UNIVERSITY OF NAIROBI

AN INVESTIGATION INTO THE ADAPTABILITY OF OLD OFFICE BLOCKS TO CHANGING USER NEEDS
(CASE STUDY: NAIROBI CENTRAL BUSINESS DISTRICT)

BY

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DECLARATION

I, OTIENO E. OWUOR, hereby declare that this project is my original work and has not been presented for a degree in any other University.

Signed: .... Date: 3/7/2008 ....

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DECLARATION OF THE SUPERVISOR

This research has been submitted for examination with my approval as a university supervisor.

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DEDICATION

This work is dedicated to my parents William Owuor and Naohmi Akoth; my siblings Kenneth, Victor, Judith, Vider, Winnie, Sharon, Verah, and Gift. My fountains of life and foundation of love, whose dedication and commitment have inspired me throughout my life. Thank you.

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ACRONYMS

- **CBD:** Central Business District

DEFINITION OF TERMS

1. **Users:** In this context, users mean those who actually use the building in their everyday activities. In this sense all people working in a building including staff, management and service personnel are users. Users that are not included in this category are those who are some sort of visitors.
2. **Technology:** This is the knowledge and use of tools and crafts to control and adapt to environments (Wikipedia, 2008).
3. **Flexibility:** enabling minor shifts in space planning i.e. the ability to change within existing main structure. Some built-in possibilities to rearrange, take away, or add elements and systems
4. **Convertibility:** allowing for changes in use within the building; and
5. **Expandability:** facilitating additions to the quantity of space in a building.

ABSTRACT

This study sought to assess the adaptability of old office buildings to the changing needs of the building users. This entailed establishing the adequacy of the building design as well as facilities incorporated in the buildings to cater for the changing needs.

The study relied on responses from questionnaires and interviews with architects, property managers/building owners and building users. Surveys of selected buildings were also carried out.

Findings indicated that the old office blocks are less adaptable to the changing needs of their users. This is because their systems of space deployment, electric infrastructure and cable management contain little or no flexibility. They accommodated adaptation only with difficulty and at unacceptable cost. This is evident from the interviews and responses that were given by the architects, property managers, building users and the buildings' survey.

The study recommends that, for future developments, the principles of adaptability i.e. independence, upgradeability and compatibility, should be considered in the design stages of a building to avoid the high costs and inconveniences of consequent modifications. For the existing buildings, however, modifications and improvements are required.

One way of promoting this is to incorporate incentives in public policies directed at sustainable urban development. If adaptability is embraced in public policy, it may be necessary to relate adaptability to basic principles of sustainable development, such as stewardship and intergenerational equity. From this perspective, the responsibility of the designer or developer is to meet the client's needs and expectations without compromising those of future building owners and users.

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 General Background

Buildings are structures that offer shelter to their occupants who derive the most out of such facilities by way of being relevant to their needs. These structures are primarily developed for human habitat with the expectations of the best return of shelter utility (Njuguna, 2004).

They are static in location and state of facilities whereas human beings change their habits relatively faster than the developments in design where this over time brings an accumulation of unfulfilled user needs (Russel and Moffat, 2001). It is thus important to realize that these facilities need to accommodate substantial changes to accommodate these emerging needs (Regnier, 1994).

Change is inevitable in the needs and expectations of building occupants. For instance, the tasks performed in a given place are subject to modification or total replacement over time; the systems employed to facilitate the performance of the tasks are also subject to updating and replacement, as are building services (Njuguna, 2004).

The changing needs promote new functionality that older buildings may not be able to accommodate. It is therefore of significance for buildings to be designed with mechanisms which can be able to accept new functional requirements as presented by occupants and adapt to the enduring needs of the individual person.

It is pointless building something that meets everyone's needs now only for it to be demolished thirty years down the line because it no longer meets the needs of the community it was designed to serve. Buildings need to be designed not only to meet the requirements now but also to be able to adapt to any changes that may arise in the future (The building engineer journal, 2007).

Adaptability is ability to modify, update and re-organize elements of a building to reflect technological change, change in user needs or external influence (Boyd, 1994).

When a building is not able to adapt to changing needs it becomes functionally obsolete as it is no longer compatible with user needs (Barreca, 1999). Functional obsolescence is the loss in value resulting from a relative deficiency of an asset to function as demanded by its users (Ndumi, 1997) and the net impacts become either (Barreca, 1999):

- Underutilization,
- Complete disuse of the building as the building becomes totally useless, or
- Reduced lifespan resulting in premature demolition as the buildings may be put to accommodate activities that strain their capacity.

Underutilization leads to loss of yields which translates into loss of income to the building owners.

Disuse and demolition of buildings are acts which are not environmentally sustainable. The society is experiencing a general resource scarcity and an ecological crisis. It would be imperative to conserve as much resource as practicable in order to save the environment of imminent danger of depletion. The building stock is also the longest financial, physical and cultural asset that any country can use to trace its social, economic and political history. A sustainable society cannot be possible until this key resource can be managed properly therefore there is a general need for the building industry to embrace sustainable construction which in this sense involves the culture of adaptability of buildings.

1.2 Problem statement

There have been cases of underutilization, disuse and demolition of old office blocks in the central business district (CBD) of Nairobi.

In 2005, Kibet noted that investors in the building sector had been frustrated by the inability of the buildings they own to give them adequate returns. This problem was associated with poor occupancy levels in old office blocks they owned. Cases of underutilization are still evident in the CBD as can be seen buildings like Parisan House and Cresent House along Moktar Dadah Street, Sawa House and Green Palace House along Monrovia Street.

Old office buildings left derelict or completely disused are also evident in the CBD. These can be seen along Moktar Dadah Street, University Way, Tubman Road and Tom Mboya Street as shown in table 1.1 below.

Table 1.1: Disused buildings

Street/Road/Way	**Number**
University way	**2**
Moktar Dadah Street	**1**
Tom Mboya Street	**1**
Monrovia Street	**1**
Total	**5**

Source: Field Survey, 2008

A number of demolitions have also taken place in the city's central business district. This has happened along Monrovia Street, Biashara Street, Moi Avenue including Kenyatta Avenue.

The above cases of underutilization, disuse and demolitions raise questions on the capacity of these buildings to adapt. A building that is adaptable is utilized more efficiently, and stays in service much longer. An adaptable building is able to accommodate new needs and demands as presented by the users and hence insure itself against underutilization, disuse and premature demolition (Russel and Moffat, 2001).

In the event that these questions are not addressed with the seriousness they need, such consequences as underutilization, disuse and demolitions will hit even harder with the result that the commercial activities supported in the built environment reduced. This will reduce income from the property business sector which will consequently lower economic growth of the country. In addition, the quest for a sustainable society will be immensely compromised.

The aim of this study was therefore to assess the adaptability of old office buildings to the changing user needs and give any necessary recommendations.

1.3 Objectives of the study

The main objectives of the study were:

1. To establish the adequacy of the buildings' design in adapting to the new needs.
2. To assess the building performance in relation to the occupants needs.
3. To examine any challenges faced in meeting these needs and their effects on the building form.
4. To suggest appropriate measures that would contribute in solving the problem.

1.4 Research questions

In order to guide the research in achieving the objectives, three leading questions were formulated:

1. Is the building design adequate to accommodate changes as may be presented by occupants?
2. How do users rate the building in terms of performance?
3. Are ~~their~~ there challenges faced in meeting new needs?

1.5 Study hypothesis

The following hypotheses were tested in the study:

1. Null hypothesis, H_0:

   Old office blocks are adaptable as their systems of space deployment, cable management and electrical infrastructure contain flexibility.

2. Alternative hypothesis, H_1:

   Old office blocks are less adaptable as their systems of space deployment, cable management and electrical infrastructure contain no or little flexibility.

1.6 Justification of the study

An adaptable building provides a lot of benefits to users and owners in terms of cost, convenience and marketability. More often than not, when a building is unable to respond precisely to an increasingly diverse range of user requirements, it loses value as the occupants become dissatisfied and relocate to other buildings. This consequently leads to low yields to the building owners. Therefore the knowledge of factors that may hamper adaptability and how they

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These variables were taken to be the design measures necessary for flexible space deployment, adequate electrical infrastructure (power and lighting) and cable management/communication infrastructure.

1.8.2 Population and sample

The target population consisted of all old office buildings in Nairobi central business district constructed not less than 40 years ago and more than one storey high. It was made up of 44 buildings which were along Monrovia, Moktar Dadah, Biashara , Tom Mboya, Mbingu streets, University way including Moi Avenue (Source: Field survey, 2008). However, the target population was reduced to an accessible population of 39 buildings as illustrated in table 1.2 below.

Table 1.2: Accessible population

Population class	**Total number**
Target population	44
Non-operational buildings	5
Accessible population	**39**

Source: Field survey, 2008

1.8.3 Instruments of data collection

The instruments of data collection were:

i. Observations with the aid of a checklist

ii. Interviews and

iii. The questionnaire designed by the researcher and checked by a referee.

Observation as an instrument was used to collect data on the observable design aspects of the buildings. Questionnaires and interviews were administered to the building users, owners/property managers and Architects.

Users were targeted to assess building performance while form architects and property managers/owners the researcher intended to establish the ease with the buildings could adapt.

1.8.4 Data Collection

The researcher adopted both primary and secondary methods of data collection. Drop and pick method was used to administer the questionnaires to the respondents to collect the primary data. The data collected was then used to establish the views of different groups of people about the concerned topic as well as their recommendations. Secondary data was gathered through reading of related books, journals, publications, reports, previous works and other relevant sources such as the internet.

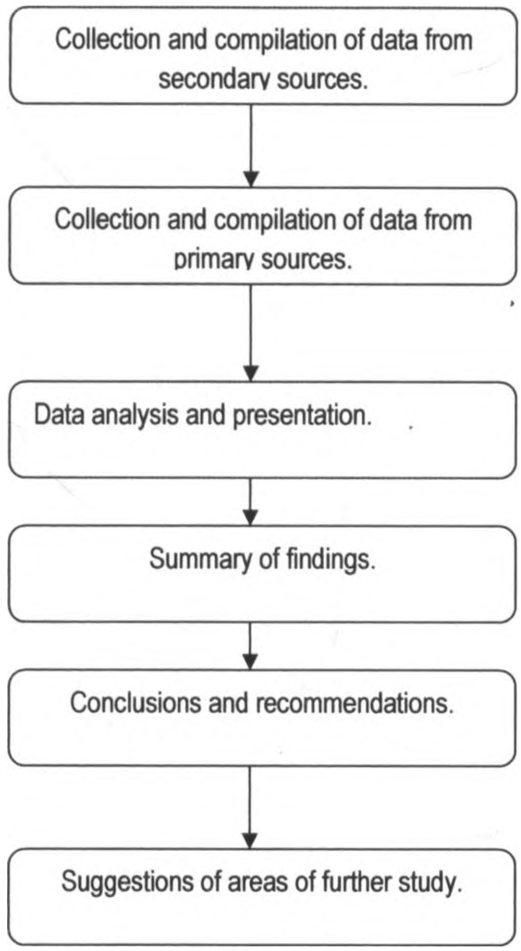
1.8.5 Data Analysis

The data collected by the questionnaires and observational forms was converted into numerical codes representing measurement of variables. Descriptive statistics – frequency tables and charts - are used to summarize the data by stating the frequency of occurrence. Inferential statistics is then used to test the significance of the results on adaptability of the old office buildings.

