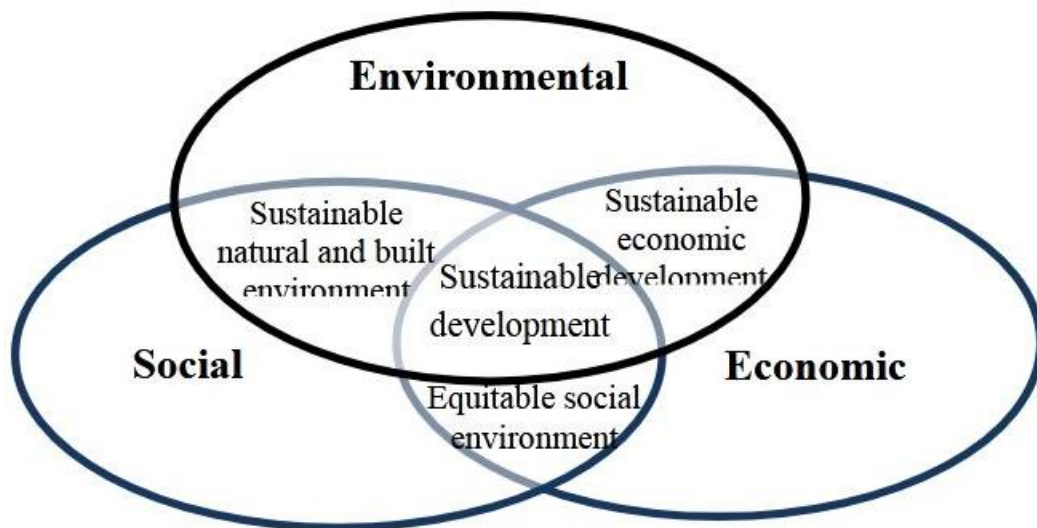
As an occupation, Interior design defines the connection between people to spaces grounded on emotional and psychical strictures, in order to increase the quality of life (IFI, 2013). Sustainable interior design is designing of interiors that every system, process and materials are considered with an accent on incorporation into a whole for the purpose of lessening damaging effects on the environment and inhabitants while exploiting positive effects on the ecological, economic and societal organizations in the lifetime of a structure (Guerin D. a., 2009). Additionally, according to Kang & Guerin (2009) and Moxon (2012), ecologically sustainable interior design is the technique of diminishing harmful effects and exploiting positive effects of the indoor environmental structures throughout the lifecycle of a building (Moxon, 2012).

Pilatowicz, (1995) defined sustainable interior design as interior spaces planned in such a fashion that they shrewdly discourse the effect of their function, part and features on the universal environment. Plus, it's the efforts to make interior spaces which are ecologically sustainable and fit for the inhabitants (Pilatowicz, 1995). Sustainable interior design practice transforms the obligation of interior designers not to be restricted and adjust planning of spaces and furnishing locations conferring to HVAC zones (Heating, ventilation, and air conditioning), powered rooms, tools, picking of colors, finishing, lighting and window treatment comparative to energy productivity and other sustainable approaches (Guerin & Kang, 2009). Today, there is a high level of demand for sustainable buildings. The most



important decisions regarding building's sustainable features are made during the design and preconstruction stages (Azhara, Carltona, Olsena, & Ahmad, 2011).

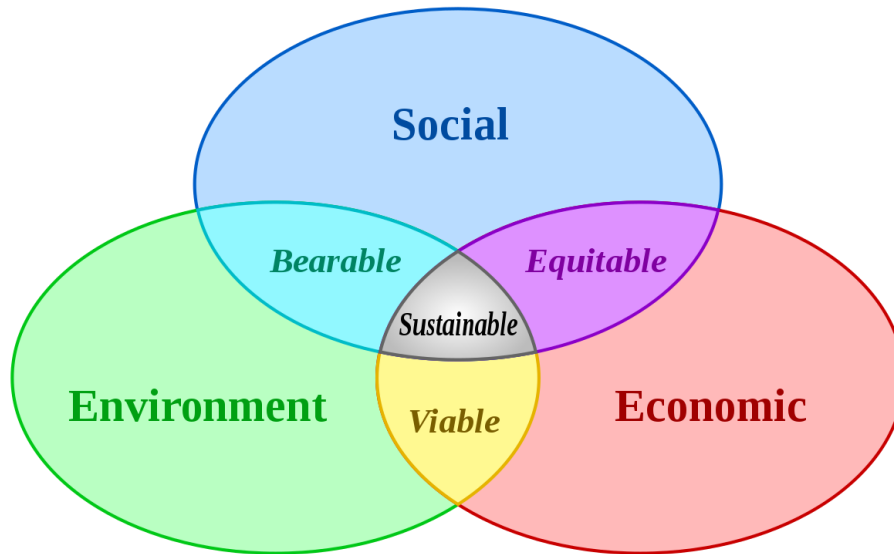
To accomplish sustainability in any interior design project, it is vital to construct an equilibrium between social, economic, and conservational dimensions, the three are interconnected parts of sustainability. Whereas involving environmental principles in an interior design project, the aspects of social and economic sustainable design can be certainly be recognized (Kramer, 2012). The idea of incorporating ecological aspects in an interior design project can accomplish about 80 per cent for the aspects of economic and social (Moxon, 2012).



*Figure 5: Solidarity of three aspect of sustainable design  
(Source: <https://www.researchgate.net/publication>, 2020)*

#### *Relationships among the environment, economy and society*

The model of sustainability looks poised to remain influencing the future discourse concerning development discipline. According to Porter & van der Linde (1995), they disguised that the best selections are probable to remain those that are meeting the essentials of the society and are environmentally and economically feasible, economically and socially unbiased and also socially and environmentally tolerable (Porter & van der Linde, 1995). Therefore, this connections between the three disciplines clues to three unified domains of sustainability that define the relations between the environment, economic, and social features.



*Figure 6: Relationships among social, environmental and economic sustainability (Source: Wanamaker (2018))*

According to Wanamaker (2018), the three domains establish a set of interconnected notions which forms the base of human choices and actions in the pursuit for sustainable development (Wanamaker, 2018). This argument is supported by Yang (2019), haranguing that essentially the interconnection portrays that good choices on sustainable resource management brings about sustainable development for sustainable societies. These includes choices on land use, water management, agronomic practices, construction design, education, equivalent opportunities as well as law making and administration (Montaldo,2013; Porter & van der Linde,1995). Furthermore, when the notions confined in the three domains of sustainability are practiced well in the real world circumstances, everyone triumphs as natural resources are conserved, there is protection to the environment, the economy is strong, common life is good since there is peace and harmony for human constitutional rights (DESA-UN,2018 ; Kaivo-oja, Panula-Ontto, Vehmas, & Luukkanen,2013). According to Khan (1995) as cited in Bassiagio (1999):

*“If a man in a given geographical area lacks a job (economic), he is likely to be poor and disenfranchised (social); if he is poor and disenfranchised, he has an incentive to engage in*

*practices that harm ecology, for example, by cutting down trees for firewood to cook his meals and warm his home (environmental). As his actions are aggregated with those of others in his region cutting down trees, deforestation will cause vital minerals to be lost from the soil (environmental). If vital minerals are lost from the soil, the inhabitants will be deprived of the dietary nutrients required to sustain the intellectual performance needed to learn new technologies, for example, how to operate a computer, and this will cause productivity to reduce or stagnate (economic). If productivity stagnates (economic), poor people will remain poor or poorer (social), and the cycle continues.”*

The theoretical case exemplifies the connections amongst the three connected areas of sustainability and the necessity to assimilate them for sustainable development (Basiango, 1999).

### *2.7.1 Economic sustainability*

Economic sustainability indicates a scheme of creation that gratifies current ingesting levels without negotiating for the future needs (Lobo, Pietriga, & Appert, 2015). Customarily, economists presumptuously that the supply of natural resources was limitless, placing unjustified stress on the volume of the marketplace to apportion resources proficiently (Du & Kang, 2016). Furthermore, according to Cooper & Vargas (2004), they also alleged that economic development would be escorted by the industrial development to refill natural resources damaged in the production process (Cooper & Vargas, 2004). Conversely, studies have been comprehended that natural resources are not unlimited and also not all of them are renewable. The rising gauge of the economic scheme has overstressed the natural resource base, stimulating a reconsideration of the customary economic suppositions (Basiago, 1996, 1999; Du & Kang, 2016).

Economies entail of marketplaces where businesses happen. According to Dernbach, (1993), there are supervisory contexts by which dealings are assessed and verdicts regarding economic activities made. The three key activities that are carried out in any economy are production/construction, supply and consumption however the accounting outline used to guide and assess the economy with respect to these actions totally alters values and this does not go well for the society and the environment (Cao, 2017. Allen and Clouth (2012) resonance that mankind life on earth is maintained and preserved by using the limited natural resources originate from the earth. Dernbach (2003) had previous disputed that, due to populace growth, mankind essentials like food, cloths, housing rise, nevertheless the resources existing in the world cannot be increased to meet the necessities forever. Moreover, Retchless and Brewer (2016) allege that, as the chief apprehension appears to be on economic development, significant cost constituents like the effect of exhaustion and contamination, for instance, are overlooked whereas cumulative request for goods and services endures to drive marketplaces and invade damaging effects of the environment (UNSD, 2018). Therefore, economic sustainability needs that choices are made in the most reasonable and financially sound manner possible while considering all the other aspects of sustainability (Zhai & Chang, 2019)

### *2.7.2 Social sustainability*

Social sustainability incorporates philosophies of impartiality, authorization, convenience, contribution, cultural distinctiveness and institutional steadiness (Daly, 1992). The idea suggests that humans matter as growth is all about humans (Benaim & Raftis, 2008). Fundamentally, social sustainability implies a scheme of social association that lessens poverty (Littig & Grießler, 2005). Nevertheless, in an extra essential intellect, “social sustainability” relates to the relationship among social circumstances such as poverty and environmental damaging (Farazmand, 2016). In this respect, the philosophy of social sustainability postulates that the lessening of poverty ought to neither involve unjustified environmental obliteration nor

economic unpredictability. Therefore, it should purpose to lessen poverty inside the obtainable environmental and economic resources of the society (Kumar, Raizada, & Biswas, 2014; Scopelliti et al., 2018).

According to Saith (2006), social level sustainability involves nurturing the growth of persons, societies and values to aid attain significant life, proper healthcare, education, gender equality, peace and steadiness transversely the world. It is contended that social sustainability is not easy to attain since the social aspect appears complex and devastating (Benaim & Raftis, 2008). Contrasting the environmental and economic schemes where movements and sequences are effortlessly noticeable, the subtleties in the social scheme are extremely imperceptible and cannot be simply demonstrated (Benaim & Raftis, 2008; Saner, Yiu, & Nguyen, 2019). Everest-Phillips (2014) puts it, “the definition of success within the social system is that “people are not subjected to conditions that undermine their capacity to meet their needs”

Kolk (2016) argues that social sustainability is not about guaranteeing that everybody’s essentials are met. Somewhat, it purposes at providing permitting circumstances for everybody to have the capability to comprehend their necessities if they so need. Whatsoever that obstructs this capability is deliberated to be a barrier and requests to be addressed in order for persons, society and communities to make growth towards social sustainability (Brodhag & Taliere, 2006; Pierobon, 2019). By understanding the nature of social subtleties and how the structures appear from a schemes viewpoint is of inordinate significance to social sustainability (Lv, 2018). Beyond all, in Gray (2010) and Guo’s (2017) views, social sustainability also encompasses many issues such as human civil rights, gender parity and impartiality, public contribution and decree of law all of which encourage peace and communal stability for sustainable development.

### *2.7.3 Environmental sustainability*

The idea of environmental sustainability is around the natural environs and how it remains fruitful and tough to support human being life. Environmental sustainability re-counts to ecology uprightness and carrying capability of the natural environment (Brodhag & Taliere, 2006). It obliges that natural capital be sustainably used as a basis of economic contributions and as a sink for wastes (Goodland & Daly, 1996). The insinuation is that natural resources need to be reaped not faster than they can be renewed whereas waste must be released no faster than they can be integrated by the environment (Diesendorf, 2000; Evers, 2018). This is because the earth schemes have bounds within which balance is sustained.

Nevertheless, the expedition for unrestrained development is striking ever superior demands on the world organization and insertion greater pressure on these restrictions because technical improvement could fail to care for the exponential development. Evidence to support concerns about the sustainability of the environment is growing (Gilding: ICSU, 2017). For example, the effects of climate change offer a definite dispute for the necessity for environmental sustainability. Climate change refers to noteworthy and long-term alterations in the climate structure triggered by natural climate inconsistency or else by human activities (Coomer, 1979). These variations comprise of heating of the air and oceans, lessening ice levels, increasing sea level, increasing acidity of the oceans and increasing concentrations of greenhouse gases (Du & Kang, 2016). The sustainable design strategies i.e. design for waste prevention, design for recycling, as presented in the waste hierarchy model of the efficient resources' management strategy, enable control over the negative impacts of these destructive procedures on the natural environment.

Sustainable design strategies is a concern to interior designers because the building and day-to-day running of a building devours a great deal of energy and resources. Through the

selections that interior designers make when fitting out or renovating a building will have the chance to affect, for better or worse, the environs. Interior designers should pledge to minimize the impact on the environment on every project they undertake through the choices that we make. Though the topic of sustainability is presented here as a chapter in its own right, designers ought to understand that thinking about and acting upon sustainability matters needs to be a basic part of the design process. They duty to deliberate the prospects for generating lesser impact interiors all the way through the project. It should become just as much a part of the process as space arrangement, accessibility subjects or sourcing of materials, and should not just be an “add-on” or afterthought.

## **2.8 Sustainability in Kenya**

The Government of Kenya has established various nationwide strategies to incorporate environmental strategies into development plans in Kenya e.g. Vision 2030. Moreover, environmental conservation education and awareness creation have continued to be assumed nationwide (Research ICT Africa, 2019). In 2018, the Association of Sustainability Practitioners in Kenya (ASPK) was officially launched at the Radisson Blu Hotel in Nairobi. The event was attended by over 150 business executives and sustainability champions from the various sectors in Kenya. The initiative by Kenya Climate Innovation Center (KCIC) was to increase the culture and practice of sustainability in the Kenyan business sectors. The event aimed to discuss the sustainability trends affecting the Kenyan private sector with a focus on why now more than ever Kenyan companies need to adopt sustainability as a core business practice to stay competitive (Kenya Climate Innovation Center, 2018). Furthermore, according to a consumer study by KCIC (2018), 57% of Kenyans would prefer to spend more on sustainably-made products and services rather than spending less on unsustainable ones whereas 24% of Kenyan CEOs are unaware of the Sustainable Development Goals. As consumers and other stakeholders are increasingly demanding sustainable business practices,

more enterprises must raise their awareness and receive consulting on sustainability (KCIC, 2018)

## **2.9 Challenges to sustainable design**

Implementation of sustainable design practices might however present a number of challenges to designers. According to Hes (2005) assimilating green innovation into the built environment is a “wicked” problem, which makes classifying barriers deterring this practice essential (Aye, 2003; Mate, 2006). Additionally, Stieg (2006) presents similar observations in referring to the practice of sustainable design as both difficult and complex. Designers should therefore understand the social and moral obligation associated with sustainable design whilst recognizing that the practice of sustainable design presents various difficulties.