1.8.6 Presentation of Data

The processed data was then presented in the form of frequency distribution tables, pie charts and bar charts. Plates were also used to present the information captured by photography.

1.8.7 Summary of the methodology



1.9 Scope of the study

1.9.1 Geographical scope

Nairobi was taken to be the study area and only the old office buildings in Central Business District were studied. The Central Business District (CBD) was taken to be the area enclosed by the University Way, Uhuru Highway, Tom Mboya Street and Haille Selasie Avenue. This area was chosen due to the following reasons:

1. There has been cases of underutilization and neglect of old office blocks in the CBD. This has been associated to tenants relocating to upcoming modern buildings in the sub-CBDs. The researcher was therefore motivated to find out factors behind this phenomenon.

2. The area has a variety of old office buildings in terms of age, design and ownership and was believed to enrich the findings due to the varying degrees of adaptability that was expected from these buildings.

3. There exist numerous old office blocks in this area most of which are still in use as commercial premises. This presented a reliable source of information on how these buildings coped with the changing user needs.

The findings of this study were therefore taken as a representation of the situation in Kenya as a whole.

1.9.2 Elemental scope

- **Adaptability**

  Adaptability of a building can be analyzed under various aspects:

1) Space deployment: Space provision.
2) Building services: Services are used primarily to provide a habitable environment for occupants and equipment within space. The major building services are: heating, ventilation and air-conditioning (HVAC), lighting, electric power and cable management systems.
3) Finishes
4) External appearance

Due to the limitation of time, the study only covered space deployment, lighting system, power system and cable management systems.

Chapter three outlines and details the methodology used to realize the objectives of the study. Data collection instruments and procedures are explained.

Chapter four takes an insight into the data collected. Data analysis and presentation are also contained in this chapter and the problems encountered in the field mentioned.

Chapter five mainly involves the major conclusion and recommendation. This simply states the recommendations based on the results obtained from the research. A summary of the main findings is also given.

At the back page is attached a CD format of the project.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter covers both the theoretical and conceptual framework for the study. The introductory section generally highlights the various definitions and aspects of adaptability as well as the need for and significance of an adaptable building design.

Adaptability refers to the capacity of buildings to accommodate substantial changes. Boyd in his book "The Intelligent Building" defines adaptability as the ability to modify, update and re-organize elements of a building to reflect technological change, change in use or external influence (Boyd (1994).

The concept of adaptability can be broken down into a number of simple strategies that are familiar to most designers:

1. Flexibility or enabling minor shifts in space planning i.e. the ability to change within existing main structure. Some built-in possibilities to rearrange, take away, or add elements and systems
2. Convertibility, or allowing for changes in use within the building; and
3. Expandability or facilitating additions to the quantity of space in a building.
4. Upgradeability of building services.

Building adaptability relates to structural design; spatial deployment and other building services. Structural adaptability is the ability of the building elements i.e. walls, floors and roofs to accommodate changes as may be required. Spatial adaptability on the other hand is the ability of spaces occupied to accommodate different uses and allow for expansion to permit additional space requirements. Adaptability in servicing relates to the upgradeability of building services.

Adaptability of a building can also be defined in relation to tenant needs. The definitions can be under the following categories:

1. Adaptability within user - the extent to which a building can support the needs of the existing occupier without requiring major or frequent refurbishment and upgrading;
2. Adaptability within use - the ease with which a building can support the requirements of different users from the same user group with minimal refurbishment;
3. Adaptability across user - the ease with which a building can be adapted to support the requirements of a new use type, for example a switch from commercial to leisure or residential.

Adaptability is also closely related to – but different from – the other design strategies that attempts to enhance long-term environmental performance i.e durability.

Durability: selecting materials, assemblies and systems that require less maintenance, repair and replacement. Since durability extends the useful lifetime of materials and technology in a building, it is complimentary to adaptability.

2.1.1 The Need for Adaptability

There are many areas where the importance of adaptability can be seen.

All other things being equal, a building that is more adaptable will be utilized more efficiently, and will stay in service much longer. A longer and more efficient service life for the building may, in turn, translate into improved environmental performance over the lifecycle.

Unless a building is capable of responding to changing circumstances it is vulnerable to becoming poorly utilized, prematurely obsolete and unable to accommodate new and more efficient technologies. The combined impact of such failures may be to increase resource use within the building sector by 20 to 30%. Adaptable buildings help improve environmental performance in the following ways.

2.1.1.1 More efficient use of space

Adaptable buildings are likely to use the same amount of space and materials more efficiently, on average, over their entire life. For example, increased flexibility of spaces might mean that it is easy for occupants to use floor area more effectively as their needs change, or as the nature of their business expands. Convertibility may allow basements, attics, hallways, storage areas, roofs and entrances to be used for other purposes, as new needs arise.

Expandability may allow the building to accommodate much higher densities with the same footprint and infrastructure. If such adaptations can create even small improvements in space utilization over the lifecycle of buildings, the impact on resource use can still be significant. For example, if the average lifetime space utilization is 10% improved, and all buildings are similarly designed for adaptability, then the country needs 10% fewer buildings.

2.1.1.2 Increased Longevity

Adaptability is also a strategy for extending the total lifetime of buildings. Most buildings are destroyed due to technological obsolesce, not structural deterioration (Russell and Moffatt, 2001). Adaptability can therefore extend lifetimes without imposing any of the significant environmental impacts associated with the entire one –time investments in the building structure and infrastructure.

Consider, for example, the embodied energy in reinforced concrete – probably the single greatest pollutant source in a typical commercial building. Or consider the other long lasting elements of a building like wood, metal, glass and landscaping materials. Or consider the energy used in construction, demolition, and haulage and disposal of earth, materials and waste.

If adaptable designs can extend the average lifetime of buildings by 10%, (and possibly much more), then we can similarly reduce the total country's investment in replacing these long -lasting elements of the building stock. The most environmentally benign building is the one that does not have to be built.

2.1.1.3 Improved Operating Performance

Adaptability can also mean easier change - over as new technology becomes available. Thus adaptable buildings benefit from technological innovation sooner and at lower cost. The average efficiency of many technologies used in buildings – like lighting and ventilation systems - has more than doubled over the past 10 years. If a building has features that allow easier adoption of new, efficient technology, it is reasonable to assume an increase in average lifetime operating efficiency of 10% or more. This in turn would reduce the total environmental impact of operating the world's buildings by 10% – a very significant improvement.

2.2 Changing user needs

This section tends to highlight the dynamic nature of human needs and the need for buildings to have adequate measures to accommodate them.

Buildings are static in location and state of facilities whereas human beings are dynamic in terms of needs as they progress in life and therefore buildings should be designed with adequate measures to allow for accommodation of any new functional requirements. Change is inevitable in the needs and expectations of building occupants.

It is pointless building something that meets everyone's needs now only for it to be demolished thirty years down the line because it no longer meets the needs of the community it was designed to serve.

Changing needs in commercial buildings may be as a result of changes in the nature of commercial activities for example:

- Business expansion or contraction.
- The need to change or replace the tasks performed in a given space.
- The need to upgrade systems employed for carrying out the tasks e.g. power and lighting.
- The need for greater complexity of equipment, plant and processes which require different accommodation in terms space and power supply.

As stated by Highfield (1987), advances in industry and commerce together with the demand for a more sophisticated interior environment can lead to older buildings becoming outdated.

An adaptable building will however be able to support such at low costs (Russell and Moffatt, 2001).

2.3 Occupier satisfaction

This section highlights the significance of the ability of a building to accommodate the changing needs. It also analyzes the impacts of the inability of a building to respond adequately to such needs.

Occupier satisfaction with a building is a product of the ability of the tenant to function as effectively within the building, as their competitors. A dramatic change in occupier requirements can render a building obsolete for that particular use or user group in a short space of time, having a devastating effect on building worth. More usually occupier satisfaction with a building changes slowly as requirements change.

The impact such changes have on property worth depend upon whether they are property specific or affect the user group as a whole (market specific). Where dissatisfaction is property specific it could affect any user of the building. The impact on worth will be significant to that building, undermining rental growth as the building continually fails to perform satisfactorily for tenants and is outperformed as an asset by other buildings within its class. The long-term impact could be:

1. Faster depreciation of large elements of building stock;
2. Increased capital outlay on more rapid refurbishment and redevelopment, and reduced overall investment return;
3. Increased rents on more sustainable buildings, encouraging an increase in their speculative development and, in time, supply.

In a market environment in which tenant power is increasing, the efficacy with which a property supports all aspects of the occupier function is increasingly crucial to its lettability. A property unable to support all the functional requirements presented to it is considered functionally obsolete.

2.4 Functional obsolescence

The functional requirements of asset are subject to change over time. Changing consumer expectations, for example, may promote new functionality that older assets may not accommodate (Barreca, 1999). When an asset losses its value as a result of its relative deficiency to function for its intended purpose it is considered obsolete.

The Oxford Dictionary defines obsolete as 'disused, discarded or antiquated.' It defines obsolescence further as 'going out of date.'

According to Bruce Walker (1976), obsolescence in housing sector, refer to the relative degree of uselessness or disutility as accessed by the occupants themselves.

Functional obsolescence, therefore, entails a deficiency in equipment or layout that makes a building less suitable for use than the general run of its contemporaries (Ndumi, 1997). The overall likelihood of obsolescence will increase as the services provided by the building decrease relative to the requirements as needs change.

Keith Aslop (1979), in his study saw that obsolescence had occurred in many of older urban areas because buildings become functionally substandard or because the existing infrastructures were no longer adequate for modern demands.

2.4.1 Measurement of Obsolescence

There are two standards to which obsolescence may be related: the first is that of the market and the second is that which the community regards as minimum which ought to be permitted in the public interest.

a) Market Standards

In this case obsolescence is examined against market standards. The degree can be measured in terms of the loss in value which can be calculated in two ways:

i. Curable: Where it is economically worthwhile to remedy the deficiency and so the cost of work provides a guide to the extent of deprecation caused by obsolescence.

ii. Incurable: Here obsolescence can only be measured in value terms either by comparing the value of the obsolete properties with others which they are similar to but free from obsolescence; or by estimating the remaining life of the property and comparing the value of its income over that period as against its income in perpetuity.

b) Social Standards

It can happen that properties may retain an economic value due to scarcity but, the community's point of view at large, their life should be terminated.

Therefore, any factors that tend, over time, to reduce the ability or the effectiveness of a building to meet the demands of its occupants, relative to other buildings in its class, will contribute towards functional obsolescence of the building.

Functional obsolescence however is a state that can be reversed. Many deficiencies giving rise to functional obsolescence can be remedied by adaptation i.e. modifications and installation of the required equipment (Kanyi, 2001). This emphasizes the significance of the ability of a building to adapt. If no actions are taken then the obsolete state is threatened.

2.5 Consequences of the failure a building to respond to changes

Failure to adapt to changes occurs when a building is unable to respond precisely to user requirements. A building unable to be updated to user needs becomes functionally obsolete. The consequences include (Barreca, 1999):

- Underutilization.
- Complete disuse of the building.
- Reduced lifespan resulting in premature demolition.

2.5.1 Underutilization

Underutilization is a situation where a building's rental spaces are not fully occupied.

One of the causes of underutilization in a building is the failure to meet user needs. A building that is more adaptable will be utilized more efficiently, and will stay in service much longer. Unless a building is capable of responding to changing circumstances it is vulnerable to becoming poorly utilized or prematurely obsolete (Russel and Moffat, 2001).

Urban areas everywhere are experiencing problems related to poor use of old buildings (Russel and Moffat, 2001). In the central business district of Nairobi, for example, evidence of underutilization can be seen. For instance plate 2.1 shows one Parisan House along Moktar Daddah Street in Nairobi. It is a two storey building but only occupied on the ground floor.

Plate 2.1: Parisan House along Moktar Dadah Street

Source: Field survey, 2008.

2.5.2 Complete disuse of buildings:

Disuse is a state of being neglected or being no longer in use. Disuse occurs when a building completely loses its worth. This can be as a result of functional obsolescence or structural obsolescence which is a state when a building structure comes to the end of its service life and the building becomes unsafe for use.

Plates 2.2 and 2.3 shows some examples of buildings completely neglected without any use in the central business district of Nairobi. Plate 2.2 shows a building along Moktah Daddah Street while plate 2.3 of a building along University Way.

Plate 2.2: A building left derelict along Moktah Daddah Street

Source: Field survey, 2008.

Plate 2.3: A building left derelict along University Way

Source: Field survey, 2008.

2.5.3 Demolition of buildings:

A building with poor capacity to adapt attracts a high risk factor than buildings that have been made adaptable. A decreased life span is almost a certainty in such a building because it may be put to accommodate activities that strain its capability. In some cases, a building that fully fails is demolished depending on is life.

Demolition rates are rising. The average age of a building in Tokyo is now 17 years. In Germany, of the 60% of buildings that survived WW2, only 15% remain standing today (Russel and Moffat, 2001).

In Nairobi, a number of old buildings have been demolished in the city's central business district. This has happened along Monrovia Street, Biashara Street, Moi Avenue including Kenyatta Avenue. This is not a sustainable trend given the scarcity of resources. The conclusion is therefore clear: increasingly, buildings need to be designed for long-term adaptability.

2.6 Factors influencing adaptability

It should be noted that it is not every building that is easily adaptable to changes and as much as we would like buildings to be adaptable, there arise hindrances. Some of the factors that may influence the adaptability of a building include the following.

2.6.1 Building design

Building design will heavily impact on the outline of a building in determining how easy it is for adaptation. A rigid design for example discourages adaptation as its systems of service and space deployment are less flexible and can only accommodate changes with difficulty.

2.6.2 The 'lowest-cost' mentality at the design stage

The high degree of uncertainty about the future makes any investment in long term adaptability less valuable. For this reason the concept of adaptable design may be largely restricted to accommodating changes that are expected to occur in the very near future.

However, where significant investment is required primarily for the purposes of enhancing adaptability, the potential advantages need careful weighing against future costs associated with inadaptability.

2.6.3 Building regulations

Over-regulation can constrain adaptation (Kincaid, 2000). This is so because building regulations govern the types of materials and technology to be used in construction.

In Kenya for example, the 1968 Building Code, calls for building foundations, structural steel works, walls and partitions of blocks and slabs to be load bearing: "All walls built of stone, bricks shall be hard durable and suitable for the purpose which they are used", it states. Technology now advocates for lighter materials but materials with more strength to support buildings as opposed to weighty materials.

Generally, lightweight building materials produce light buildings which have great advantages in flexibility and reuse of building components. On the other hand, weighty materials result in heavy buildings which are difficult to change and with components that are hard to separate (Campioli and Lavagna 2000).

2.7 Design Considerations for Inherent Adaptability

This section looks at the design considerations that can be used to enhance adaptability of a building in terms of space deployment, electric infrastructure and cable management. If adaptability is to be a useful design concept, it must be possible to properly distinguish those features of new buildings that will significantly increase their capacity for change.

Design considerations that enhance adaptability are those key principles or design strategies that tend to improve flexibility in all elements of a building. These principles include (Russel and Moffat, 2001);

- **Independence:** Integrate systems within a building in ways that allow parts to be removed or upgraded without affecting the performance of connected systems.

  By far the most important key principle for enhancing adaptability appears to be the independence of building elements. The more each feature is uncoupled from the others, the more adaptable a building becomes. It is especially important to uncouple those layers of a building that have significantly different lifetimes. According to Francis Duffy, co-founder of a British firm that specialized in advance office designs, a building over its lifetime changes not as a single entity, but rather as separate layers: Shell, Services and Scenery. Each layer has a unique time period for repair and replacement.

  1. Shell; Structure of building, including skin if load-bearing - 50 years
  2. Services; Pipes, ducts, cables, machinery, elevators, escalators - 15 years
  3. Scenery; Partitioning, ceiling, finishes - 6 years

The challenge is to achieve functional interdependence, without losing the independent features that enhance adaptability such as redundancy, robustness, and ease of access, repair and replacement.

- **Upgradability:** Choose systems and components that anticipate and can accommodate potential increased performance requirements.

- **Lifetime compatibility:** Do not encapsulate, or strongly interconnect short lifetime components with those having longer life times. It also may be advantageous to maximize durability of materials in locations where long lifetimes are required, like structural elements. Durable foundations for example can greatly facilitate adaptability, often tipping the scale over demolition.

- **Record Keeping:** Ensure that information on the building components and systems is available and explicit for future use. It will assist effective decision making with regard to adaptation and prevent costly probing exercises.

It is possible to rate each element of a building in terms of its inherent adaptability. Inherent adaptability is assumed to relate to the inclusion in the design of the element a number of specific features. Such features may be identified through surveys of buildings that have adapted well to changes. Or common sense can be used to identify features that are likely to work well in typical change scenarios. Adaptability of buildings should increase in proportion to the number of such features that are incorporated into the design.

2.7.1 Design considerations for adaptable spaces:

Building strategies for adaptable spaces include:

- Flexible spaces,
- Multifunctional spaces,

- Partitionable spaces and
- Design for disassembly

2.7.1.1 Flexible space:

Tenants may present a wide range of space needs. Some tenants may require smaller spaces while others larger spaces depending on the nature of their businesses. Most of the commercial buildings in the central business of Nairobi are currently faced with the need to house a variety of commercial activities. Some of these activities include but are not limited to (Field Survey, 2008):

- Private offices
- Cyber cafes (printing, typing, photocopying, e.t.c.)
- Boutiques
- Electronic shops
- Exhibition shops
- Fashion shops

To accommodate such a variety of space needs a building needs to have a space deployment system that is easily adjustable to provide the nature of spaces required without major structural changes. The most effective design considerations that would enhance adaptability in space deployment are as follows:

i. **Open building concept**

Implied in this term is the notion of uncomplicated structures that lend themselves to flexibility and change of use in the course of time. Open Buildings distinguish between building parts, which have a long life e.g. the structure, and those parts that can change more quickly like the internal fit-out.

A key feature of open buildings is the separation 'fit-out' from the structure and the building skin. Fit-out refers to all the componentry and elements that contribute to particular use of a building, but are not needed for the basic functioning of a building. An example of a fit-out is internal partitioning. The better the separation of fit-out from the structure, the more adaptable the building.

Figure 2.1: Typical open floor with column supports.

Source: www.googleimages.com

ii. Light and Demountable wall partitions

These are interior partitions that are light, demountable and reusable. Lightweight wall partitions can be made of timber products or metal strips and glass. The use of these walls in open buildings is one of the most effective ways of ensuring flexibility in space deployment as they are easy to install and relocate.

There are three types of demountable wall systems.

a. Mobile or openable system

This system has a sliding mechanism that allows a wall panel to move along ceiling tracks. Figure 2.2 below shows an example of a mobile wall made of aluminium frame with glass infill.

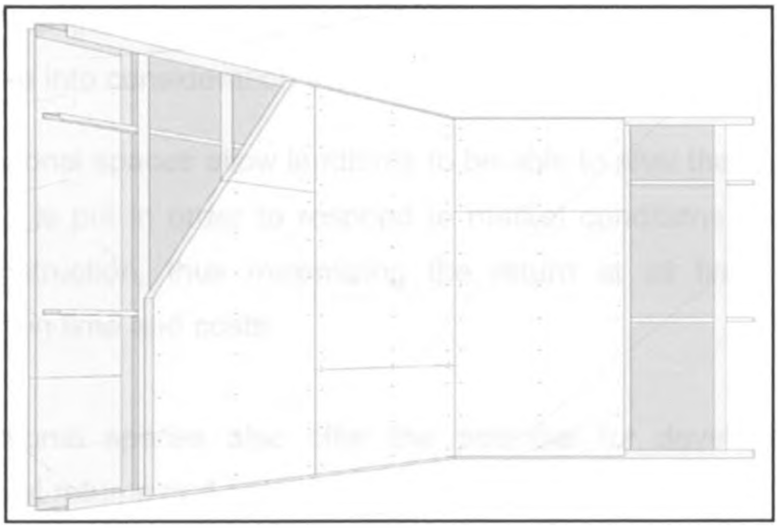
Figure 2.2: Mobile or openable wall system

Source: www.googleimages.com

b. Demountable system

The concept in this system is similar in principle to that of a conventional dry wall system. The walls are constructed with metal studs that are placed at specific intervals. Prefinished wallboards are then affixed with special clips to the metal frame.

Figure 2.3: Demountable wall system



Source: www.googleimages.com

c. **Portable partition system**

This is made of prefabricated panels, which are brought to a desired location and held in place by channels in the ceiling and floor.

2.7.1.2 Multifunctional Spaces

These are spaces which can be used in different ways and for different functions. The objective of this approach is to design rooms with dimensions and proportions that allow a variety of functions to occur within them.

There are several guidelines that need to be considered when conceiving multifunctional spaces (Friedman, 2002):

- The room's dimensions and proportions are perhaps the most important aspects. The larger the space is, the wider the options for adaptability. Since ample space is not always available, one must therefore envision the types of uses that the same room could accommodate. When proportions are decided, a square shape would be desirable as it presents fewer limitations on internal rearrangements.
- There should be ample light to accommodate a range of uses. Decisions about the number of windows and their dimensions therefore need to take into consideration the range of uses of the room.