Research conducted in the United States of America (US) and Australia suggest that although there is interest in sustainable design, its frequency of application is poor (Aye, 2003; Kang & Guerin, 2009; Mate, 2006). These authors identified multiple barriers to incorporate sustainable design into practice. These include perceived cost (Aye, 2003; Mate, 2006); time to source materials, education and training, understanding and in house experts (Aye, 2003). Studies also identified client resistance (Aye, 2003), knowledge of materials, limited material selection and authenticity of suppliers (Mate, 2006), along with understanding of the impact of materials (Kang & Guerin, 2009), accurate and accessible information and appropriate tools (Aye, 2003). Other barriers that were identified are client demands (Hes, 2005), client knowledge and call backs from clients (Davis, 2001), accurate and accessible information (Hes, 2005; Davis, 2001) and appropriate tools (Hes, 2005).

## **2.10 Waste in interior design**

Waste is unavoidable in all human activities and it comes in different forms and measures. In the construction industry, precisely interior design, its appearance is largely felt in form of time,



resources and human resources, which reduces the cost growth and profit loss in the project execution. Amongst the three recognized constituents, waste from building materials is the most noteworthy, obvious and hard to eliminate (Kareem & Taiwo, 2006).

Sources	Causes
Design	<ol style="list-style-type: none"> <li>1. Inaccuracy in contract papers</li> <li>2. Incompleted contract papers at the beginning of the construction phase</li> <li>3. Changes to design</li> <li>4. Inaccurate designs</li> </ol>
Procurement	<ol style="list-style-type: none"> <li>1. Ordering mistake, in excess ordering, under ordering, and so on</li> <li>2. Suppliers error</li> </ol>
Material handling	<ol style="list-style-type: none"> <li>1. Spoiled during shipping to site or on site handling</li> <li>2. Incorrect storage leading to damage or wear</li> </ol>
Operations	<ol style="list-style-type: none"> <li>1. Mistake by tradesperson or manual workers</li> <li>2. Equipment failure</li> <li>3. Extreme weather</li> <li>4. Accidental damage instigated by succeeding trades</li> <li>5. Use of improper material necessitating replacement</li> </ol>
Residual	<ol style="list-style-type: none"> <li>1. Alteration waste from cutting wasteful shapes</li> <li>2. Offcuts from cutting materials to required lengths</li> <li>3. Overmixing of materials for wet trades owing to an absence of information of requirements</li> <li>4. Waste from application process</li> </ol>

	5.Packaging
Others	1.Criminal waste due to damage or theft 2.Lack of onsite materials control and waste management plans

*Table 1: Sources and Causes of Construction Waste (Source: Gavilan and Bernold, 1994)*

The table 1 above gave us comprehensions into the causes and bases of building waste generation from the design phase to the construction phase. Diverse parties in a construction projects have a part to play in waste minimization exertion. Below are some of the motives why waste minimization is vital and aids in providing a sustainable building industry. Decrease costing and saves money: Waste minimization will lessen the quantity of raw material to be purchased and henceforth ultimately saves the contractor cash to buy the raw material.

*Environmental benefits*

Mineral deposits and raw materials are lessening owing to the high activities of the construction industry (Han, 2014). Waste minimization in the long run will certainly decrease the quantity of raw materials that will be used in the construction site and henceforth lessen the effect on these resources exhaustion. The lessening of raw material will similarly decrease the carbon footprint as the mining of raw materials yield quite a noteworthy quantity of carbon footprint. These carbon footprint are fashioned largely from the construction and shipping of raw materials to the building site (Han, 2014).

Stakeholder	Project Phase	Waste minimization strategy (WMS)	Key issue in implementing waste minimization Strategy (WMS)
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Designers, architects and engineers	Planning and Designing	Design to prevent waste	<ol style="list-style-type: none"> <li>1. Including waste minimization in project scope.</li> <li>2. Efficient design with standard sizes for building materials.</li> <li>3. Design for deconstruction instead of demolition.</li> <li>4. Influencing client choices for green and energy efficient materials, durable non-toxic interior finishes or materials.</li> <li>5. Including waste management in project management scope.</li> <li>6. Use of recycled material.</li> <li>7. Design precast concrete members and prefabricated elements.</li> <li>8. Consider reusing materials.</li> </ol>
Developers, builders and contractors/subcontractors	Construction	Plan for waste prevention	<ol style="list-style-type: none"> <li>1. Using value chain approach of WMS.</li> <li>2. Efficient material planning and inventory management.</li> <li>3. Resource efficient construction methodologies.</li> <li>4. Implementing CWM strategies and promoting it.</li> <li>5. Using of professionals and trades crew.</li> <li>6. Reuse of the discarded materials.</li> <li>7. Prefer off site prefabrication.</li> <li>8. Set up central cutting areas for wood and other materials.</li> <li>9. Locate recycling stations, storage bins.</li> <li>10. Standardize the material handling processes and work procedures to avoid rework and errors.</li> <li>11. Revise the site layouts as project progresses.</li> </ol>
Developer, demolition contractor	Demolition and Redevelopment	Demolition and Redevelopment	<ol style="list-style-type: none"> <li>1. Identify items being reused, salvaged and recycled on site.</li> <li>2. Plan for protecting, dismantling, and handling, storing, and transporting items.</li> <li>3. Investigate removal and separation techniques.</li> <li>4. Consider using deconstruction.</li> <li>5. Identify material of unique or antique feature and material with high resale value that would make it worth saving.</li> <li>6. Discuss reuse ideas and the project timeline with the owner and the designer.</li> </ol>

Product Suppliers	Project Design and construction	Project design and construction	<ol style="list-style-type: none"> <li>1. Efficient packaging to minimize waste.</li> <li>2. Avoid wastage in transportation.</li> <li>3. Emphasize EOQ and similar techniques of material ordering and management.</li> <li>4. Ensure the correct quantity of each material is delivered at right place.</li> <li>5. Address recyclability and recycled content of products.</li> <li>6. Denote specifications for efficiency in product use.</li> <li>7. Strict control on timely supply.</li> <li>8. Adherence to quality.</li> <li>9. Purchase salvaged, recycled, or recycled-content materials.</li> <li>10. To take back or buy-back substandard, rejected, or unused items.</li> </ol>
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*Table 2: Key stakeholders and issues in employment of WMS at different stages of construction project (Source: Author, 2020)*

In a construction site, there are many parties that will be involving themselves working together to see a project comes to its completion. These parties play a different role and each of the role are identify and suggested approach summarized at the table below used by Priyadarshi, 1994 will be referred to as a guideline for the further improvement of the approach. This approach is used to minimize the amount of waste generated from the C&D activity and hence reduce the amount of waste going to the landfill area.

### **2.11 Waste minimization**

The sustainable design strategies permit control over the adverse effects of damaging processes to the natural eco-system. These measures are positioned between the prevention of waste produced and discarding of the waste in landfills. The aim of these sustainable design approaches is to generate a negligible amount of wastes (Attmann, 2009).

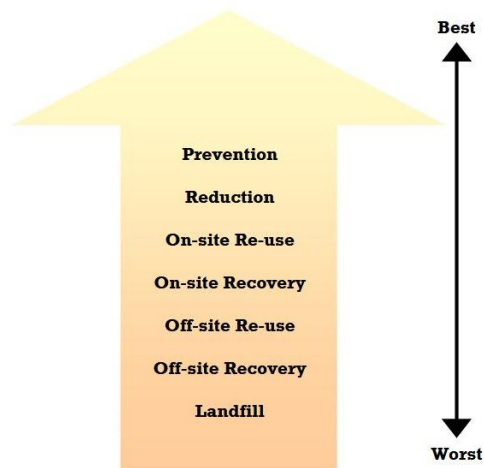


Figure 7: EU Waste Management Hierarchy (EU, 1997)

Although the reduction and prevention of waste are at the top of the European Union Waste Management Hierarchy, it is positioned at the lowest in the waste minimization exploration programs, (Keys, Baldwin, & Austin, 2000). Countless obstacles and chances are present in coming up with a strategy of waste minimization in interior design. Study on “*Designing to encourage waste minimization in the construction industry*” by Loughborough University together with AMEC Construction, concentrated on methods that generate waste. Results showed the numerous industry preferred waste minimization alternatives, including designing for waste reduction, designing for recycling, extended life and disassembly. They were termed ‘best practices’, as they addressed the causal matters and not the outcome which is the problem.

According to Lu and Yuan (2011), one of the best waste minimizations methods is reduction. It lessens the waste produced, eradicates disposal of waste and also reduces the cost of sorting, shipping, and discarding of waste (Lu & Yuan, 2011). Another efficient method is Waste Minimization Design (WMD) which is commonly termed as a significant strategy as it entirely considers all aspects of the entire project ahead of time hence avoids redundant wastage of materials (Baldwin et al., 2009). Zhang et.al. (2012), addresses other design methods of waste minimization include, prefabricated modular (Baldwin et al., 2009; Shen et al., 2009a; Li et al., 2014); use of modular designs (Poon and Jaillon, 2002); evading adjustments to the design

(Faniran and Caban, 1998); and using recycled materials (Tam, et al., 2006). Bertram et.al (2019), coincided that the use of modular structures can lessen the waste produced since production is undertaken in workshops where the making is manageable (Bertram, et al., 2019).

Ali et.al (2013), agreed that, while there exists a vast awareness on waste management in the built environment, the significant part played by designers on waste minimization is not precisely defined (Ali, Badinelli, & Jones, 2013). Besides, Osmani et.al (2008), concluded that negligible efforts are there in addressing the consequence of design practices in waste generation (Osmani, Glass, & Price, 2008). However, Attmann (2009), concluded that the addition of environmental measures in interior design procedures will guarantee the achievement of sustainability in the practice (Attmann, 2009). Although a growing knowledge on resources management and methods of waste digression from construction locations already exists, the significant role of designers in reducing the amount of waste is not exactly defined (Ali et al., 2013). A very few attempts have been made to address the effect of design practices on the generation of waste (Osmani M. , 2013)

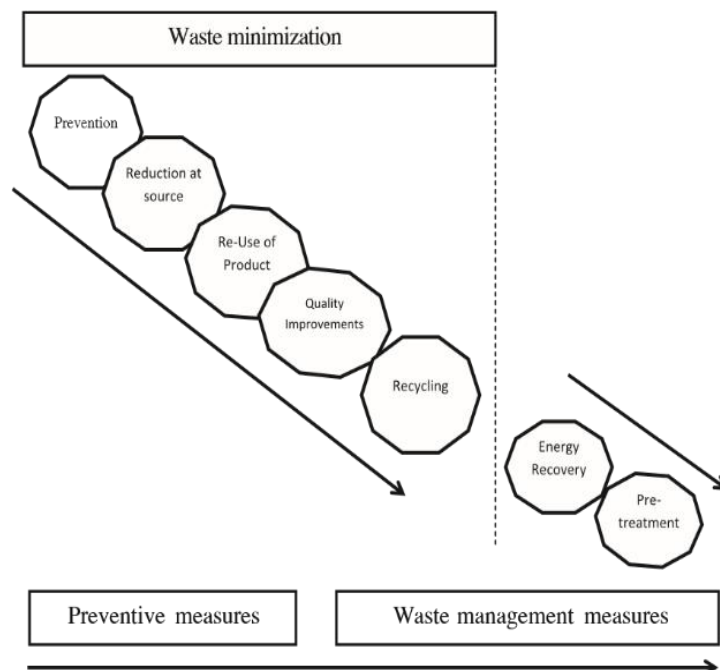


Figure 8: Graphic representation of waste minimization (Source: Lasaridi, 2011)

With the progressive raised for concerning the sustainability of the construction industry, the demand for an effective waste management and ways to prevent environmental destruction and to make the best use of the increasingly scarce natural resources (Omer, 2008).

According to a research on waste in Malaysia verified that a successful of waste management is very much dependent on the involvement of principal parties of a projects: owners, designers, architect, engineer, contractor and subcontractor (Kumkhar et al., 2013). Contractors frequently have a little precedence on environmental aspects compared to meeting budget targets and plans (Poon, S., Yu, W, & and Ng, 2001) . Moreover, instant economic profits are not typically discovered from waste reduction, reuse, and recycling activities, though management of building material waste can lead to attain higher building productivity, time investments, and increase on-site safety (Gavilan and Bernold 1994; Poon et al. 2001). Therefore, it is essential to include general strategies linked to improving the decision-making capability at the design, procurement, and construction stages. This includes financial and nonfinancial measures, to attain economic benefits of an on-site waste management program (Carlos T. Formoso, 2002). There are many research studies on wastes (Cochran et al. 2007), source assessment (Bossinket al.1996) and planning of waste management(Tam 2008; Ruwanpura et al., 2003; Chandrakanthi et al. 2002); though fully incorporated waste control in designing, production, planning and construction process, in real time is yet to be attained. Furthermore, authors realized that building waste management process must involve not only the site supervision management crew, but also the interior designers, architect and engineers who are involved in the design process. The interior design process follows a systematic and coordinated methodology, including research, analysis and integration of knowledge into the creative process, whereby the needs and resources of the client are satisfied to produce an interior space that fulfills the project goals (National Council for Interior Design Qualification, 2004).

It is apparent that little researches recognize the roots and causes of waste generation and influential factors (Bossink and Brouwers 1996; Gavilan and Bernold 1994; Osmani et al. 2008b). These scholars identified reasons of construction waste creation throughout various project phases connected to the processes and operations. Some of the factors acknowledged the causes of waste creation were grounded on numerous phases throughout the project lifecycle such as at the initiation stage, design stage, and procurement stage. The chief causes were categorized as design organization, absence of preparation in conveyance of materials, unconventionality in dimensions under the different stages of project life cycle. Weather, burglary, and wreckage were identified as minor origins. Osmani et al. (2008a) primarily focused their study on lessening of the waste during the design stage and the study deliberated the influences contributing to waste generation in the designs stage. Hao et al. (2008) embraced a different method for handling construction waste by using system dynamics modelling (SDM), whereby building waste amounts were assessed as a permanent percentage of the bought amount of material. His model highlighted on on-site waste categorization approaches, to minimize landfill unit charges and shipping charges.