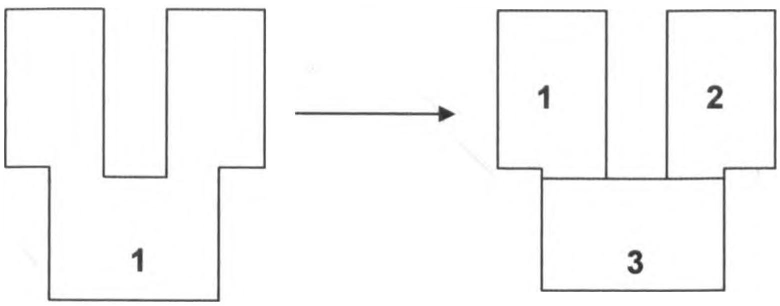
Multifunctional spaces allow landlords to be able to alter the mix of use to which a building is put in order to respond to market conditions without altering the shell construction, thus maximizing the return at all times and minimizing construction time and costs.

Multifunctional spaces also offer the potential for developers to maximize commercial returns and reduce risk associated with mixed use buildings without having to predetermine which parts of the building perform a particular use.

2.7.1.3 Partitionable Spaces

These are shapes which can be easily sub-divided into different habitable rooms with minimum wastages. These spaces are regularly shaped and are designed with partitioning grids to facilitate partitioning. An example of a partitionable space is illustrated in figure 2.4 below.

Figure 2.4: Illustration of a Partitionable space



Source: www.googleimages.com

The above figure shows a floor space subdivided from a single use to three habitable spaces.

2.7.1.4 Designing for Disassembly

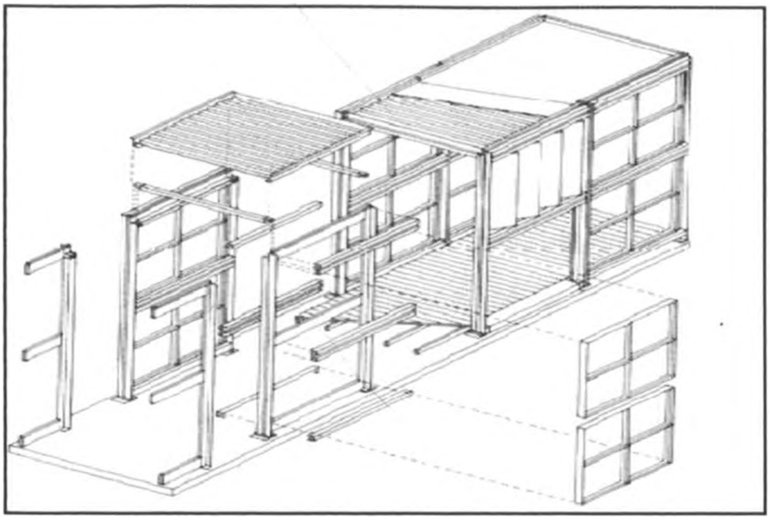
The ability to disassemble is the possibility of different parts or elements of a building to be removed without affecting the performance of the other connected parts as illustrated in figure 2.5 below. Designing for disassembly can reduce the costs and environmental impact associated with adapting buildings to new uses.

This type of design is achieved by:

- Avoiding composite materials. These are materials made from more than one material.

- Reducing the number of components or products.
- Using mechanical rather than chemical connections

Figure 2.5: Disassembling wall and floor elements



Source: www.googleimages.com

Design for disassembly does not only promote adaptability but also enhances maintenance, reuse and recycling of materials at the end of life.

Generally, the life-time of a building depends on the decline of functionality and performances of building components (Campioli and Lavagna, 2000). Once the life-time of various components of a building is known, design for disassembly allows for change of components, with maintenance and partial substitution to prolong life-time of the building. Changes to accommodate new functional requirements can also be done without demolition and rebuild of the building.

2.7.2 Design consideration for adequate cable management

Cable management refers to an important step during the installation of building services (i.e. electrical services) and the subsequent installation of equipment providing means to tidily secure electrical, data and other cables. The term is often used interchangeably to refer to products used for the same purpose of managing cables or to the workmanship carried out to cables whilst being installed.

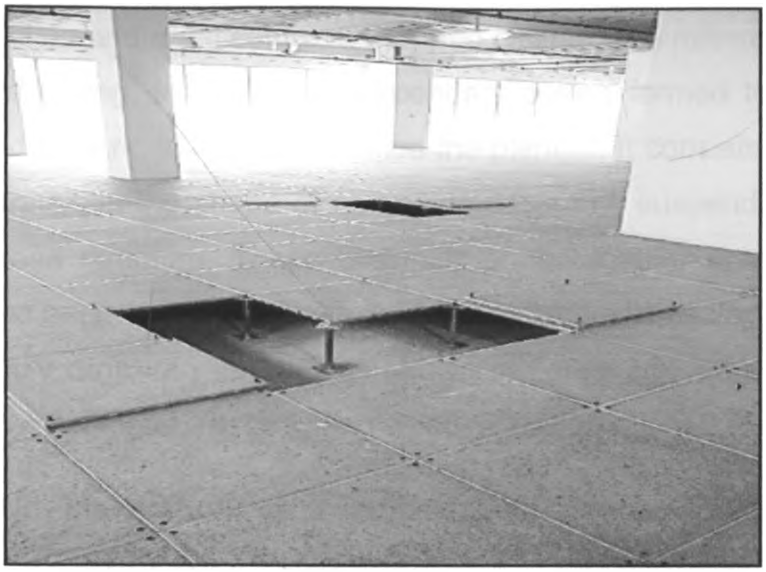
Connectivity for voice, data, lighting and power systems can generate the greatest stress to the adaptability of a workspace. The following design measures will enhance the efficiency of a building in terms of cable management if incorporated in a building design.

1. Adequate allowance given to risers, wiring closets and other spaces through which cables can be drawn. Allowance for cabling reduces the use of embedded infrastructures for power, data and HVAC systems.
2. Pre-wired horizontal distribution systems in ceilings or floors, with spare capacity and easy access.
3. Ample space over and above the normal slab-to-slab height to permit quick access to raised floor system/service floors or lowered ceilings.
4. Electrical skirting ducts.

2.7.2.1 Raised floor system

A raised floor consists of a gridded metal framework or understructure of adjustable-height legs (called "pedestals") that provide support for individual floor panels, which are usually 60×60cm in size as shown in figure 2.6 below. The height of the legs/pedestals is dictated by the volume of cables and other services provided beneath. The panels are normally made of steel-clad particleboard or a steel panel with a cementitious internal core.

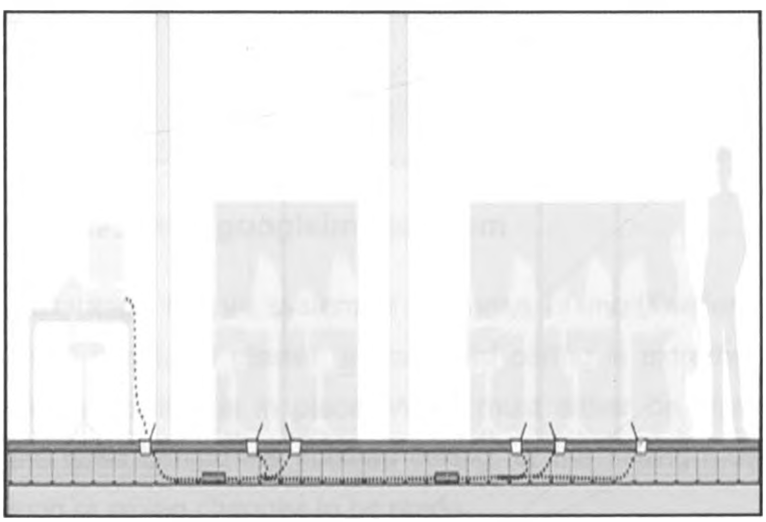
Figure 2.6: Raised floor system.



Source: www.googleimages.com

An access floor with power wiring and cabling provides complete flexibility. As the business changes, so can the service distribution system - quickly, easily, and cost-effectively. This improves occupiers' satisfaction. Figure 2.7 below shows a raised floor serving a computer room and a service ceiling.

Figure 2.7: Raised floor system and service ceiling

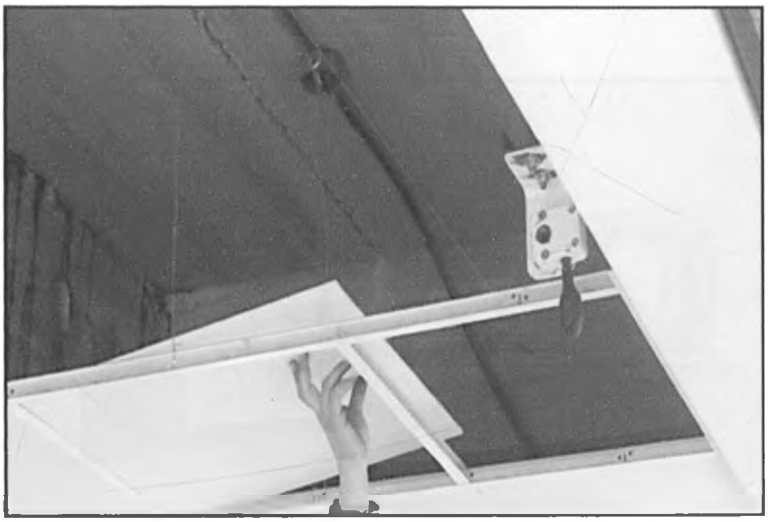


Source: www.googleimages.com

2.7.2.2 Dropped/lowered/suspended ceiling

In construction and architecture, a dropped ceiling, also referred to as a drop or suspended ceiling, is used as a secondary ceiling formed to conceal piping, wiring, or ductwork, into an area called the plenum. It consists of a grid-work of metal channels in the shape of an upside-down "T", suspended on wires from the overhead structure. These channels snag together in a regular spaced pattern and each cell is filled with lightweight "acoustic ceiling tiles" or" panels" which simply drop into the grid as shown in figure 2.8. Tiles, can be selected with a variety of materials, including wood, metal, or mineral fibres.

Figure 2.8: Installation of a drop ceiling (Notice the enclosed cable conduit)



Source: www.googleimages.com

The main advantage of this system is the ease of modification. Wiring and piping installed behind traditional plaster or wallboard ceiling is extremely difficult to modify once the finished ceiling is in place. Wires must either be finished through hollow spaces in the walls behind the finished ceiling, or the ceiling must be demolished in order for wiring or piping changes to be made.