## 2.12 Waste generation

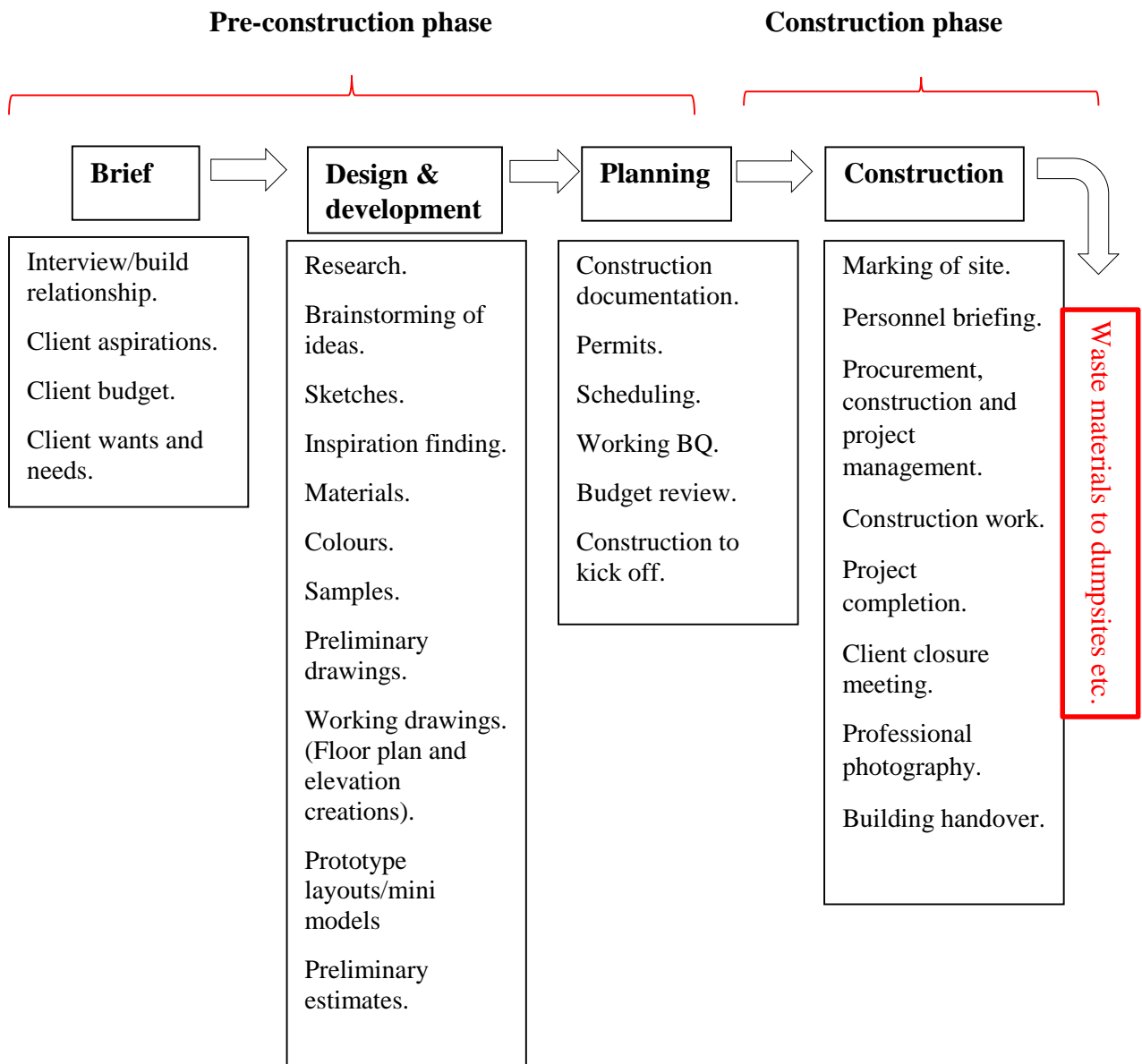


Figure 9: Interior design process breakdown (Source: Author, 2020)

### 2.12.1 Stages in Pre-Construction phase

Esenwa (2004), scrutinized the eight different pre-construction and post-construction processes at the different stages including (Esenwa, 2004):

Commencement or Project Planning – This is where project briefing, project deliberation, organization arrangement and selection of designer, architect or a project manager is

recognized. Feasibility – This is where site studies, right of ways, right of light, easement and other preliminary investigations such as site visiting etc. are made. Outline proposals – sketching of plans relating general approach to layout, design, etc. are put in to place. Scheme Design - all the briefs and decisions on the project are made including- planning arrangement, constructional method, outline specifications, costs and obtainment of all proposals by the designer. Detailed Design – The final decisions on all design matters are made, including specifications, construction and cost of any part or component of the building, which is, working drawings. Production Information – This is where Clients are to make decisions and take action on matters of such details in the agreed brief, while Consultants obtain specialist quotations and/ or agreed Prime Cost (PC Sums) including contract particulars for preliminaries. Bills of Quantities - production of complete document and arrangement to obtain tender.

#### *2.12.2 Post-construction phase*

Three comprehensive operation are analyzed in this phase including:

Project Planning - involving signing of contract documents, handing over of site to contractor by the Client through the designer and preparation of program of works.

Operations on Site - involving honoring of certificate, preparation of progress and early appointment of maintenance staff by the Client. Completion - handling over for occupation, defects rectification, and settlement of final, accounts and honoring of final certificate.

#### *2.12.3 Waste at the Pre-construction Stage*

Wastes are being categorized according to their origination from the different stages of the construction process. These wastes originates from:

Client: Uncertainty of the Client in brief specification leading to alteration, demolition and changes in the course of construction. Designer's choice / analysis of grid, forms, space, shapes and dimensions leading to multiple offcuts.

Improper integration of all other Consultants' output before commencement of construction resulting in amendments, alteration and demolitions.

Designers/ Clients: Wrong specifications or insufficient knowledge regarding availability and serviceability of products leading to alteration, variation and extreme maintenance.

#### *Waste at the Post-Contract Stage*

There are mainly construction-bound wastes originating from human, material and time resources. Human Resources: Inappropriate use of skilled and unskilled labor, Excessiveness and redundancy in labor and Low labor efficiency and productivity. Olomolaiye (1984), in his findings revealed that an average of 44%, 51% and 56% of carpentry, bricklaying and iron bending workers' time respectively are spent on productivity and while their remaining time is either spent being idle, taking instructions or waiting for materials.

Other waste sources according to Kareem & Taiwo, (2004) include, Material resources: Sourcing and quality control in material procurement, material transportation and material storage and material fixing. Time resources: This includes additional interest on loan, failed target and Price fluctuation. Wastes at the Post-Occupancy Stage These are mainly operational and maintenance-bound wastes. Operational Costs: Costs accruable to ill-functional/designed building services operations. Maintenance Costs: Frequent replacements due to poor workmanship and / or poor quality material. Wastes from Other Sources: These include natural-bound wastes such as wind, hurricane, earthquake, erosion, etc. including war and other disaster-bound wastes (Kareem & Taiwo, 2004).

#### 2.12.4 Types of Construction Wastes

Construction waste, which can extensively be classified - domestic or industrial, comes in three basic forms of solid, liquid and gases. As stated earlier in the introduction, this paper is limiting discussion to building material waste in its solid form. According to Butler (1992), construction wastes are of two broad divisions - *Direct waste and indirect waste*.

*Direct Waste:* This category of waste related to complete loss or irreparable damage to goods/materials in the course of:

1. Transportation as loss/damage in transit.
2. Storage as per the result of poor stacking, pilfering and vandalism
3. Installation with respect to fixing, removal and dressing.
4. Cutting / conversion waste - off-cuts/dressing from wood, sheets boards, etc.
5. Design waste arising from dimensional inaccuracies {especially in pre-fabricated components}.
6. Inaccuracy waste - arising from wrong measurements, setting and generally poor workmanship from tradesmen, apprenticeship and labor on site.
7. Make-up waste - in the form of hacking, felling, rendering and plastering to fit.
8. Excess material wastes, which include left over resulting from over estimation, excessive batching, over supply, unfavorable weather conditions, etc.

*Indirect Waste:* This category of waste refers to all materials misused or used in excess of provisions in the contract bill in the form of:

1. Substitution waste - due to excessive availability of the substitute (even when it is of higher grade) on site.
2. Negligent waste - due to incorrect judgment, over-design, insufficient information or missing formation.

## 2.13 Waste Minimization Measures

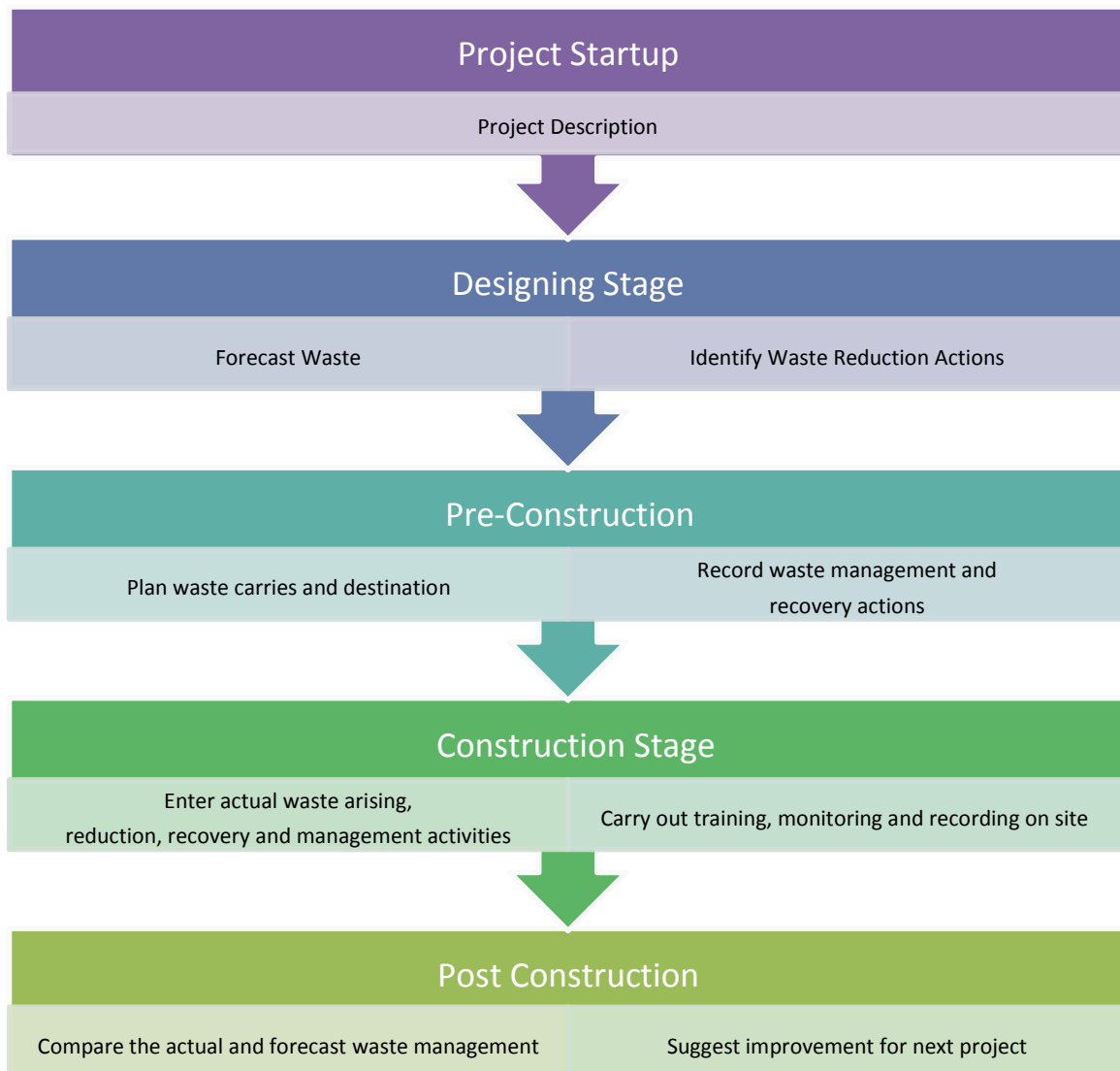


Figure 10: Waste Minimization Strategy Plan outline (Source: Author, 2020).

At the commencement of the project phase, the company will have to highlight the requirements of the project and also the nature of the project. This is to simplify the work of classifying the project according to their nature. The second stage of CWMP is to design the policy concerning the designing stage, pre-construction stage and during the construction stage. The different variable that the company will be anticipating is the forecast waste generation, identification waste reduction actions, route for the waste to be recycled or delivered and also the monitoring works. At the end of the construction,

the actual results from the waste management will be collected and compared with the original forecast value. If the result is satisfactory, it will be benchmarked and reuse in the other project as a tool for the company CWM.