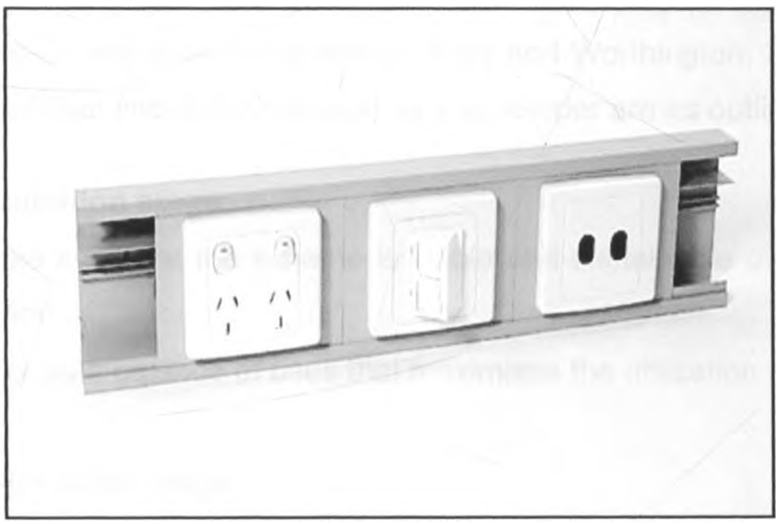
In contrast, the tiles and other parts of a drop ceiling are easily removed to allow access to the area above the grid to do any necessary wiring or plumbing modifications. This enhances adaptation.

In business, the drop ceiling can be used in conjunction with hollow steel studs to construct small workspaces out of a much larger cavernous space. Wiring and other services are run through the open ceiling, down through the stud walls, and to the outlets in the work areas. If business needs change, the workspaces are easily dismantled and the overall cavernous space reconfigured with a different floor plan.

2.7.2.3 Electrical skirting ducts

These skirting ducts have capacity to satisfy the requirements of most installations with ample capacity to meet future needs.

Figure 2.9: Electrical skirting duct



Source: www.googleimages.com

2.8 Execution of adaptation

This section looks at how a building can be successfully adapted in response to a change in the functional requirements.

The execution of adaptation involves putting into consideration three important requirements. In the handbook on good practice in urban regeneration, (URBED, 1987) the following is recommended;

- Adopt the appropriate development approach for the scheme. This helps in the production and maintaining momentum over a long period.
- Make sure that there is a committed driving force. This ensures that the scheme is taken to a sustainable end-use.
- The building should be suitable for adaptation in the light of structural, legal or economic considerations

In the book on industrial rehabilitation (Eley and Worthington, 2000) the stages of execution that should be followed by a developer are as outlined below;

a. Incubation stage

- Make sure that the scheme is viable and sustainable over the projected period.
- Choose a balance of uses that maximizes the utilization of space.

b. Negotiation stage

- Obtain the property and seek for finance.
- Choose a sound professional team and make sure that a reliable contractor is chosen.
- Obtain quotations and make detailed designs in order to be able to truly reflect the actual picture of the project.

c. Construction stage

- Ensure that the building works are closely overseen and keep control of time, money and the workmanship employed.
- Carry out the work in phases where necessary.

d. Management stage

- Continue to foster the success of the users.
- Manage the building tirelessly and plan future actions where need be.
- Review the method used if the adopted scheme does not solve any of the problems experienced.

2.9 The benefits of an adaptable building design:

The benefits generally arising from an adaptable design are as follows.

- An adaptable design minimizes significant environmental impacts associated with the one - time investment in building structure and infrastructure. The workload that would otherwise be used in construction, demolition, haulage and disposal of earth, materials and waste is conserved and in terms of energy that means a huge environment benefit.

- There is improved operating performance as an adaptable design provides easier change over as new technology becomes available. Therefore the buildings benefit from technological innovations sooner and at a lower cost.

- Physical benefits to the structure because the building is not abused and thus the structural strength is guaranteed. An adaptable building is able to accommodate new functional requirements without major structural interference.

- There is an opportunity of advanced planning of preventive maintenance due to the high level internalization of the building and its elemental components. An adaptable design allows parts to be removed without affecting the performance of other connected parts. Secondly, the design does not interconnect long-life parts with short-life ones. These two attributes makes it possible for parts to be upgraded independently.

- There is the case of accommodating the future, based on how the building is handling the emerging needs. An adaptable building is flexible in all its systems i.e. space deployment; electrical infrastructure; cable management and heating, ventilation and air-conditioning. Therefore an adaptable building is able to adjust to the future requirements presented to it by tenants for example increased need for space, power, cable management and environmental control.

- Rental incomes are likely to be high and efficiently managed due to the reliability of the tenants. A house that responds to the changing needs will not suffer vacancy levels as it ensures occupier satisfaction.

- There would be a generally improved productivity of the tenants due to the mental or psychological satisfaction. When tenants' are satisfied their concentration is uplifted and this yields positively on their work activities.

- There is a quality control over services and system installations. This helps in curbing consequential costs like those associated with water and energy wastage.

- The building itself acts as a check when anything goes wrong because feedback is given by the infrastructure itself or the system performance.

- Cost saving and adherence to the budget by the land lord is an added aspect. The landlord does not have to carry irregular repairs or alterations, which are associated with inadaptable buildings.

- There is a general advantage to the design team, which in future can offer a comprehensive building package with known performance parameters.

2.10 Building users and adaptable design

This section discusses how users can contribute in achieving an adaptable building design. It also highlights the benefits associated with user participation.

One of the most widely accepted principles of system analysis and design is that user participation in the system development process increases satisfaction with the results. This principle is drawn from Participative Decision Making (PDM) theory.

2.10.1 Why should users participate in design?

PDM theory argues that when users participate in design, they:

- Provide knowledge of current practices and other expectations;
- Develop realistic expectations;
- Increase their ability to work with the facility after installation.

The main benefit is that it ensures that the basic work environment quality is met in the design of work places. The other reason in the development of the notion of participation is to improve the performance of users.

Although PDM theory advocates that all those affected, directly or indirectly, by the proposed design be included, this is often a large group with diverse interests.

2.10.2 How can users be involved in design?

The involvement of users in design can be through the carrying out of consultations on regular intervals. A questionnaire floated to the occupants of the current facilities would serve as a good basis for enhanced user participation.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the procedures that were followed in conducting the research. It discusses the study area, the population, sampling techniques and data collection methods used by the researcher.

3.2 Research design

Kothari (2004:31) defines research design as the arrangement of conditions for collection and analysis of data; in a manner that aims to combine relevance to the research purpose with the economy in procedure. It is the conceptual structure in which the research is conducted; it constitutes the blueprint for collection, measurement and analysis of data.

Research can be classified by the approach used to collect primary data. The two broad categories are: observation and communication approaches.

Observation includes the full range of monitoring behavioral and non-behavioral activities and conditions such as listening, reading, visual data collection, smelling and touching. In other words information is sought by way of the investigator's own direct observation without asking from the respondent.

The communication approach, on the other hand, involves surveying people and recording their responses for analysis. It is the most effective method of learning about opinions, attitudes, motivations, intentions and expectations. These attributes can be effectively harnessed using the questionnaire, being the most effective instrument for collecting survey data. The communication approach is the most effective method for collecting the survey data (Cooper and Schindler, 2003:319 and 322).

The study adopted a survey design. This refers to an attempt to collect data from the members of the population in order to determine the current status of that population with respect to one or more variables. A survey gives an original data or purposes of describing and generalizing on the targeted population (Mugenda and Mugenda, 1999).

The survey in this study was used to collect data on old office buildings in order to determine their current status in respect to the changing user needs.

3.3 Background of the area of study

Nairobi is the capital city of Kenya. It has the highest urban population in East Africa, with a population of over 3.5 million. The city centre has an area of over 700 square kilometers and stands at an altitude of 1,675 meters above the sea level. It is 140 kilometers south of equator and approximately 480 kilometers west of the Indian Ocean (Wikipedia, 2006).

Nairobi was founded in 1899 as a supply deport for Uganda railway which was being constructed between Mombasa and Uganda. It was named after a water hole known in Maasai as *Ewaso Nyirobi*, "cool waters". It was totally rebuilt in 1990s after an outbreak of plague and the burning of the original town. Nairobi placed Mombasa as the capital of the British East Africa Protectorate in 1905. The railway brought wealth into the city, which made it grow dramatically. In 1919, Nairobi was declared a municipality, and in 1954, was granted city status (Wikipedia, 2008).

After Kenya got its independence in1963, Nairobi grew rapidly. High-rise buildings slowly replaced the low-rise buildings to maximize on space in the city center and create buildings with a higher floor area out of relatively small ground area.

3.3.1 Nairobi Central Business District

Nairobi grew around the Central Business District (CBD). The CBD is the area bounded by Uhuru Highway to the west, Haile Selassie to the south, Tom

Mboya Street to the east and University Way to the north taking a rectangular shape (Kingoriah, 1987). It is the center of many important activities including: commerce, administration, education, religion, culture as well as recreation. Some of the old buildings found in this area include: Gill house, Imenti house, Popman house just to mention.

3.4 Investigation method

The two major methods of investigation are (Abwunza, 2006):

i. Quantitative
ii. Qualitative

The qualitative method is concerned with obtaining an in-depth understanding of a subject. It includes designs, techniques, and measures that do not produce continuous numerical data; the data is mostly in the form of words often grouped into categories. Such data is captured from a small number of respondents using open-ended questions.

The quantitative method is used to measure things discreetly and numerically and is based on a representative sample of the population, within estimated levels of accuracy. This method places emphasis on methodology, procedure and statistical measures of validity.

The study adopted both the methods of investigation. While perception is a subjective concept, there is evidence from past studies of its application and measurement (Ibid).

3.5 The population

3.5.1 Old office Blocks:

The term 'Old' was used to differentiate the commercial buildings in terms of age. All buildings constructed not less than 40 years ago were considered old.

Old office blocks not more than five storeys high within the CBD were selected. It was found that there are 44 old office blocks which were more than 1 storey but less than 5 storeys high. This formed the target population. The target population included 5 buildings which were non-operational (Field survey, 2008) and thus the researcher had to establish the accessible population.

Accessible population was arrived at as illustrated in table 3.1 below.

Table 3.1: Accessible population of the old office buildings

Population class	**Total number**
Target population	44
Non-operational buildings	(5)
Accessible population	**39**

Source: Field survey, 2008

3.5.2 Property Managers/Building Managers:

One of the responsibilities of property managers is to provide for their tenants' needs. Property managers were therefore in a position to have the full knowledge of the challenges that might be faced in meeting these needs and hence the justification of their choice as one of the respondents.

The targeted properties managers were those of the buildings surveyed and therefore the target population for this category of respondents was taken to be the same as that of the number of buildings surveyed i.e.

Target population = **39**

Some of the old buildings were managed by their owners. The owners were therefore considered as the managers in those cases.