Discussion was focused on measures required to improvement on the roles of the construction team as stipulated below:

1. Client / Developers should endeavor to properly articulate their desire in the design brief, appoint competent Consultants and generally resolve all outstanding issues on land transactions before commencement of project.
2. The initial step in a construction waste reduction strategy is good planning. Design should be based on standard sizes and materials ordered accurately.
3. Use of high quality materials such as engineered products reduces rejects. Likewise, use of prefabrication where possible should be considered as this generates less material waste.
4. Ensuring accuracy in drawings and supporting information.
5. Build-ability and serviceability should always be considered in all project design.
6. Tender consideration to merge quality and cost considerations.
7. Ensuring proper site organization / layout to reduce time and labor waste on site.
8. Ensuring proper storage systems, security, record keeping and stocking.
9. Adequate knowledge of material sourcing, quality identification / control, safe transportation, etc. required by the procurement management team.
10. Employment of skillful and highly efficient tradesmen to ensure quality workmanship and yield high productivity,

11. Thorough supervision by Consultants to ensure non-compromise of quality and standard.

12. Waste materials to be re-used / recycled as much as possible.

## **2.14 Waste minimization strategies**

Research studies on approximation of construction waste amounts frequently classify the amount of waste generation connected to net worth of construction, demolition and repair, building group, and size (Cochran et al. 2007). Waste minimization is any method used which either evades, eradicates or lessens waste at its cause (Crittenden, 1995). Numerous associated terms are being used to define waste minimization in diverse fields including waste reduction, clean technology, pollution prevention, environmental technologies, low and non-waste technologies (Keys A. A., 2000)

### *2.14.1 Interior Design for Adaptive Reuse*

Interior design for adaptive reuse is defines as a waste minimization concept that is based on the restoration of salvaged building materials acquired from refurbished building structural portions in to the building of interior constituents (Celadyn, 2019). The strategy puts design approaches and techniques in the interior design practice at the center of environmentally accountable architectural design. Mc Donough and Braungart (2012) termed it as a design practice towards the achievement of a closed loop concept (Mc Donough & Braungart, 2002). This strategy adheres to the ecologically sustainable mandate for waste reduction in the built environment (Celadyn, 2019). She further added that the issues associated with the increment of the lifecycle of a building with its physical constituents are inadequately acknowledged by the interior designers. Akadiri et.al (2012) suggested that the recycle of reclaimed construction

materials and products should be treated as the subsidiary method for the reduction of construction waste(Akadiri et al., 2012)



*Figure 11: Rubble of tile waste (Source: <https://thumbs.dreamstime.com>, 2019)*



*Figure 12: Counter top made from waste tiles (Source: <https://i.pinimg.com>, 2020)*

Victor Papanek (1980), also asserts that the Interior Design for Adaptive Reuse (IDAR) notion is can be assessed as an effort to accomplish resources efficacy, as well as an alternative solution to the waste of valuable construction materials (Papanek, 1980)

#### *2.14.2 The concept of designing out waste*

Designing out waste in the primary phase of the building process provides the utmost major opportunity for waste minimization. The most effective waste management method is the one



that manages the process and systems so that there is no waste to manage. The fundamental goal is to eradicate or minimise the waste produced at each step in the building process. This includes conception, detailing, construction information, description, procurement, supplying, site preparation and building.

Koskela (1992) and Alarcon (1993) conquered in their studies on the other forms of waste. They found out that time and procedures used generated waste. This might be from the activities that take a lot of time and resources without significant value addition. Formoso et al., (1999) additionally, defined time and resources waste as all the damages created through actions that create costs directly or indirectly but have no value addition to the final product from the consumers' opinion.

However, Treloar et al. (2003) proposed that the amount of waste should be measured in terms of the energy of the resources. Bossink and Brouwers (1996) described three cases where the waste of different types was quantified through diverse approaches: i) proportion of the entire quantity of waste; ii) proportion of acquired material; iii) proportion of the entire cost of the wastes. All three approaches are descriptive of the levels of waste produced and they can be applied concurrently. Though, to compute the proportions, the documentation of waste sources and volumes produced for everyone is essential. Moreover, according to Wrap (2007), calculating waste is a requirement to its managing i.e. knowledge on the quantity produced can be used as a reference instrument for other projects, firms or a noble practice (Wrap, 2007). Next phase is to establish the gap amid the accomplished and the good practice. Decreasing this gap can be accomplished by knowing the causes of waste and examining the sources behind its production. The introduction of environmental guidelines reinforced by escalating user consciousness is redefining the perception of waste from '*by-products*' of procedures to unused chances to reduce expenses, improving project performance and to boost the business forecasts.

According to Keys et.al (2000), the concept of designing out waste addresses the causal aspects of waste. They further gave a summary of the methodologies that can be used to design out waste including: Use of prefabrication and off-site prefabrication, Standard component/bespoke design, Realistic component size, capacity and specification, Minimizing temporary works, Optimizing design lives , Allowing specification of recycled materials in design, Designing for recycling and ease of disassembly and Identify building products which create waste.

### *2.14.3 Design for waste prevention.*

According to the Waste Framework Directive (WFD-2008/98/EC) waste prevention is defined as “the measures taken before a substance, material or product has become waste, that reduce the quantity of waste, the adverse impacts of the generated waste on environmental and human health or the content of harmful substances”. Preventing waste means reducing the amount of waste generated, reducing the hazardous content of that waste and reducing its impact on the environment. Waste prevention includes strict avoidance of waste generation, qualitative and quantitative reduction at source and reuse of products. It does not include recycling of materials and separate waste collection (Pre-waste, 2012). In the last decade numerous efforts have been taken, both at national and international level, to define waste minimization and waste prevention, along with setting legal targets and guidelines to reach an effective waste prevention (Salhofer et al., 2008).

The WFD established a legal framework for the management of waste within the European Union. It aims at protecting the environment and human health through the prevention of the harmful effects of waste generation and management. Member States takes measures for the treatment of their waste in line with the following hierarchy, which is listed in order of priority: prevention, preparing for reuse, recycling, other recovery, notably energy recovery, disposal.

As waste prevention is becoming gradually important for waste and resources management, both at the level of planning and implementation, it is crucial to develop a reliable methods to monitor, measure and evaluate waste prevention and its benefits, as well as to assess the effectiveness of actions aiming to promote relevant awareness and behavioral changes (Zorpas & Lasaridi, 2013). Waste prevention means eradicating or reducing the amount and/or the toxicity of waste, including recyclables. For businesses, government agencies and other organizations, it includes processes that: conserve supplies and inventory; eliminate, reduce and reuse products and packaging; deploy waste-reducing technology and equipment; use more durable, reusable, repairable and less toxic products and packaging. (NYCDS, 2000; Sharp et al., 2010).

#### *2.14.4 Design for recycling.*

Recently, the amount of construction waste materials being retrieved and recycled has been dropping. The quantity of recyclable materials being sent to landfills is currently around 50 per cent greater than what it used to be decade ago (Addis, 2006). The overall goal of this strategy is to upsurge resource and financial proficiency and decrease pollution effects in the final elimination of structures, also, to recuperate materials for salvaging, re-building and recycling (Guy, et al., 2006).

#### *2.14.5 Design using sustainable materials*

Sustainable interior design in the recent years has become a key topic in interior design practice. However, according to studies the rate at which interior designers make sustainable choices in actual practice is quiet inadequate, predominantly where the materials choice is concerned (Hayles, 2015). Materials selection and choice is a zone where interior designers can play a significant role on the sustainable performance of the spaces. Aspects like cost margins, design

negotiations and environmental requirements can play a substantial part in the selection of materials.

Materials choice has a higher effect on the sustainable result of entirely interior design developments but specifically commercial interior design project. This is because they are generally replaced every 5 to 7 years, which means, introducing a hefty burden on resources and generating enormous quantities of waste (Maté, 2009). By incorporating sustainable materials into construction projects, it makes it conceivable to reduce environmental effects through minimizing energy intake, minimum natural resource exhaustion and contamination, plus lesser toxicity to both the inhabitants and the whole environment. These eventually minimizes the harmful effects on the environment and inhabitants while exploiting positive effects over the lifespan of a structure (Araji & Shakour, 2013).

According to Lee et.al (2013), slight research has been done on interior designers' selections of environmentally sustainable materials (Lee, Allen, & Kim, Interior design practitioner motivations for specifying sustainable materials, 2013). Client resistance, professed cost, lack of skills and awareness of materials, inadequate materials assortment, time to source materials, knowledge on the effect of materials, precise and available information and proper tools have altogether been selected as obstructions to the adoption and implementation of sustainable interior design (Davis, 2001, Aye, 2003, Hes, 2005, Maté, 2006, Jones, 2008, Kang and Guerin, 2009, Hankinson and Breytabace, 2012).

An investigation led by Moussatche et al. (2002) revealed that interior designers choose materials mainly according to the clients' likings, wishes, beauty and price, they don't consider sustainability as a standard (Moussatche, King, & Roger, 2002). The study concurs with another study carried out by Kang and Guerin (2009), the findings established that the exertions

to expand understanding about sustainable materials and merchandises was deliberated as too much time consuming for the designers' programmes (Kang & Guerin, 2009).

Inversely, Maté's (2006) study on designers in Australia, established that designers' morals was an influential factor when it came to choosing of environmentally sustainable materials. The once who supported sustainable interior design exhibited certain characteristics and behaviors, for example, inquiring on the legitimacy of eco materials. Furthermore, they didn't see price as a barrier while they contemplated the significance of sustainable abilities in materials choosing (Maté, K.J., 2006). Additionally, Lee et al. (2013) establish that interior designers with affirmative attitude towards selection of sustainable materials led to their stronger actions confliction to embrace use of sustainable materials. The outcomes advocate on the significance of developing interior designers' positive environmental attitudes (Lee, Allen, & Kim, 2013)

#### *2.14.5 The use of assessment tools.*

Interior designers everywhere have instigated the awareness of sustainable strategies as the call for sustainability in interior design solutions has amplified. This is as a result of most traditional interior design practices have a hostile environmental effect owing to the noteworthy consumption of resources throughout building and installation (Wael & Ashour, 2017).

Assessment tool assess, indorse and increase sustainable growth in the construction industry, also they offer a scheme that gives a wide-range understanding of sustainability through the process of data examination, assessment, and disparity (Nguyen & Altan, 2011). According to Cole, (2005) the objective is to induce a process that evaluates buildings environmental performance while including sustainable growth into construction processes. Furthermore, they establish a feasible design requirements and goals, create appropriate design processes, and finally, determines measures of enactments to regulate the design process. Also, they offer a



measurable performance indicator to the design choices and as a grading tool for the whole building performance (Cole, 2005).



Assessment tools assist in reinforcing a sustainable methodology of the design. Furthermore, it explores on how to create sustainable design selections about space planning, suitable energy systems and products. These roles of these tools differ according to the user's interests i.e. users can be interior designers, clients, and inhabitants' e.tc. For instance, it aids interior designers to come up with projects towards a negligible environmental effect while satisfying the financial part for clients and produce comfortable and safe environments for the inhabitants (Cain, 2007). Leadership in energy and environmental design (LEED) and Building Research Establishment's Environmental Assessment Method (BREEAM) are possibly the well-known and extensively used. Other significant tools for interior designers include Ska-Rating, that is designed for interior furnishings, while National Australian Building Environmental Rating Scheme (NABERS) is intended for evaluating the sustainable performance of existing building structures. Other tools include Green Star, Green Globes, BEAM, CASBEE, DGNB etc. (Moxon, 2012, Ding, 2008).

The table below summarizes the chief assessment tools existing globally, the areas they contain, the classifications of assessment and the phase they apply.



*Table 3: Chief assessment tools worldwide (Source: Author, 2020)*

Assessment tool	Categories, stages, ratings	References
<b>LEED</b> Leadership in energy and environmental design	<ul style="list-style-type: none"> <li>• Sustainable Sites</li> <li>• Water Efficiency</li> <li>• Energy and Atmosphere</li> <li>• Materials and Resource</li> <li>• Indoor Environmental Quality</li> <li>• Innovation and Design Process</li> <li>• Regional Priority</li> </ul>	(Kubba, 2010)

 <p>Figure 13: Leadership in energy and environmental design Source: <a href="http://www.usgbc.org/leed">www.usgbc.org/leed</a></p>	<ul style="list-style-type: none"> <li>• For new and existing commercial interior projects</li> </ul>	
<p><b>BREEAM</b> Building Research Establishment's Environmental Assessment Method</p>  <p>Figure 14: Building Research Establishment's Environmental Assessment Method Source: <a href="http://www.breeam.org">www.breeam.org</a></p>	<ul style="list-style-type: none"> <li>• Energy</li> <li>• Transport</li> <li>• Pollution</li> <li>• Materials and Waste</li> <li>• Water</li> <li>• Land Use and Ecology</li> <li>• Health and Wellbeing, and Management</li> </ul>	(Moxon, 2012)
	<ul style="list-style-type: none"> <li>• Both new and existing buildings can be assessed</li> </ul>	
	<ul style="list-style-type: none"> <li>• BREEAM has five levels: Pass, Good, Very Good, Excellent and Outstanding</li> </ul>	
<p><b>Ska-rating</b></p>	<ul style="list-style-type: none"> <li>• Energy and Carbon</li> <li>• Waste</li> <li>• Water</li> <li>• Materials</li> <li>• Pollution</li> <li>• Wellbeing</li> <li>• Transport and Other</li> </ul>	(RICS, 2012)

 <p>Figure 15: <b>Ska-rating</b> Source: <a href="http://www.ska-rating.com">www.ska-rating.com</a></p>	<ul style="list-style-type: none"> <li>• Assessments are carried out at the design stage, at handover to the client and one year after occupation.</li> <li>• There are four ratings: Unclassified, Bronze, Silver and Gold.</li> </ul>	
<p><b>NABERS</b> The National Australian Building Environmental Rating Scheme</p>  <p>Figure 16 The National Australian Building Environmental Rating Scheme Source: <a href="http://www.nabers.com.au">www.nabers.com.au</a></p>	<ul style="list-style-type: none"> <li>• Energy</li> <li>• Water</li> <li>• Waste Indoor</li> <li>• Environment performance</li> <li>• Projects are assessed during occupation, using performance data for the previous 12 months.</li> <li>• Rating of up to 5 stars</li> </ul>	(Ding, 2008)
<p><b>Green Star Australia</b></p>	<ul style="list-style-type: none"> <li>• Management</li> <li>• Indoor</li> <li>• Environment Quality</li> <li>• Energy</li> <li>• Transport</li> <li>• Water</li> <li>• Materials</li> <li>• Land Use and Ecology</li> <li>• Emissions, and Innovation</li> </ul>	(Moxon, 2012)



 <p>Figure 17: <b>Green Star Australia</b> Source: <a href="http://www.gbca.org.au">www.gbca.org.au</a></p>	<ul style="list-style-type: none"> <li>Existing offices is in the pilot stage</li> <li>Rating from 0 to 6 stars</li> </ul>	
<p><b>BEAM</b></p>  <p>Figure 18: <b>BEAM</b> Source: <a href="http://www.beamsociety.org.hk">www.beamsociety.org.hk</a></p>	<ul style="list-style-type: none"> <li>Site Aspects</li> <li>Materials Aspects</li> <li>Energy Use</li> <li>Water Use</li> <li>Indoor Environmental Quality</li> <li>Innovations and Additions</li> <li></li> <li>New and existing buildings</li> <li></li> <li>Rating of Bronze, Silver, Gold or Platinum</li> </ul>	(Ding, 2008)

Atanda, (2018) highlighted that the sustainable construction environment encompasses two categories of valuation apparatuses which include life cycle assessment tools and criteria based tools. The criteria tools include Building Research Establishment Environment Assessment Method (BREEAM), Leadership in Energy and Environmental Design (LEED), Comprehensive Assessment System for Building Environment Efficiency (CASBEE), Green Building Council of Australia (GBCA) also known as Green Star, Green Building Tool (GB

Tool), Global Sustainability Assessment System (GSAS) and Sustainable Building Assessment Tool (SBAT).