3.5.3 Building users:

Building users were taken to be the occupiers of the old buildings. They were interviewed to gather information pertaining to building performance and any difficulties faced in trying to meet their needs. The researcher also filled questionnaires during the interviews.

3.5.4 Architects

Architects are the chief designers of buildings. Their views on flexibility of traditional designs were therefore very important in assessing adaptability of old buildings to the current needs of the building users.

The Board of Registration of Architects and Quantity Surveyors (BORAQS) require all practicing architectural and quantity-surveying firms to register not only with the Registrar of Companies but also with the Board. The Board, therefore, was the best source for the most comprehensive list of consulting firms in the country. A list of consulting firms obtained from the Board in April 2008 indicated that there were 228 registered architectural firms in the country. This formed the target population which was then reduced by a total of 67 inaccessible firms to an accessible population of 161. This is illustrated in table 3.2 below.

Table 3.2: Accessible population of architects

Target population	**228**
Inaccessible population (Firms whose addresses were not provided and those that operate from outside Nairobi)	(67)
Accessible population	**161**

Source: Field survey, 2008

Table 3.3: A list of some of the old office blocks in the central business district of Nairobi:

Building	Number of stories	Street/Road/Avenue
Nanak House	5	Kimathi Street
Kenwood House	5	Kimathi Street
Market Mansion	5	Tubman Road
Gill House	5	Moi Avenue
Ruprani House	5	Moktar Dadah
Raja Building	4	Biashara Street
Shah Mansion	4	Moktar Dadah
Popman House	4	River Road
Mukhi House	4	Moktar Dadah
Valji Building	4	Moktar Dadah
Krishna Mansion	4	Moktar Dadah
K & S Building	4	Moktar Dadah
Mutige Kiboti	4	Moktar Dadah
Narshi House	4	Moktar Dadah
Cresent House	4	Moktar Dadah
Rentford House	4	Muindi Mbingu
Kenya house	3	Koinange Street
Rahimtula trust	3	Moi Avenue
Parisan House	3	Moktar Dadah
Cambrian House	3	Jamba lane, Moi Av.
Imenti House	2	Cabral Street
Diamond Building	2	Tubman Road

Source: Field survey, 2008

3.6 The sample:

When determining the sample size, a confidence level of 95% of the target population was assumed and that the response achieved from the sample would be within –ve 5 or +ve 5 of the true state of the population targeted.

Chava F. and Nachmias D. (1996) have recommended the following expression as appropriate for calculating the sample size for this kind of study.

$$n = \frac{Z^2pqN}{e^2(N-1) + Z^2pq}$$

(Chava and Nachmias, 1996)

Where

N = Population size

n = Sample size

p = Sample population estimated to have characteristics being measured. Assume a 95%confidence level of the target population

q = 1-p

e = Acceptable error (e = 0.05, since the estimated should be 5% of the true value).

Z = The standard normal deviate at the required confidence level = 1.96

3.6.1 Sample size and sampling technique for old office blocks:

Over the course of a building's lifetime, change is inevitable, both in the social, economic and physical surroundings, and in the needs and expectations of occupants. Therefore a survey of old buildings with the objective of assessing their adaptability to the changing user needs was justified.

The accessible population for the old commercial buildings was used as the sample size for the same i.e.

Sample size = **39**

3.6.2 Sample size and sampling technique for property managers:

The sample size for property managers was taken to be equal to the sample size of the buildings surveyed which was calculated as 39.

3.6.3 Sample size and sampling technique for building users:

Consequent upon statistical computation of the sample size for the old commercial buildings to be verified as 39, the buildings were identified and one tenant from each building was targeted for interview based on a judgmental/purpose sampling. Herein the researcher considered the tenant who could provide the most viable information to achieve the objectives of the study (Kumar, 2005).

Building users questionnaires were therefore administered in the hereunder manner:-

- The tenant who had ever raised complaint to the property manager with respect to flexibility issues.
- The tenant who had recently rented any of the spaces.
- If a tenant was picked in a given line of business in one building, another tenant dealing with a different line of business would be picked in another building.

3.6.4 Sample size and sampling technique for architects:

Given accessible population of 161, the sample size for architects, n was calculated as follows:

$$n = \frac{1.96^2 \times 0.95 \times (1-0.95) \times 161}{0.05^2 \times (161-1) + 1.96^2 \times 0.95 \times (1-0.95)}$$

= 50 Architectural firms.

The architectural firms to be sampled were selected randomly. Due to time constraint, only 41 questionnaires were administered.

3.7 Data collection instruments and procedure:

Primary data was collected by use of the following instruments:

3.7.1 Observation

Observation was used to examine:

i. The design attributes of the buildings influencing adaptability e.g. building layout. This was aided by use of a checklist.

ii. The manner in which the building owners had tried to meet the new needs of tenants and how this has affected the building form.

3.7.2 Photography

According to Kothari (2004), photography is an indirect way of data collection. It was majorly used to capture the effects of the changing needs on the building form and some design attributes of the old buildings that affect flexibility.

3.7.3 Questionnaires

This was the main method of data collection that was used. The questionnaires were self-administered and the respondents were;

i. The users of the building
ii. The property managers/building owners
iii. Architects

3.7.3.1 Format of Questionnaires

Both open-ended and closed-ended questions were asked in the questionnaires. Closed ended or structured questions were only beneficial on those aspects that the researcher considered to be common and thus the respondents were only to tick where appropriate. This gave the respondents easier time thus making the exercise friendlier.

Open-ended questions were meant to collect data that appeared unique for each study case. This was meant so as not to limit the respondents in terms of their thinking and thus enriching the data collected.

3.7.3.2 Administration of the questionnaires

Both self and researcher-administered questionnaires were employed in this study. Self-administered questionnaires were used where the respondents were asked to fill the questionnaires which were later collected. However this method failed in some firms which were very busy. In such cases the researcher-administered questionnaires were utilized mainly to increase the response rate.

3.8 Data analysis and presentation

The data collected by the questionnaires and observational forms were converted into numerical codes representing measurement of variables using the Statistical Package for Social Sciences (SPSS) for Windows version Vista.

Descriptive statistics – frequency tables and charts - are used in chapter four to present a summary of the data by describing the type of data collected and its frequency of occurrence. Plates are also used to clearly show some of the information captured through photography.

Descriptive statistics was used because it enables meaningful description of scores or measurements using few statistics. Inferential statistic – deduction - is then used to test the significance of the results on adaptability of the old office buildings.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter is concerned with the analysis of data collected as well as presenting the analyzed information so that meaningful deductions can be made. The hypothesis of this study has also been tested in this chapter. The data has been analyzed using descriptive statistic tools and the information presented by use of frequency distribution tables, bar charts and pies charts. Plates have also been used.

The field study set out to study the adaptability of old office blocks to changing user needs with reference to the old commercial buildings in Nairobi's Central Business District. Its prime aim was to establish the adequacy of design measures as well as facilities in the old buildings to cater for the changing needs of occupants.

The study had a negative hypothesis giving that old office buildings are less adaptable to the changing user needs. Their systems of space deployment, electrical infrastructure and cable management contain little or no flexibility. As a result, they are likely to accommodate adaptation only with difficulty and at unacceptable cost.

Data collected for the purposes of this study was analyzed with the aim of addressing the objectives of the study and to test the hypothesis of the study. To obtain this data, the researcher administered questionnaires to architects, property managers and building occupiers. A field survey was also undertaken.

4.2 Response to questionnaires

Table 4.1 shows the response rate to the questionnaires administered:

Table 4.1: Response rate s

Respondent	Questionnaires administered	Questionnaires returned	Response rate (%)
Architects	41	31	62
Property managers	39	27	69
Building occupiers	39	30	77
Total	**119**	**88**	**74**

Source: Field survey, 2008.

In this study 88 out of 119 questionnaires that were administered were returned answered giving a success rate of 74%. Gay L. R. in his book "Educational Research Competencies for Analysis and Application" states that a response rate of 70% or more gives a strong basis for data analysis and drawing conclusions and generalizations. It is therefore considered that the data collected from the respondents in this study is to give the actual and reliable picture on the level of adaptability of old office blocks to the changing user needs.

4.3 Responses from the Building Users

4.3.1 Duration of stay in the building

This was a general question and was meant to find out the general experience of the respondents with respect to the subject of the study. The tenants gave a variety of responses which were categorized and presented as shown in table 4.2 below.

Table 4.2: Duration of stay in the buildings

Response	Frequency	Percentage
1-3	7	22
4-9	22	74
10 and above	1	4
Total	**30**	**100**

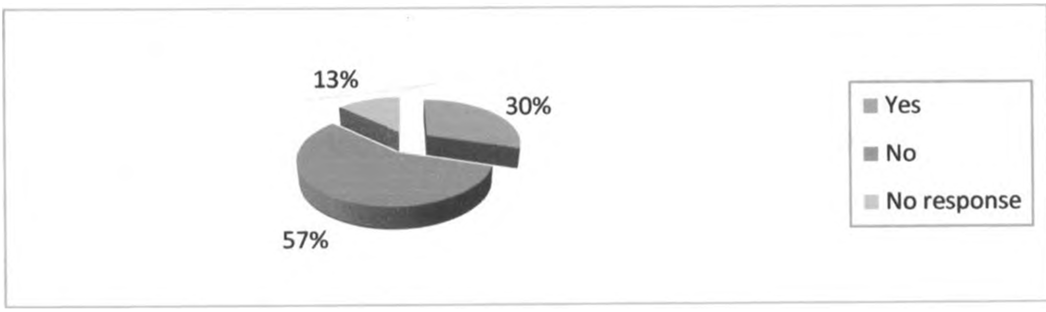
Source: Field survey, 2008.s

It emerged that most (74%) the tenants had been exposed to the study conditions for over 4 years a period the researcher believed was able to give rich information for the study.

4.3.2 Adequacy of rental spaces

In establishing whether the buildings were satisfying the tenants' space needs, it emerged that some of them were satisfied while others were not. This is shown in chart 4.1 below.