Assessment tools in construction have been established with a precise end goal which is to help the solicitation of sustainable growth in the building and construction area (Atanda, 2018). Yet, regardless of the international attention towards sustainable assessment tool as a marvel, it continues to lack a comprehensive scrutiny for the collective feature of sustainable growth.

There is need on improving construction practices so as to reduce their negative effects on the environment (Cole, 1999; Holmes & Hudson, 2000). Building enactment has become a major worry of professionals in the building industry (Crawley & Aho, 1999) and their performance assessment has become one of the key subjects in sustainable building (Cole, 1998; Cooper, 1999; Holmes & Hudson, 2000). The objective of sustainable assessment goes further than at the design stage afore any comprehensive design or even before an obligation is made to proceed with the development(Ding, 2008). Nevertheless, slight or no apprehension has been set to the importance of choosing environmentally friendly designs at the project evaluation stage which is the stage in which environmental matters are best fused.

## 2.15 Conceptual framework

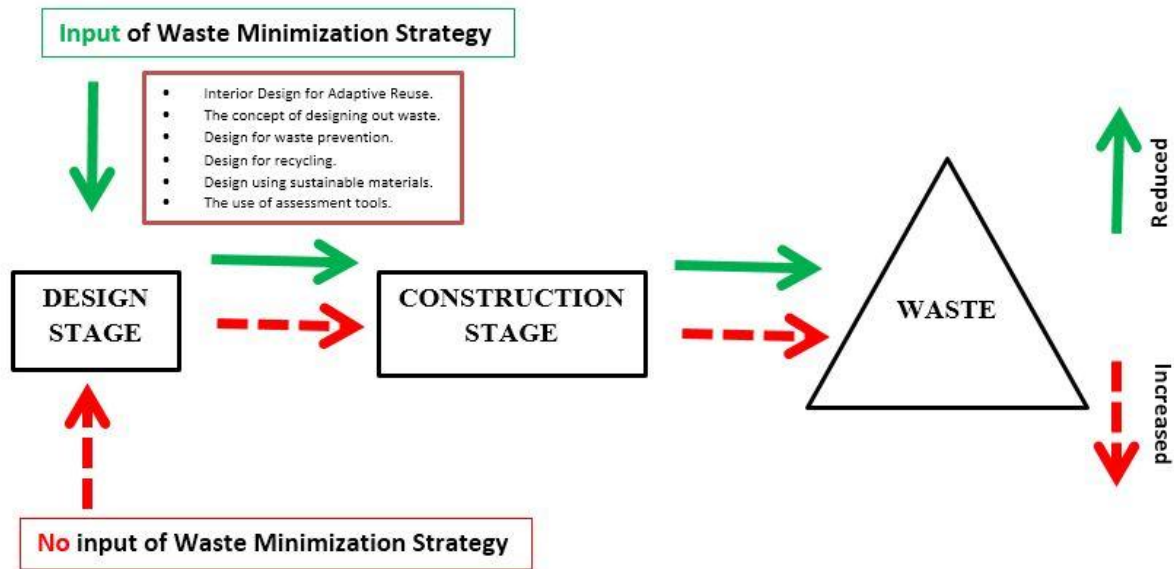


Figure 19: Conceptual framework (source: Author, 2020)

The conceptual framework basically explains the stages of the design process from the design, construction and finally the waste that is produced at the end of the whole process. With the incorporation of waste minimization strategy at the design stage of the design process will reduce the amounts of waste that is produced at the end of the process. The waste minimization strategies include Interior Design for Adaptive Reuse, The concept of designing out waste, Design for waste prevention, Design for recycling and Design using sustainable materials. Similarly, without any application of any waste minimization strategy at any point of the design process, the amounts of waste will be large at the end of the design process as there are no measures taken in to account to reduce them.

According to Ajayi et.al (2017), they suggested that site management functions through contractual provisions for waste minimization, waste segregation, maximization of materials reuse and effective logistic management could significantly reduce waste generation during construction process. Provision of waste skips for specific materials and maximization of on-site reuse of materials are also found to be among the key factors for engendering waste

minimization. The result of factor analysis suggests four factors underlying on-site waste management practices with 96.093% of total variance.

## **2.16 Conclusion**

From the literature review, it occurred that there are vast waste minimization strategies that can be employed in achieving the sustainable interior design. The interior designers need to apply and use green design in their projects through the appropriate waste minimization strategies which will not only lower but will also assist in minimizing environmental degradation and at the same time reduces costs that are incurred due to waste generated. The researcher aims at investigating and establishing the best waste minimization strategy that can be used by interior designers in Nairobi and its environs. This will be done by assessing what strategies other interior designers are using, what currently Kenyan interior designers are doing and to suggest the best waste minimization strategy. This section is giving more attention to the minimization of construction material waste in interior design with specific orientation not only to reduce the amount of waste produced but also to save costs, reduce redundant use of raw materials, improve work behaviors, improve the environment and lastly to sustain standard of living through reserves now and for the future generations. Effective Construction waste minimization through well-organized and well-articulated design cooperation is conversely beheld as a key instrument in accomplishing the above objectives. The paper would address waste minimization strategies for sustainable interior design in regards to materials, time and human resources at the pre-construction stage of building plans. Moreover, according to Means (2002), “Owners are beginning to realize that the value of the team’s time spent coordinating early in the design process is likely to be returned several times over in lower construction and operation costs.” The design team in the building management have the responsibilities, waste classification, types, waste minimization measures and recommended suggestions, further constitute relevant issues for discussion in the text.

## **3.0 CHAPTER THREE**

### **3.1 METHODOLOGY**

#### **3.1.1 Research Design**

For this study, a descriptive qualitative approach was used. This helped to explore the research questions as this approach is suitable for the study of human experiences whose goal is to understand the waste minimization strategies employed by interior designers as well as their attitude towards sustainability in interior design (Nieswiadomy, 2008).

#### **3.1.2 Research Approach and method**

The investigator used both qualitative and quantitative research methodologies. According to (Mwituria, 2018) a qualitative research approach is used in collecting, examining and interpreting data by perceiving what people say and do. Data for this study was collected from an in-depth interview with interior designers on the subject of waste minimization strategies as well as observing and recording their activities which will both be analyzed. Qualitative researchers believe that there is no solitary truth to be revealed. Instead, there might be various standpoints held by different individuals with each of their viewpoints having an equal legitimacy of truth (Leedy & Ormond, 2005).

#### **3.1.3 Population**

The population for the research consisted of interior design firms within Nairobi and its environs. The population of the interior design firms was acquired from an updated database (2019) of 110 interior design firms which are located in Nairobi and its environs.

#### **3.1.4 Sampling**

Stratified Simple random sampling method was employed for this study. According to Mwituria (2018), in stratified sampling, the researcher divided the population into separate

groups called strata. The population sample is then drawn from each group (strata) (Mwituria, 2018). The population, for this study, was acquired from a 2018 database of interior design firms in Nairobi and its environs. The database comprised of 110 interior design firms in Nairobi and its environs. The design firms were grouped into small, medium and large firms (stratus) according to the size of the firms. The international standard of grouping companies i.e. according to the number of employees in the firms where micro-enterprises employ fewer than 10 personnel, small firms employ 10 - 49 personnel, medium-sized firms employ 50 - 249 personnel and large enterprises employ 250 and more personnel's (OECD, 2019). A sample of 11 companies was picked from the stratus. The researcher ended up with a sample of 11 companies which are going to study.

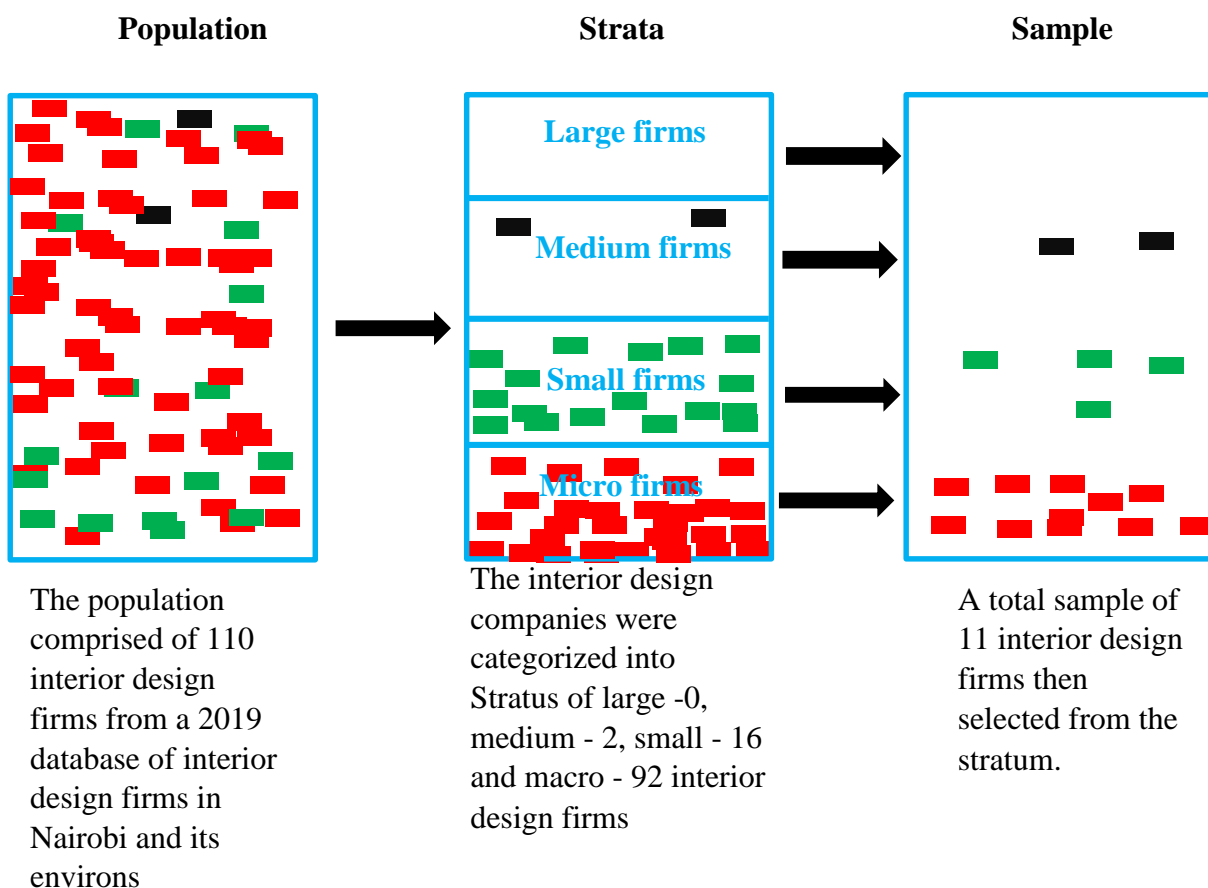


Figure 20: Distribution of sample (Source: Author, 2019)

### **3.1.5 Sample size**

The size of the sample was managed by level of conviction that the nature of the collected informations was representative of the attributes of the entire populace.

Model,  $n_a = (n \times 100) / re\%$ , supported by Thornhill, Saunder and Lewis(2007), cited by (Obare, 2015)was applied in the estimation of the definite sample size to be studied, where;

n - The definite sample size

$n_a$  - The lowest estimated size of the sample

re% - The estimated degree of response conveyed as a percentage.

$n_a = \{(1/10 \times 110) \times 100\}/95$  11 respondent firms

### **3.1.6 Sampling method**

Purposive sampling was employed in the selection of the eleven firms which are going to be studied. In purposive sampling, people and components are selected for a specific purpose (Leedy & Ormond, 2005). Being a practicing interior designer, this sampling method fits for the researcher because he will select his sample from individuals involved in the interior design firms. Interior design firms that have been practicing for not less than 5 years will be selected because they are assumed to understand the profession better.

### **3.1.7 Data Collection tools**

Data collection, defined as the process of gathering and computing facts on targeted variables in a known methodical manner that permits one to answer significant questions and assess the outcomes (Mwituria, 2018). For this research, several tools for data collection were employed. They included in-depth interview guides, semi structured questionnaires, telephone interviews and focus discussion groups.

### *3.1.7.1 In-depth interviews*

It is as well-known as unstructured interviews. Researchers use in-depth interviews to cause the facts for them to accomplish a complete understanding of the interviewee's opinion. Furthermore, it can as well be used to discover fascinating areas for further examination (Mwituria, 2018). Closed-ended and open-ended interviews will be in this study. Face- to - face interviews had the benefit of permitting the investigator to create a good relationship with the interviewees, therefore, gaining collaboration input hence yielding maximum feedback rates (Leedy & Ormond, 2005)

### *3.1.7.2 Questionnaires*

Questionnaires typically ask questions that provoke ideas, behaviors, likings, personalities, attitudes and truths. The researcher will also use structured questionnaires. This will be issued to interior design designers.

### *3.1.7.3 Telephone interviews*

Respondents who were not be in a position to fill the questionnaires were given the option of a telephone interview. According to Leedy & Ormond (2005), telephone interviews consume less time and are less expensive. Moreover, the researcher has ready entree to almost everyone on the planet who owns a telephone. Though the response degree is not high as face to face interviews it is significantly higher than that of mailed questionnaires. Telephone interviews will allow the researcher to seek an explanation for unclear answers and when seeking to follow up information, however, the researcher cannot create similar kind of rapport like in a face to face conversation and also the sample is limited to people with telephones only. (Leedy & Ormond, 2005).



### 3.1.7.4 Observations

Observation, according to Mwituria, (2018), is an orderly data collection method where investigators use all their senses to observe people in their natural settings. The researcher observed the interior designers activities both at the office and in the field and record data on waste minimization strategies that they employed. Observation was also done when observing the firms design process by the interior designers.

### 3.1.8 DATA ANALYSIS

Qualitative data examination was applied for this study. According to Mwituria, (2018), qualitative data analysis is the process where the researcher takes descriptive information and suggestion an explanation or analysis. Content investigation was also conducted to make in-depth inferences towards the accomplishment of the three study objectives. From the analysis, inferences and information obtained was presented in the form of text as well as graphical charts.

### 3.1.9 LOGICAL FRAMEWORK

OBJECTIVE	DATA NEEDS	DATA SOURCE	METHODS	ANALYSIS METHODS	EXPECTED OUTPUT
i. To determine the waste minimization strategies that are used by interior designers to achieve sustainable	Waste minimization strategies Waste minimization processes	Exemplars	Literature review Systematic review	Thematic Analysis	Knowledge of good waste minimization strategies that can be used to achieve sustainable interior design practice

interior design practice.					
ii. To establish the current waste minimization strategies used by interior designers in Nairobi and its environs	Currently used waste minimization strategies	Notes on observations made Filled interview guides Literature	Observations Interviews Literature review Examination of documents	Thematic Analysis	Current waste minimization strategies that are used by Kenyan interior designers to achieve sustainable interior design practice
iii. To propose a waste minimization strategy that can be adopted by interior designers in Nairobi and its environs to achieve sustainable interior design practice.	Contextualized waste minimization strategy	Participants Interior designers	Interviews Workshop Focus groups	Thematic Analysis	Appropriate waste minimization strategy that can be adopted by Kenyan interior designers to achieve sustainable interior design practice

Table 4: Logical framework (Source: Author, 2020)

### 3.1.10 Ethical Consideration

Approval was sought from the University Of Nairobi School Of Arts and Design before fieldwork was undertaken. Honesty, confidentiality and integrity was highly maintained

throughout the study. The research adhered to three principles of moral codes which consist of respect, generosity and integrity. The participants were made conversant of the purpose of this study before any information was sought from them thus in compliance with the code of voluntary and conversant consent.

### **3.1.13 EXPECTED OUTCOMES**

1. Knowledge of good waste minimization strategies that can be used to achieve sustainable interior design practice
2. Current waste minimization strategies that are used by Kenyan interior designers to achieve the sustainable interior design
3. A proposed waste minimization strategy that can be adopted by Kenyan interior designers to achieve sustainable interior design practice

## **4.0 CHAPTER FOUR**

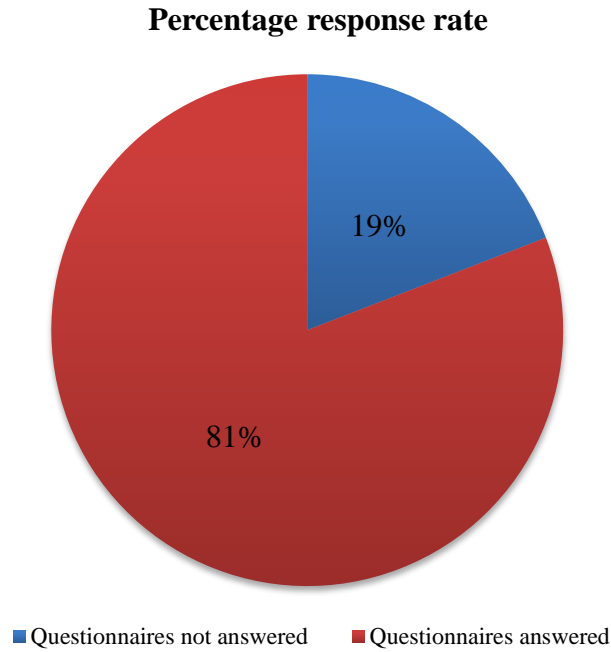
### **4.1 DATA ANALYSIS AND PRESENTATION**

#### **4.1.1 Overview**

The chapter focuses on interpreting the information that was attained from the primary study. The findings are centered on questionnaires, interviews, focus group discussion, photographs and observations. The data was evaluated by Microsoft Excel whereas the findings are presented in both pie charts and thematic tables. The tables attached in the appendix presents the frequencies of answers from the respondents, while the pie charts present percentages of the same. The description analysis regarding the charts is presented above the pie charts. The scholar focused on gathering together the data collected and started putting it in a form that would enable him to carry out analysis and interpretation. The author contributed to this study by highlighting the waste minimization strategies that interior designers can employ so that to practice a sustainable interior design practice and also the challenges that they are likely to encounter when employing these waste minimization strategies in their practice. Furthermore, the researcher also highlighted the possible mitigation actions to counter the highlighted barriers.

#### **4.1.2 Analysis of response**

In this section, the investigator wanted to establish the rate of the response to the questionnaires issued to the respondents. As presented in the charts below, the researcher issued a total of sixty (68) questionnaires with the target population. Of these interviews, a total of fifty five were positively carried which was a response rate of eighty one percent (81%). Therefore, this study can be said to have been successful.



*Chart 1: Response rate (Source: Author, 2020)*

#### **4.1.3 Profession Category of Respondents**

At this point, the investigator wanted to establish the numerous professional classifications of the selected respondents as revealed in the chart below. The results indicated that the respondent’s professions were distributed as follows: Managing Directors who comprised of 9% of total respondents, Creative Directors who comprised of 15% of total respondents, Project

### Professional Categories of Respondents

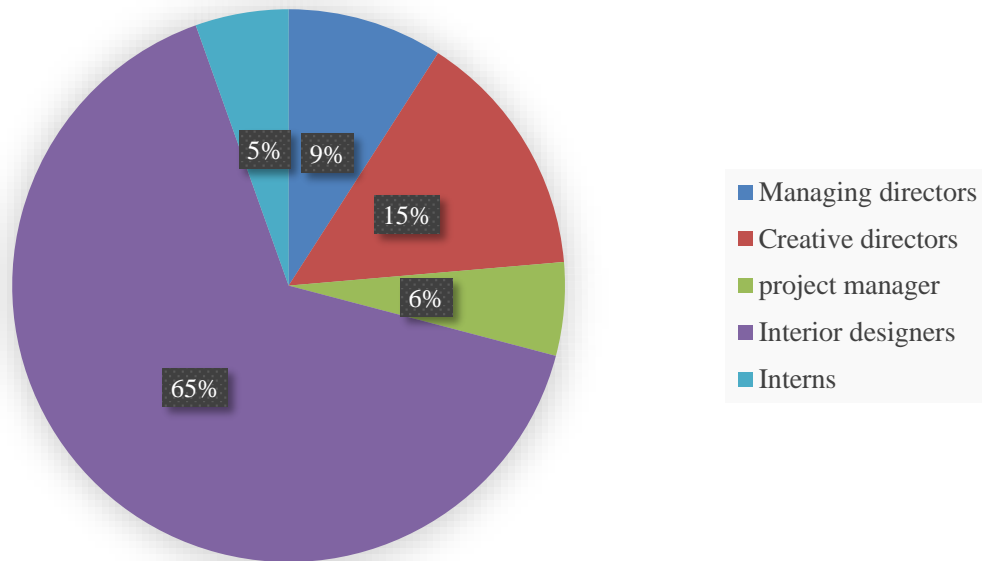


Chart 2: Chart 2: Professional category of respondents (Source: Author, 2020)

managers who comprised of 6% of total respondents, Interior Designers who comprised of 65% of total respondents and Interns who comprised of 5% of total respondents.

#### 4.1.4 Knowledge of sustainability and waste minimization strategies

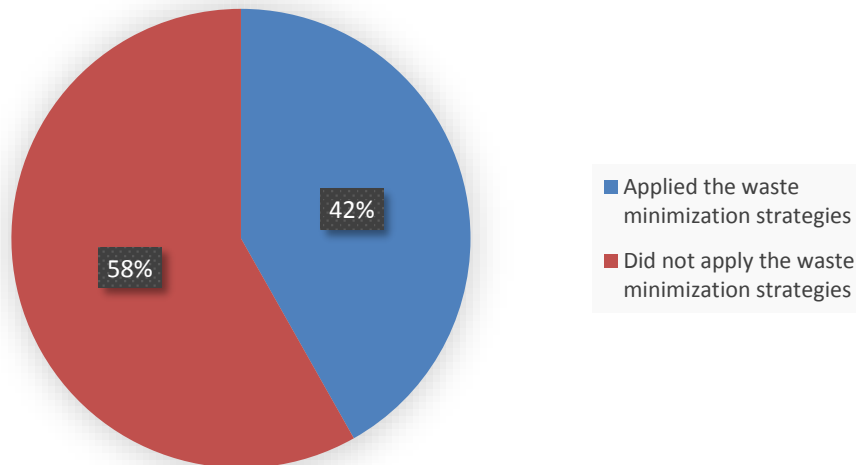
The researcher further sought information from respondents on their knowledge of sustainability and the waste minimization strategies and if they applied the waste minimization strategies in the interior design practice. All the fifty five respondents which is equivalent to one hundred percent of the respondents responded positively that they were aware of sustainability and the waste minimization strategies that are there.

#### 4.1.5 Application of the waste minimization strategies

The researcher further sought information from respondents if they applied the waste minimization strategies in their interior design practice. The results in chart 4 below interestingly indicated that although all the respondents had the knowledge on waste

minimization strategies only 42% applied in their practice while the other 58% either applied by chance or at client's request.

**Application of waste minimization strategies**



*Chart 3: Application of waste minimization strategies (source: Author, 2020)*

#### **4.1.6 Design process and stage where waste minimization is applied**

The researcher further asked the respondents to illustrate the design process that they use in their companies and to indicate the stage or phase where they applied or introduced the waste minimization strategy. The results were categorized into three design processes as indicated in the figure 15 below. The respondents were categorized into three groups whereby the first group did not apply the waste minimization strategies at all, the second group applied at the beginning of the process and the third group applied at the build stage and this group is the one that applied mostly by chance.

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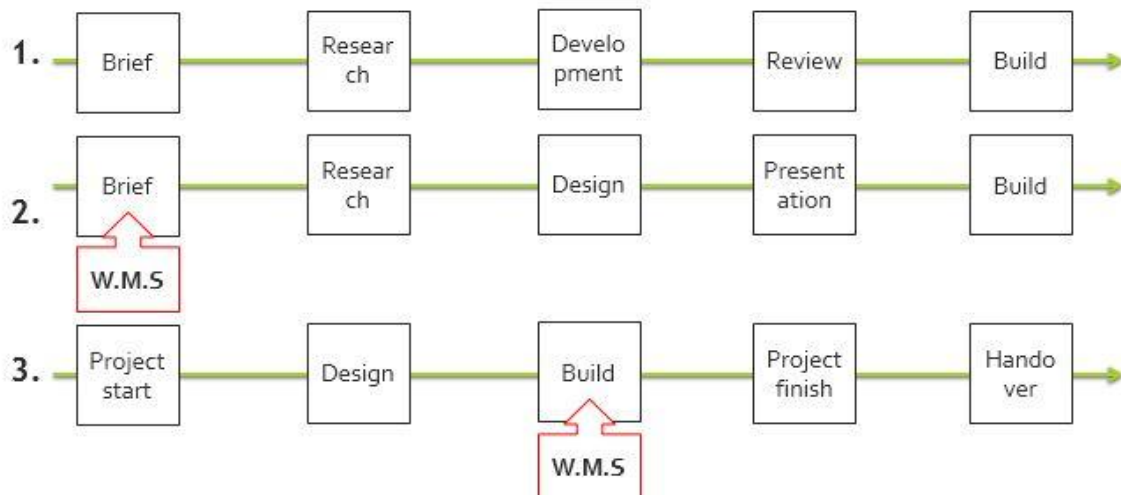


Figure 21: Design process and stage where waste minimization is applied (Source: Author, 2020)

#### 4.1.7 Waste minimization strategies for sustainable interior design

The researcher further sought information from respondents on what waste minimization strategies that they were familiar with in interior design practice. The results in the chart below indicate the waste minimization strategies indicated by the respondents: Adaptive reuse (7%) equal to 4 respondents; Designing out waste (4%) equal to 2 respondents; Waste prevention (11%) equal to 6 respondents; Recycling (22%) equal to 12 respondents; using sustainable materials (16%) equal to 9 respondents; and lastly the use of assessment tools (40%) equal to 22 respondents.



### Waste Minimization Strategies for Sustainable Interior design

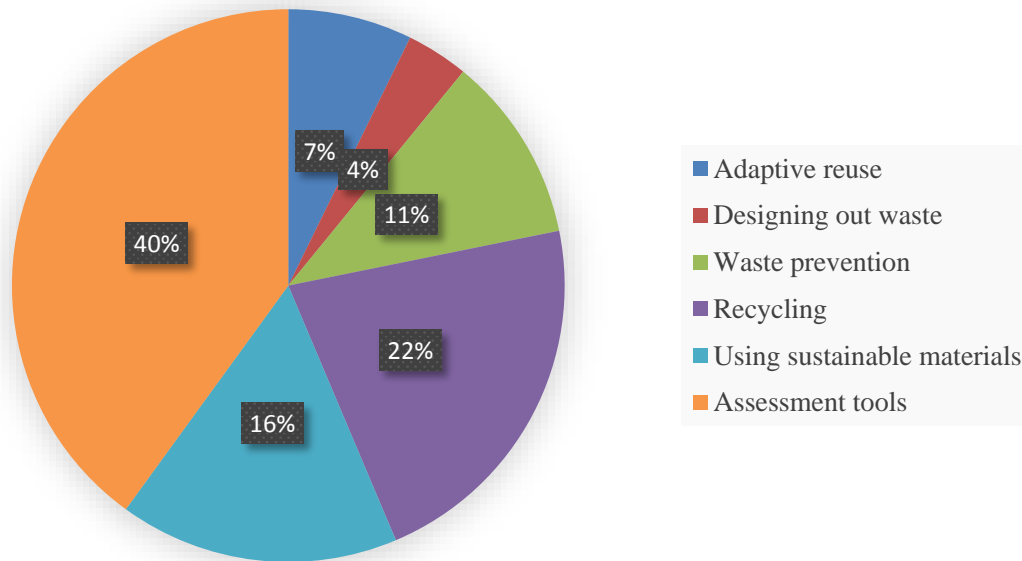


Chart 4: Waste minimization strategies for sustainable interior design (Source: Author, 2020)

#### 4.1.8 Challenges to incorporation of the waste minimization strategies in interior design practice

The researcher with this question pursued information on what challenges the respondents had experienced in the incorporation of the waste minimization strategies in their interior design practice. The results in the below chart indicates that 31% of the respondents indicated that the perceived high cost of implementation was the biggest challenge making it one of the biggest barrier. Other barriers were lack of time and resources at 20%, Client resistance to ‘sub-standard’ materials was another challenge at 15%, resistant to change 11%, Lack of in-depth training on how to incorporate the strategies 9%, Lack of information on benefits of waste minimization strategies 5%, Lack of adequate interpretation of environmental sustainability 5% and finally Lack of consistent supply of recycled waste materials 4%