Chart 4.1: Response on whether the spaces occupied were adequate



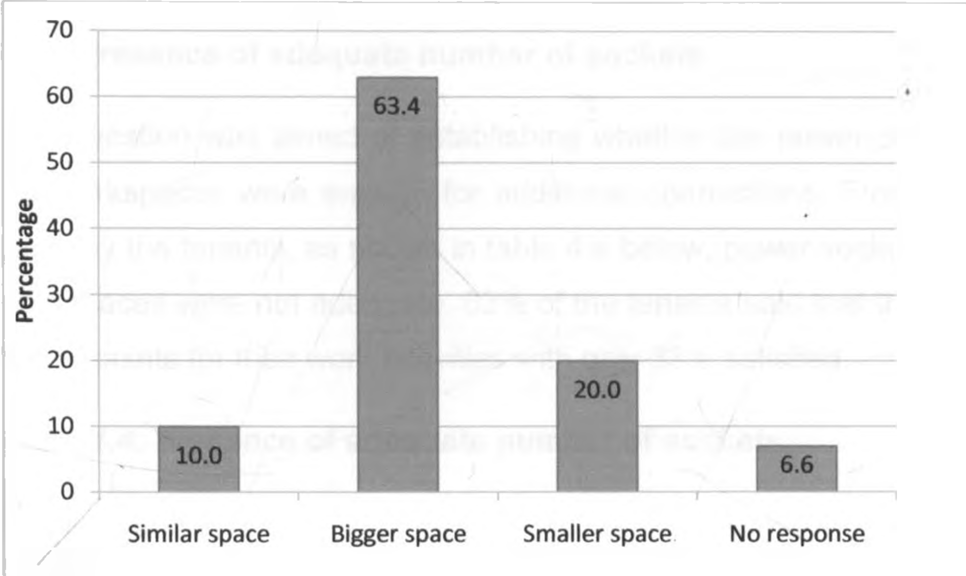
Source: Field survey, 2008.

From the chart, it is shown that, most (57%) of the tenants interviewed said that the spaces were smaller than what they needed while 30% said the spaces were adequate. From the responses, it can be seen that different tenants have different space needs in terms of space size.

4.3.3 Nature of spaces opted for incase of relocation.

63% of the tenants said that if they were to relocate, they would go for bigger spaces while 20%, smaller spaces and only 10% opted for similar spaces. This is presented in chart 4.2 below.

Chart 4.2: Nature of spaces opted for by tenants if they were to relocate



Source: Field survey, 2008.

From the responses presented in chart 4.2, it can be deduced that the tenants' space needs were not fully met. This is because 83.4% of the tenants interviewed either needed bigger or smaller spaces than what was provided by the buildings they were currently occupying. Only 10% were satisfied.

4.3.4 Need for power supply

It was found that most of the activities in these buildings required power supply. This was represented by 90% 'Yes' response on the need for power. Among the commercial activities that required power supply for their operations include boutiques, cyber cafes, electronic shops, music shops, e.t.c. Table 4.3 shows responses as were given for power needs.

Table 4.3: Responses for the need of power supply

Response	Frequency	Percentage
Yes	27	90
No	3	10
Total	**30**	**100**

Source: Field survey, 2008.

4.3.5 Presence of adequate number of sockets

This question was aimed at establishing whether the power points provided in the workspaces were enough for additional connections. From the responses given by the tenants, as shown in table 4.4 below, power sockets in most of the workspaces were not adequate. 63% of the tenants said that they needed more power points for their work activities with only 33% satisfied.

Table 4.4: Presence of adequate number of sockets

Response	Frequency	Percentage
Yes	10	33
No	19	63
No response	1	4
Total	**30**	**100**

Source: Field survey, 2008.

4.3.6 Presence of redundant power points

In establishing whether the building anticipated increased need for power connections, the inadequacy of power points was confirmed as most of tenants (83%) said that there were no redundant power points in their workspaces.

The responses are presented in table 4.5 below.

Table 4.5: Presence of extra power points

Response	Frequency	Percentage
Yes	3	10
No	25	83
No response	2	7
Total	**30**	**100**

Source: Field survey, 2008.

4.3.7 Need for cable distribution

The need for cable management systems was not confirmed by many tenants. 33% of the tenants interviewed said that they needed the system while 57% did not. Among those who needed cable distribution system were cyber café businessmen and private office tenants. The responses that were given are tabulated in table 4.6 below.

Table 4.6: Need for cable distribution system

Response	Frequency	Percentage
Yes	10	33
No	17	57
No response	3	10
Total	**30**	**100**

Source: Field survey, 2008.

4.3.8 Presence of adequate cable allowance in workspacess

In trying to ascertain whether the workspaces had adequate allowances for additional cable runs, most of the tenants (66%) did not find the question applicable. This is because they did not require the system. However most (27%) of those who needed the cable management system said that the allowances that were present in their workspaces could not accommodate additional cable runs. The responses were as shown in table 4.7 below.

Table 4.7: Presence of adequate allowances for cabling in workspaces

Response	Frequency	Percentage
Yes	0	0
No	8	27
No response	2	7
Not applicable	20	66
Total	**30**	**100**

Source: Field survey, 2008.

From the responses given by the tenants who needed cabling systems, one can deduce that these buildings lack adequate cable management systems.

4.3.9 Presence of adequate lighting in workspaces

The lighting in most of these buildings was satisfactory. Of all the tenants who were interviewed, 54% said that the lighting was adequate while 43% said it was not. Inadequate lighting was mainly reported in spaces that were smaller rooms created by subdividing larger spaces. This was so because the larger spaces only had single overhead lighting points. Table 4.8 below summarizes the responses as were given on lighting.

Table 4.8: Presence of adequate lighting

Response	Frequency	Percentage
Yes	16	54
No	13	43
No response	1	3
Total	**30**	**100**

Source: Field survey, 2008.

4.3.10 Presence of extra lighting points

In ascertaining whether the workspaces could accommodate additional lighting requirements, most of the tenants interviewed (76%) said that apart from the lighting points that were in use, there were no extra points. However, 17% confirmed the presence of extra points. These responses were as summarized in table 4.9 below.

Table 4.9: Presence of extra lighting points

Response	Frequency	Percentage
Yes	5	17
No	23	76
No response	2	7
Total	**30**	**100**

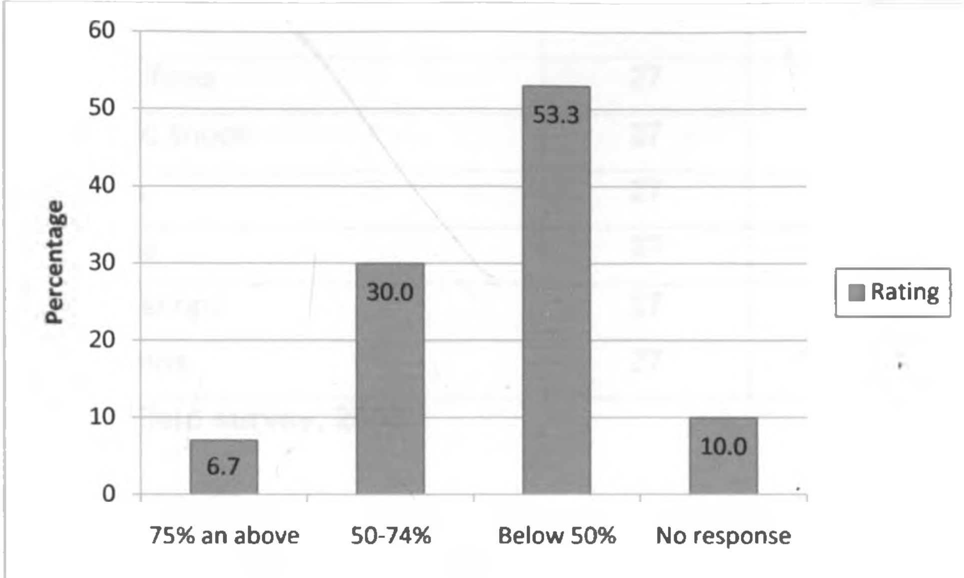
Source: Field survey, 2008.

From the responses on lighting, it can be seen that most of the tenants were satisfied. However, most of the buildings did not have redundant lighting points as stated by 76% of the tenants and this is one of the factors that compromise the flexibility of a lighting system.

4.3.11 Rating building performance

In general rating, 53% of all the tenants interviewed said that the buildings were below 50% in terms of meeting their building needs while 30% of the ratings were between 50% and 74%. Only 7% of the tenants gave ratings above 75%.

Chart 4.3: Rating of building performance by users



Source: Field survey, 2008.

4.4 Responses from the Property Managers

10% of these respondents were building owners while 90% were property managers. Both were considered as managers of their respective buildings.

4.4.1 Current uses of the building

By trying to establish the functions for which the buildings were put the researcher aimed at determining whether the buildings were facing new functional requirements or not.

Most of the property managers said that the buildings were housing a variety of uses. Apart from private offices, there were electronic shops, music shops, cafeterias, boutiques, fashion shops and cyber cafes just to mention.

Table 4.10: The building uses

Current Uses	Total	Frequency	Percentage
Private offices	**27**	18	67
Electronic shops	**27**	20	74
Cafeteria	**27**	5	19
Boutiques	**27**	19	70
Fashion shops	**27**	15	56
Cyber cafes	**27**	20	74

Source: Field survey, 2008.

4.4.2 User needs

It emerged that the new uses presented other functional requirements to the buildings. Some of the needs that the property managers/building owners identified were as shown in table 4.11 below.

Table 4.11: User needs

User needs	Total	Frequency	Percentage
Need to upgrade power supply	**27**	11	41
Need for cable management system	**27**	17	63
Need to upgrade lighting system	**27**	8	30
Need for more workspaces	**27**	15	56
Need to upgrade sanitary facilities	**27**	16	59

Source: Field survey, 2008.

Most of the property managers and building owners (63%) said there was an increased need for cable management systems. 56% on the other hand said that the demand for workspaces had also increased while 41% noted an increased need for power. 59% had the need to upgrade sanitary facilities and 30%, the need to upgrade the lighting system.

4.4.3 Space requirements by tenants

Given the mixed use of these buildings the space needs were also varied. From the responses, it emerged that the needs for rental spaces were varied as different tenants had different requirements in terms of space sizes. This was confirmed by 93% of the property managers. The responses were as shown in table 4.12 below.

Table 4.12: Responses on whether all tenants had the same space needs

Response	Frequency	Percentage
Yes	0	0
No	25	93
No response	2	7
Total	**27**	**100**

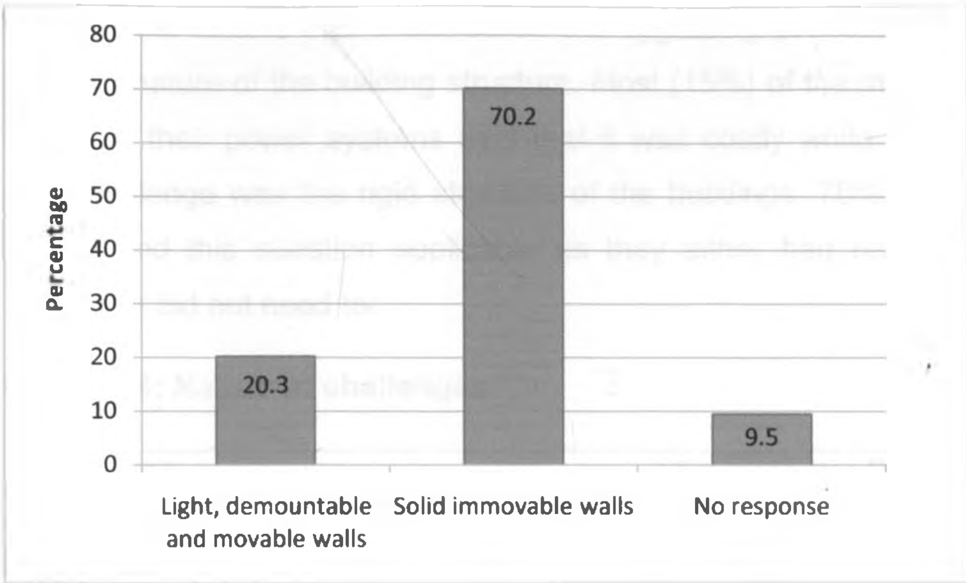
Source: Field survey, 2008.