### Challenges to incorporation of the waste minimisation strategies

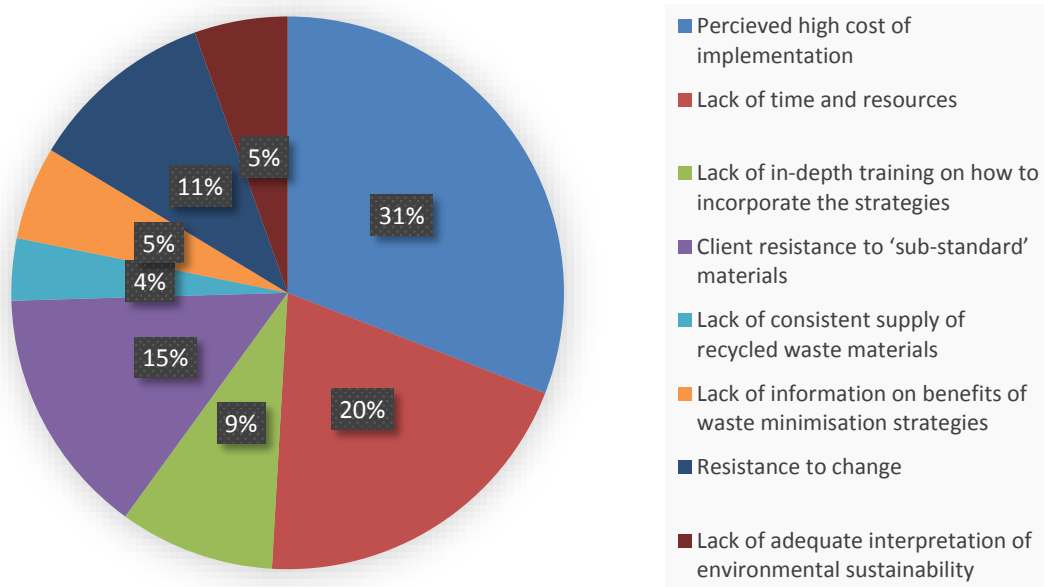


Chart 5: Challenges to incorporation of the waste minimization strategies in interior design practice (Source: Author, 2020)

#### 4.1.9 Ideal waste minimization strategy

Furthermore, the researcher inquired from the respondents about what they thought was the best and ideal waste minimization strategy that other interior designers can adopt and apply in the practices so that they can achieve sustainable interior design practice. Results was as indicated in the chart 7 below whereby the highest was 33% were in favor of assessment tool, 13% were for design for waste prevention , 18% design for recycling, 16% interior design for adaptive reuse 11% the concept of designing out waste and lastly 9% were in favor of design using sustainable materials

### Ideal waste minimization strategies

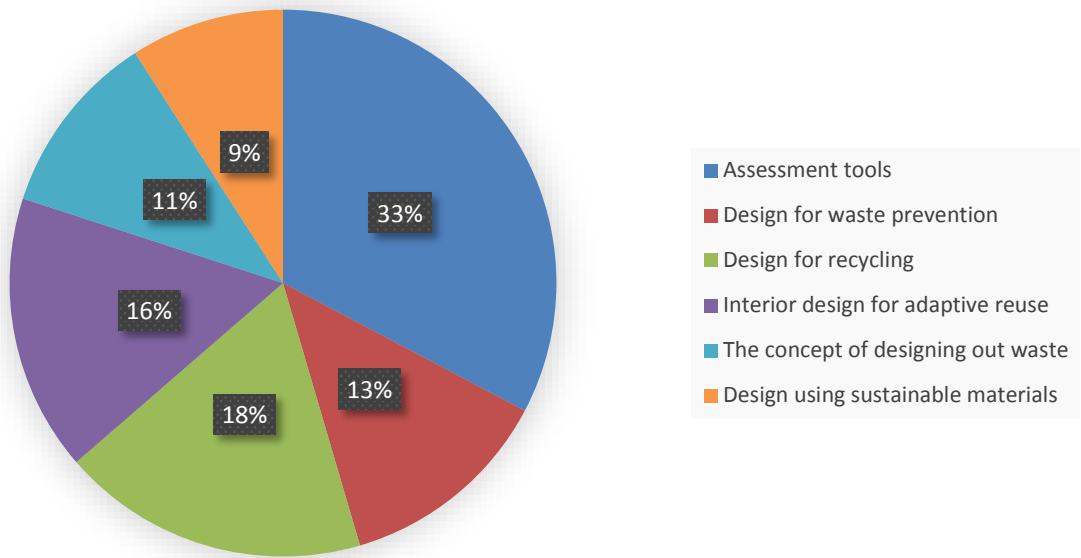


Chart 6: Ideal waste minimization strategies (source: Author, 2020)

## **5.0 CHAPTER FIVE**

### **5.1 SYNTHESIS AND INTERPRETATION OF RESULTS**

#### **5.1.1 Overview**

This chapter will center on synthesis and interpretation of the information that was examined and presented in the chapter four. The discussion in the analysis is grounded on the research questions.

#### **5.1.2 Objectives and Research Questions**

This study sought to achieve the following objectives;

- i. To determine the waste minimization strategies that are used by interior designers to achieve sustainable interior design practice.
- ii. To investigate the challenges that local interior designers encounter when applying waste minimization strategies in their practice
- iii. To propose a waste minimization strategy that can be adopted by interior designers in Nairobi and its environs.

The research questions that defined the scope of this study were:

- i. Which are the waste minimization strategies adopted by the interior designers to achieve sustainable interior design practice?
- ii. What are the challenges that local interior designers encounter when applying waste minimization strategies in their practice?
- iii. Which waste minimization strategy can be adopted by interior designers in Nairobi and its environs?

While meeting the above stated objectives, the researcher used a semi structured interview guide, questionnaires, and focus group discussions as the main methods of data collection. The guides were sub-divided into various sections each seeking to fulfill the objectives outlined at

the beginning of the study. The results revealed that indeed the respondents have knowledge of sustainability and waste minimization strategies whereas some of them apply it in their practice while others don't although they have the knowledge of its existence. However, there are challenges in applying the waste minimization strategies.

### **5.1.3 Waste minimization strategies that are used by interior designers to achieve sustainable interior design**

In a bid to answer the first research question, seeking *to determine the waste minimization strategies that are used by interior designers to achieve sustainable interior design practice*, the results revealed that indeed there are various waste minimization strategies that interior designers can employ in their projects and activities so as to achieve sustainable interior design practice. Data was collected, analyzed and results reported as shown in the tables attached in the appendix. The data used for analysis of this research objective was collected from interviews with interior designers as well as from secondary sources in literature review.

The results in the chart below indicate the waste minimization strategies indicated by the respondents: Adaptive reuse (7%); Designing out waste (4%); Waste prevention (11%); Recycling (22%); using sustainable materials (16%); and lastly the use of assessment tools (40%).

From this findings, it is clear that waste minimization strategies in interior design can be used by interior designers to minimize the wastes that are produced throughout the design process in interior design. The highlighted waste minimization strategies include Adaptive reuse, designing out waste, Waste prevention, Recycling, using sustainable materials and lastly the use of assessment tools. These assessment tools have advantages and disadvantages. From the respondents

#### **5.1.4 Challenges that local interior designers encounter when applying waste minimization strategies in their practice**

Research question two, *seeking to investigate the challenges that local interior designers encounter when applying waste minimization strategies in their practice*, the results exposed that indeed there are challenges that interior designer encounter when applying waste minimization strategies in the practice in order to achieve sustainable interior design practice.

Four key challenges were acknowledged through this study, to be exact: cost, education and experience, materials and the client.

##### *5.1.4.1 Cost:*

A major challenge to sustainable design, reiterated by all the focus groups and individual interviewees was cost. The interior designers explained that despite their personal commitment to sustainable design, and often the client's intention to choose a sustainable design approach, the costs involved in opting for and implementing such a solution were usually an overriding challenge. Discussing the implications of cost, one designer explained that "it is more expensive, so you need clients to be on board to pay a little bit extra. In total I think it is about a 10 or 20 per cent extra cost, but still, that 20 per cent makes a difference. You need someone to really want to do it" Moreover, at present environmentally responsible materials and systems carry cost implications. This is due to a number of factors, a few being research and development costs, the fact that these products are not mass produced like their unsustainable counterparts and, being fashionable, carry an innovation price tag. Another respondent explained that as far as possible, clients want immediate savings. The participant said that, "people want immediate saving as opposed to long term saving" and "the issue that a lot of people don't want to hear is that there are some upfront costs, so you would be investing more money".

#### *5.1.4.2 Time.*

Time was identified by majority of the participants within all the categories as another cost-related challenge. Some respondents expressed difficulty in finding time to do research into what materials and systems are environmentally dependable. The overall lack of time to conduct this research has a definite negative impact on the implementation of waste minimization strategies for sustainable design. The concerns around time and relation to cost is expressed as follows; “If it requires research it will be more expensive, and the client will go for the cheapest option. Another observation indicates that, “To fully practice in a sustainable way is difficult. It takes a lot of time. The designers will charge more so that they can kind of compensate for the amount of effort it takes”.

#### *5.1.4.3 Inexperience with sustainable design projects.*

During the interviews only one designer, of all of the focus group participants and individual interviewees, works solely on sustainable design projects. This indicated that there were not enough clients or projects that allow designers to gain much needed experience in sustainable design. For this reason, most participants discussed feeling somewhat “new” and inexperienced in the practice thereof.

#### *5.1.4.4 Materials:*

Due to the non-transparent nature of product suppliers and manufacturers, designers explained that not only is it difficult to source environmentally responsible materials and products, but it is also almost impossible to establish which products are authentically environmentally sustainable. This is due to the fact that very few of these products are common-place in the industry or have been widely established.

#### *5.1.4.5 Limited selection of environmentally responsible materials:*

Another barrier that was frequently raised by participants is the limited selection of environmentally responsible products and materials being produced by product suppliers and manufacturers. One participant explained that suppliers ranges are often limited and don't accommodate a client's needs. With regards to selection of environmentally responsible materials one designer stated: "there's not a whole bank of green stuff to choose from, so it is a challenge, because you are limited in what you can actually select from". The following remark was presented, "It's hard for the client to choose from a limited range of those that are sustainable, when there are so many other options out there"

#### *5.1.4.6 The client.*

Some participants explained that a number of clients expressed interest in a sustainable design. When it came to implementation however, various factors inevitably deterred their commitment to this approach. The greatest obstacle is feasibility or cost, which often results in the client disregarding sustainable design.

Participants explained that environmentally responsible materials and systems require greater upfront costs, which clients are often not prepared to pay. They also explained that, as many designers are new to the process of sustainable design, time is required for research. This inevitably costs the client which can be problematic.

#### *5.1.4.7 Education.*

Although clients have expressed interest in sustainable design solutions, and are to some extent aware of the need for sustainability, it is rarely insisted on. For this reason, it seems that the public still has a way to go in becoming informed and educated on the importance of sustainable development, before sustainable design will become a priority and common



practice in the profession. “Sustainable design is a kind of niche market and certainly not everybody’s main concern, most people have other concerns. At the end of the day it’s not the only factor that goes into the built environment, there are all sorts of other factors”. Until such time that environmental responsibility is a priority, and is enforced by government, it is not likely that clients will insist on and embrace sustainable design.

#### **5.1.5 Waste minimization strategy that can be adopted by interior designers in Nairobi and its environs.**

The third objective which was, *to propose a waste minimization strategy that can be adopted by interior designers in Nairobi and its environs*, was achieved by the researcher by posing the question to the respondents about what they thought was the best and ideal waste minimization strategy that other interior designers can adopt and apply in their practices in order to achieve sustainable interior design practice. From the results, the most favored waste minimization strategy with 33% was of assessment tool, 13% were for design for waste prevention, 18% design for recycling, 16% interior design for adaptive reuse 11% the concept of designing out waste and lastly 9% were in favor of design using sustainable materials.

According to the majority of the respondents, assessment tool was the best amongst all the other waste minimization strategies as it is applied at the commencement of the project and monitors and mitigates the amount of waste at every level of the design process and moreover some of the assessment tools like LEED is used to monitor waste even after the interior have been completed and is used by the occupants.

#### **5.1.6 Conclusions**

From the analysis, it is evident that on the issue of waste minimization strategies, the use of assessment tool is the preferred strategy followed by design for waste prevention and then the other waste minimization strategies. The researcher therefore recommends the adoption

of the assessment tool by the interior designers as an ideal strategies for minimization of waste for future application.

Based on the respondents feedback, data analysis and synthesis, several factors have been identified which forms conclusion of this study and which if taken into consideration will go a long way in integrating waste minimization strategies for sustainable interior design and therefore promoting sustainable interior design practices locally. Based on the findings of this study, the following conclusions were made:

The main conclusion as per the findings of this study was that there are various waste minimization strategies in interior design. Some of the highlighted waste minimization strategies by the respondents were; the use of assessment tool, design for waste prevention, design for recycling, interior design for adaptive reuse, the concept of designing out waste and lastly design using sustainable materials.

Further conclusions revealed that there are challenges which are a big hindrance to use of waste minimization strategies in interior design practice such as; lack of enough time to source and lack of enough information on waste minimization strategies and sustainable interior design and the benefits of using waste minimization strategies in interior design. Other barriers were: cost of implementation, lack of in-depth knowledge by some interior designers and clients, client and space owners' resistance to "sub-standard materials and finishes." resistance to change by stakeholders in the interior design industry and refusal by the same stakeholders to explore, use and recommend recycled waste materials in interior spaces.

#### **5.1.7 Recommendations**

This study identified the following aspects as areas that could receive attention in Kenya to improve and encourage the use waste minimization strategies by interior designers. From the

results, analysis and synthesis of the data in previous two chapters, it emerged the use of assessment tool as a waste minimization strategy was one of the highly rated waste minimization strategy that Kenyan interior designers can adopt in their interior design practice. This was because can applied at the commencement of the project and monitors and mitigates the amount of waste at every level of the design process and moreover some of the assessment tools like LEED is used to monitor waste even after the interior have been completed and is used by the occupants. Therefor interior designers in Kenya should adopt the assessment tools in their day to day interior design projects so as to reduce the amounts of waste that is produced at the end of the construction and also after the end life of the spaces they have designed.

#### **5.1.8 Areas for Further Research**

This research was in no way exhaustive. It has opened up various opportunities for further research. From this thesis it has been established that there are vast waste minimization strategies that interior designers can apply to reduce the amount of waste produced. The data used in this study is viable based on the number of respondents interviewed. Further to this study, more work needs to be done in terms of increasing the number of respondents, selecting respondents from a different region and increasing the number of respondents.

The researcher recommends the following key area as follow-ups to the current study:

- A study on management waste through other waste minimization ways in interior design. This is because the study identified gaps in terms of how waste in general is being managed by relevant stakeholders tasked with managing it. Mostly, waste is managed through dumping instead of creatively managing them.

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## APPENDIX 1: DATA ANALYSIS TABLES

Category	Frequency	Percentage
Questionnaires answered	55	81
Questionnaires not answered	13	19
<b>Total questionnaires issued</b>	<b>68</b>	<b>100</b>

*Table 5: Response rate (Source: Author, 2020)*

Category	Frequency	Percentage
Managing directors	5	9
Creative directors	8	15
Project managers	3	6
Interior designers	36	65
Interns	3	5
<b>Total</b>	<b>55</b>	<b>100</b>

*Table 6: Professional category of respondents (Source: Author, 2020)*

Category	Frequency	Percentage
Interior design for adaptive reuse	12	7.3
Designing out waste	6	3.6
Waste prevention	18	10.9
Recycling	36	21.8
Using sustainable materials	27	16.4
Assessment tools	66	40
<b>Total</b>	<b>165</b>	<b>100</b>

*Table 7: Waste minimization strategies for sustainable interior design (Source: Author, 2020)*

Category	Frequency	Percentage
perceived high cost of implementation	51	30.9
lack of time and resources	33	20
Client resistance to 'sub-standard' materials	15	9.1
resistant to change	24	14.5

Lack of in-depth training on how to incorporate the strategies	6	3.6
Lack of information on benefits of waste minimization strategies	9	5.5
Lack of adequate interpretation of environmental sustainability	18	10.9
finally Lack of consistent supply of recycled waste materials	9	5.5
<b>Total</b>	<b>165</b>	<b>100</b>

*Table 8: Challenges to the incorporation of waste minimization strategies into the interior design practice (Source: Author, 2013)*

<b>Category</b>	<b>Frequency</b>	<b>Percentage</b>
Interior design for adaptive reuse	54	32.7
Designing out waste	21	12.7
Waste prevention	30	18.2
Recycling	27	16.4
Using sustainable materials	18	10.9
Assessment tools	15	9.1
<b>Total</b>	<b>165</b>	<b>100</b>

*Table 9: Ideal waste minimization strategies that can be adopted by interior designers to achieve sustainable interior design practice (Source: Author, 2020)*

**APPENDIX II: SEMI STRUCTURED QUESTIONNAIRE**

**Researcher: Mike Kemboi Chesaro  
School of Arts and Design  
University of Nairobi**

Mike Kemboi Chesaro is a final year M.A. Design student at The School of Arts and Design, University of Nairobi, seeking to study *“Waste minimization strategies for Sustainable Interior Design”*. Kindly assist by filling in the Interview Guide. The report will strictly be for academic purposes only.

**Profession position**

- Managing Director [   ]
- Creative Director [   ]
- Project manager [   ]
- Interior Designer [   ]
- Intern [   ]
- Others (Explain) -----

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**Guiding Questions**

1. Are you aware of Sustainability in interior design?  
Yes [   ]                      No [   ]

If yes, briefly explain in your own words

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2. Are you familiar with waste minimization strategies used in interior design?  
Yes [   ]                      No [   ]

If yes, briefly explain in your own words

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3. If yes, please tick **one** strategy that you are familiar with.

Strategy	Not at all familiar	Slightly familiar	Moderately familiar	Very familiar	Extremely familiar



(a) Interior Design for Adaptive Reuse.					
(b) The concept of designing out waste.					
(c) Design for waste prevention.					
(d) Design for recycling.					
(e) Design using sustainable materials.					
(f) The use of assessment tools.					

4. Tick the actions that you undertake to achieve the strategy in question 3 above?

<b>(a) Interior Design for Adaptive Reuse.</b>	
The use of reclaimed materials (demolished building structural portions)	
Resource efficiency	
Reuse of materials in projects	
Reduction in the waste flow due to resources efficiency	
Assessment of the degree of sustainability of materials selected	
Reintroducing reclaimed materials or products into the building settings	
<b>(b) The concept of designing out waste.</b>	
Reuse and recovery of materials	
Off Site construction and fabrication	
Materials Optimizations methods	
Design for waste Efficient Procurement	
Presence of waste management plans	
Identify the building elements that are likely to produce the most waste	
<b>(b) The concept of designing out waste.</b>	
Assess the impact of design solutions on the waste to landfill and disposal cost	
<b>(c) Design for waste prevention.</b>	

Application of eco- efficiency and eco-sufficiency principle	
Application of precautionary measures	
Inco operation and participation of all stakeholders	
Polluter-take responsibility-principle	
Life cycle of the material and system thinking	
Principles of true costs, efficiency and minimal costs	
Cost -effective process of deconstruction	
<b>(d) Design for recycling.</b>	
Using recycled materials in projects	
Using reusable materials	
Repurposing of materials	
Repairing	
<b>(e) Design using sustainable materials.</b>	
<b>(f) The use of assessment tools.</b>	
LEED tool (Leadership in energy and environmental design)	
BREEAM tool (Building Research Establishment's Environmental Assessment Method)	
Ska-rating tool	
NABERS tool (The National Australian Building Environmental Rating Scheme)	
Green Star Australia tool	
BEAM tool	

(g) If none of the above. Explain others.

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5. Tick the strategy that you have ever applied in your interior design practice.

Strategy	Rarely	Sometimes	Often	Always
a. Interior Design for Adaptive Reuse.				

b. The concept of designing out waste.				
c. Design for waste prevention.				
d. Design for recycling.				
e. Design using sustainable materials.				
f. The use of assessment tools.				

6. What challenges did you encounter when incorporating the waste minimization strategies above?

<b>Challenge encountered</b>	
a. High and prohibitive cost of implementation	
b. Lack of time and resources to apply the waste minimization strategy	
c. Lack of in-depth knowledge on how to incorporate the strategies	
d. Client resistance to recycled materials	
e. Lack of consistent supply of recycled waste materials	
f. Lack of information on benefits of waste minimization strategies	
g. Resistance to change	
h. Lack of adequate interpretation of environmental sustainability	

Is there any other challenges that you encountered in the implementation of the waste minimization strategies?

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7. Which is the most ideal waste minimization strategy that can be adopted by interior designers in Kenya?

<b>Strategy</b>	
a. Interior Design for Adaptive Reuse.	

b. The concept of designing out waste.	
c. Design for waste prevention.	
d. Design for recycling.	
e. Design using sustainable materials.	
f. The use of assessment tools.	

Give reason for your choice above?

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8. What do you think should be done to encourage the use of waste minimization strategies in interior design? You can tick more than once.

a. Educating the public on waste minimization strategies	
b. Applying sustainable design practices	
c. Relevant government legislation to encourage pro-environmental behavior	
d. Learning institutions to teach pro-environmental subjects	
e. Use of technology in lessening environmental impact	
f. Encourage use of sustainable recycled waste materials	
g. Dissemination of knowledge and skills to interior designers concerning sustainability	

Any other suggestions on how to overcome these barriers?

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Thank you for taking time to respond!

## APPENDIX III: INTERVIEW GUIDE

**Researcher: Mike Kemboi Chesaro**  
**School of Arts and Design**  
**University of Nairobi**

Mike Kemboi Chesaro is a final year M.A. Design student at The School of Arts and Design, University of Nairobi, seeking to study *“Waste minimization strategies for Sustainable Interior Design”* Kindly assist by answering the questions in the Interview Guide. The report will strictly be for academic purposes only.

### Profession position

-  Managing Director [   ]
-  Creative Director [   ]
-  Project manager [   ]
-  Interior Designer [   ]
-  Intern [   ]
-  Others (Explain) -----

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### Guiding Questions

TOPIC ASSESSMENT	QUESTIONS
Knowledge of sustainability and waste minimization	1. What do you think is sustainability in the interior design practice? 2. What is your definition of waste minimization? 3. Are you familiar with the below waste minimization strategies? <b>(NB.</b> Actions to be undertaken to achieve each strategy to be read to the interviewees who are not conversant with the terms used)
Waste minimization strategies	(a) Interior Design for Adaptive Reuse. (b) The concept of designing out waste. (c) Design for waste prevention. (d) Design for recycling. (e) Design using sustainable materials. (f) The use of assessment tools.
Application of waste minimization strategy	

<p>Challenges encountered when applying waste minimization strategies</p>	<p>4. Have you ever been involved or applied the above waste minimization strategies?</p> <p>5. Briefly describe/illustrate the design process that you use and show the stage where you proposed the waste minimization strategy.</p> <p>6. What challenges did you encounter when applying the waste minimization strategy above?</p> <p>7. What other challenges do you think interior designers can encounter when applying waste minimization strategies?</p> <p>8. Which waste minimization strategy do you think will be ideal for interior designer in Kenya to adopt in their practice?</p> <p>9. Why do you think the strategy stated above is the best and interior designs should adopt in their practice?</p>
<p>Ideal waste minimization strategy</p>	<p>10. What do you think is the best way to make interior designers adopt to the above proposed waste minimization strategy?</p> <ul style="list-style-type: none"> <li>• Educating the public on waste minimization strategies</li> <li>• Relevant government legislation to encourage pro-environmental behavior</li> <li>• Learning institutions to facilitate pro-environmental actions</li> <li>• Change in interior designer education to factor in sustainability</li> <li>• Use of technology in lessening environmental impact</li> <li>• Encourage use of sustainable recycled waste materials</li> <li>• Dissemination of knowledge and skills concerning sustainability</li> </ul>
<p>Enforcement</p>	

(NB. Actions to be undertaken to achieve each strategy to be read to the interviewees)

**(a) Interior Design for Adaptive Reuse.**

- Reclaimed materials (demolished or refurbished building structural portions)
- Resource efficiency
- Reuse of materials in projects
- Reduction in the waste flow due to resources efficiency
- Assessment of the degree of sustainability of materials selected
- Reintroducing reclaimed materials or products into the building settings

**(b) The concept of designing out waste.**

- Reuse and recovery of materials
- Off Site construction and fabrication
- Materials Optimizations methods
- Design for waste Efficient Procurement
- Presence of waste management plans
- Identify the building elements that are likely to produce the most waste
- Assess the impact of design solutions on the waste to landfill and disposal cost

**(c) Design for waste prevention.**

- Application of eco- efficiency and eco-sufficiency principle
- Application of precautionary measures
- Cooperation and participation of all stakeholders
- Polluter-take responsibility-principle
- Life cycle of the material and system thinking
- Principles of true costs, efficiency and minimal costs
- cost -effective process of deconstruction

**(d) Design for recycling.**

- Using recycled materials in projects
- Using potentially reusable materials
- Repurposing of materials
- Repairing

**(e) Design using sustainable materials.**

**(f) The use of assessment tools.**

- LEED tool (Leadership in energy and environmental design)
- BREEAM tool (Building Research Establishment's Environmental Assessment Method)
- Ska-rating tool
- NABERS tool (The National Australian Building Environmental Rating Scheme)
- Green Star Australia tool
- BEAM tool

Thank you for taking time to respond!

## **APPENDIX IV: FOCUS GROUP DISCUSSION GUIDE**

**Researcher: Mike Kemboi Chesaro**  
**School of Arts and Design**  
**University of Nairobi**

### **Outline of the program**

**Step 1:** Introduction of the moderator and assistant

**Step 2:** Introduce the topic “Waste minimization strategies for sustainable interior design”

- *Purpose of the results:* The results will be used for academic purposes only
- *Reason for their selection:* You were selected because of your knowledge and expertise in the interior design field.

**Step 3:** Pointing out guidelines. Including:

- No right or wrong answers, only differing points of view
- We are tape recording, one person speaking at a time
- We are on a first name basis
- You don't need to agree with others, but you must listen respectfully as others share their views
- Rules for cellular phones and pagers if applicable. For example: We ask that your turn off your phones or pagers. If you cannot and if you must respond to a call, please do so as quietly as possible and rejoin us as quickly as you can.
- The role of moderator will be to guide the discussion
- Talk to each other Opening question

**Step 4:** Opening question



## **Focus Group discussion:**

### **Moderator: Mike Kemboi Chesaro**

Good afternoon and welcome to our session. Thanks for taking the time to join us to talk about “**waste minimization strategies for sustainable interior design**”. My name is Mike Kemboi Chesaro and my assistant is Margaret Wambui. We are both from the University of Nairobi. Kemboi is doing a study on the topic stated and we would like to get some information from interior design practitioners about their perception on waste minimization strategies and sustainability in interior design. We would like to know your understanding on waste minimization strategies and sustainability, challenges faced this strategies in your practice, ways to overcome this challenges and also to give suggestions on the best strategies that interior designer can adopt. You were invited because you are practitioners of interior design, so you're familiar with waste, waste minimization strategies and sustainability, and you all work within the Nairobi area. There are no wrong answers but rather differing points of view. Please feel free to share your point of view even if it differs from what others have said. Keep in mind that we're just as interested in negative comments as positive comments, and at times the negative comments are the most helpful. You've probably noticed the recorder. We're tape recording the session because we don't want to miss any of your comments. People often say very helpful things in these discussions and we can't write fast enough to get them all down. We will be on a first name basis tonight, and we won't use any names in our reports. You may be assured of complete confidentiality. The reports will be used for academic purposes only. Well, let's begin. We've placed name cards on the table in front of you to help us remember each other's names. Let's find out some more about each other by going around the table. Tell us your name and which company you work with.

## **GUIDING QUESTIONS**

11. What do you think is the difference between sustainability and waste minimization in the interior design practice?  
**Discussion 2mins each person**
12. What waste minimization strategies are there in place that assist interior design achieving sustainable interior design?  
**Discussion 2mins each person**
13. What is your opinion on the below waste minimization strategies?  
(**NB.** Actions to be undertaken to achieve each strategy to be read to the interviewees who are not conversant with the terms used)
  - a) Interior Design for Adaptive Reuse.
  - b) The concept of designing out waste.
  - c) Design for recycling.
  - d) Design using sustainable materials.
  - e) The use of assessment tools.**Discussion 5mins each person for each strategy**
14. Looking back to your practice in interior design, have ever applied any of the strategies stated in question 2 above?  
**Discussion 5mins each person**
15. What challenges did you encounter when incorporating the waste minimization strategies?  
**Discussion 3mins each person**

16. Which is the most ideal waste minimization strategy that can be adopted by interior designers in Kenya? **Discussion 3mins each person**
17. What do you think should be done to encourage the use of waste minimization strategies in interior design?  
**Discussion 3mins each person**

#### **Assistant Moderator tasks**

1. Help with equipment & refreshments
2. Arrangement of the room
3. Welcome participants as they arrive
4. Take notes throughout the discussion
5. Operate recording equipment
6. Do not participate in the discussion
7. Ask questions when invited
8. Give an oral summary
9. Debrief with moderator
10. Give feedback on analysis and report

#### **Incentives for Participation**

Food

Positive invitation

Opportunity to share opinions

Enjoyable, convenient and easy to find meeting location

Involvement in an important research project

Build on existing community, social or personal relationship

#### **Systematic Notification Procedure**

1. Set meeting times for group interviews
2. Contact potential participants by phone or in person
3. Send a written personalized invitation
4. Phone (or contact) each person the day before the focus group