4.4.4 Nature of internal partitioning

By posing this question, the researcher aimed at finding out whether the partition walls were permanent or demountable as this affects the flexibility of space deployment. Most of the buildings had solid immovable walls as opposed to those that are light and demountable. This was confirmed by 70% of the property managers. The responses were as summarized in chart 4.4 below.

Solid walls are walls made of heavy materials e.g. natural stones, concrete blocks or bricks and assume a permanent position. Light and demountable walls on the other hand, are made of light materials e.g. timber products or metal frames and glass and can be moved.

Chart 4.4: Nature of partitioning walls in old office blocks



Source: Field survey, 2008.

4.4.5 Power supply and distribution upgraded

Most of the buildings had not been upgraded in terms of power supply and distribution despite the increased need.

Of the 41% managers (Table 4.11 above) who said there was a need to upgrade the power supply and distribution, only 26% of them had actually undertaken the process. This is shown in table 4.13 below.

Table 4.13: Power supply and distribution system upgraded

Response	Frequency	Percentage
Yes	6	26
No	12	41
No response	6	22
Not applicable	3	11
Total	**27**	**100**

Source: Field survey, 2008.

4.4.6 Challenges faced during the upgrading process

Some of the factors that encumbered the upgrading process were high costs and rigid nature of the building structure. Most (15%) of the managers who had upgraded their power systems said that it was costly while 7% said that the main challenge was the rigid structure of the buildings. 78% of the managers did not find this question applicable as they either had not undertaken the process or did not need to.

Table 4.14: Nature of challenges

Response	Frequency	Percentage
Rigid structure	2	7
High cost	4	15
Not applicable	21	78
Total	**27**	**100**

Source: Field survey, 2008.

4.4.7 Presence of adequate cable management system

The buildings generally had inadequate cable management systems. 70% of the property managers issued with questionnaires said that the buildings had poor cabling systems. 15% however, said that their buildings had no problems with cable management. These responses were as shown in table 4.15 below.

Table 4.15: Presence on adequate cable management system

Response	Frequency	Percentage
Yes	4	15
No	19	70
No response	4	15
Total	**27**	**100**

Source: Field survey, 2008.

4.4.8 Presence of adequate cable allowances

By establishing the adequacy of cable allowances in the buildings, the researcher was able to deduce that poor cable management was due to inadequate cable allowances. In response, 63% of the managers said the allowances were inadequate while 21% said they were not. 16% did not respond.

Table 4.16: Presence of adequate cable allowances

Response	Frequency	Percentage
Yes	6	21
No	17	63
No response	4	16
Total	**27**	**100**

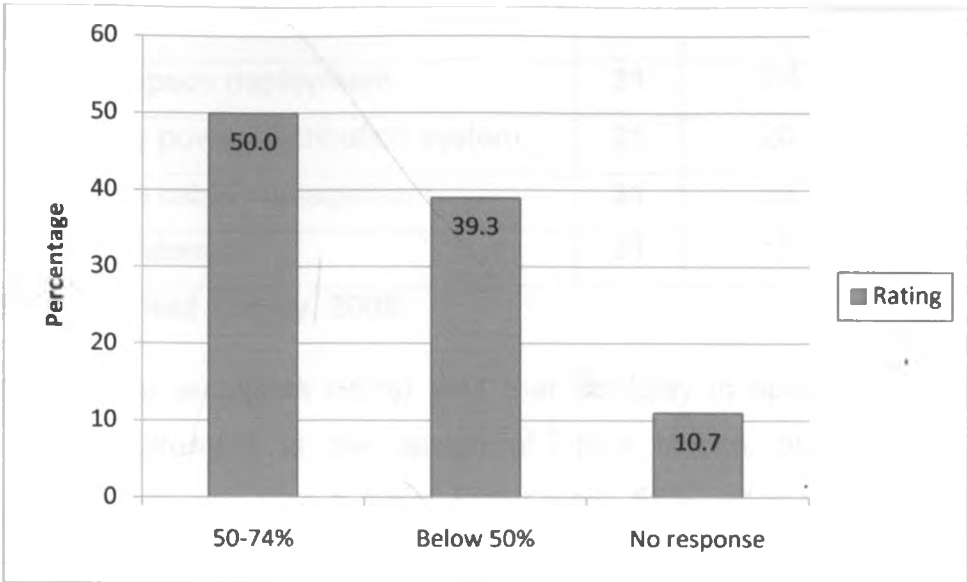
Source: Field survey, 2008.

4.4.9 General rating of building performance

In general rating, the ease with which old office blocks are able to accommodate changes in terms of space deployment, power supply and distribution and cable management was rated poorly. 50% of the property managers gave above-50%-ratings but not exceeding 74% while 39% gave ratings below 50%.

The ratings were as presented in chart 4.5 below.

Chart 4.5: The ability to accommodate changes



Source: Field survey, 2008.

4.5 Responses from the Architects

4.5.1 Needs currently faced in the design of office blocks

Of the architectural firms that were issued with questionnaires, 60% on average said that flexible space deployment, adequate power distribution, adequate cable management, heating, ventilation and air-conditioning (HVAC) systems were the major requirements in modern building designs.

The requirements are as shown in table 4.17 below.

Table 4.17: Needs faced by architects in the design of office blocks

Need	Total	Frequency	Percentage
Flexible space deployment	**31**	28	90
Adequate power distribution system	**31**	20	65
Adequate cable management	**31**	26	89
HVAC system	**31**	18	58

Source: Field survey, 2008.

Most of the architects (90%) said that flexibility in space deployment was a major requirement in the design of office blocks. 89% added that cable management was also a major factor while 65%; adequate power supply and distribution.

Various architectural firms proposed various measures that if incorporated in the building design would accommodate such needs.

4.5.2 Design measures for achieving flexible spaces

More than 70% of the architects, on average, proposed that for an office block to provide flexible rental spaces, the design should incorporate open floor plan arrangement with light and demountable partitioning.

Table 4.18: Design measures for achieving flexible spaces

Measures	Total	Frequency	Percentage
Light and demountable partitioning	**31**	23	74
Open floor arrangement	**31**	25	80

Source: Field survey, 2008.

From the responses it shown that open floor plans without permanent partition walls enhances flexibility in space deployment.

4.5.3 Design measures for enhancing power supply and distribution

For adequate power supply and distribution, the architects proposed the incorporation, in design, the measures tabulated in table 4.19 below.

Table 4.19: Design measures for enhancing power distribution

Measures	Total	Frequency	Percentage
More power points integrated in the structural elements e.g. walls, columns and slabs	**31**	21	67
Service floors and ceilings	**31**	17	55
Centralization of service lines	**31**	16	52

Source: Field survey, 2008.

From the responses, it is shown that the main design measure for ensuring adequate power distribution is the integration of redundant power points in the structural elements e.g. walls, columns and slabs (67%). The other measures specified include the use of service floors and ceilings (52%) and the centralization of service lines.

4.5.4 Design measures for adequate cable management

For adequate cable management, the architects suggested the provision, in design, service ducts, service floors and ceilings and cable allowances in the structural elements e.g. wall, columns and slabs to ensure efficiency in distribution. These measures are as tabulated in table 4.20 below.

87% proposed the provision for service ducts in the building; 61% specified the provisions for cable allowance in the structural elements e.g. walls, columns and slabs while 54% specified the use of service floors and ceilings.

Table 4.20: Design measures for enhancing cable management

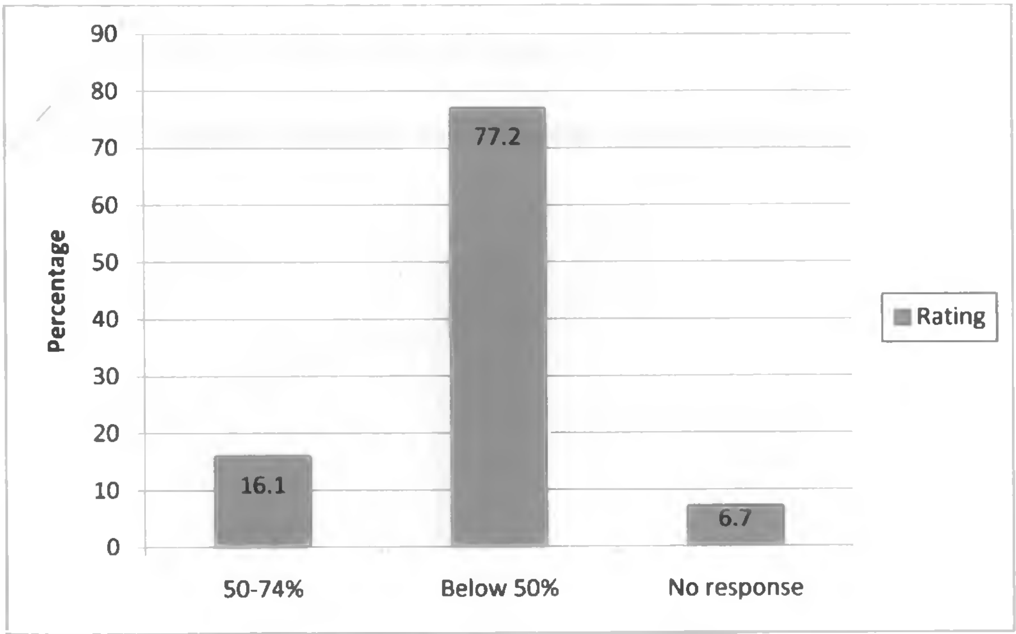
Measure	Total	Frequency	Percentage
Service ducts	**31**	27	87
Allowance for cabling in the structural elements	**31**	19	61
Service floors and ceilings	**31**	17	54

Source: Field survey, 2008.

4.5.5 Rating flexibility of space deployment in old office blocks

On general rating, most of the architectural firms (77%) rated the flexibility of space deployment in old office blocks as below 50% with only 16% of the firms giving a rating of above 50%. No single firm gave a rating of more than 75%.

Chart 4.6: Rating flexibility of space deployment in old office blocks



Source: Field survey, 2008.

The reasons they gave for rating the flexibility so poorly were as shown in table 4.21 below.

Table 4.21: Reasons for low flexibility in space deployment in old office blocks

Reason	Total	Frequency	Percent
Load bearing partitioning	**31**	19	61
Solid immovable partitioning	**31**	23	74

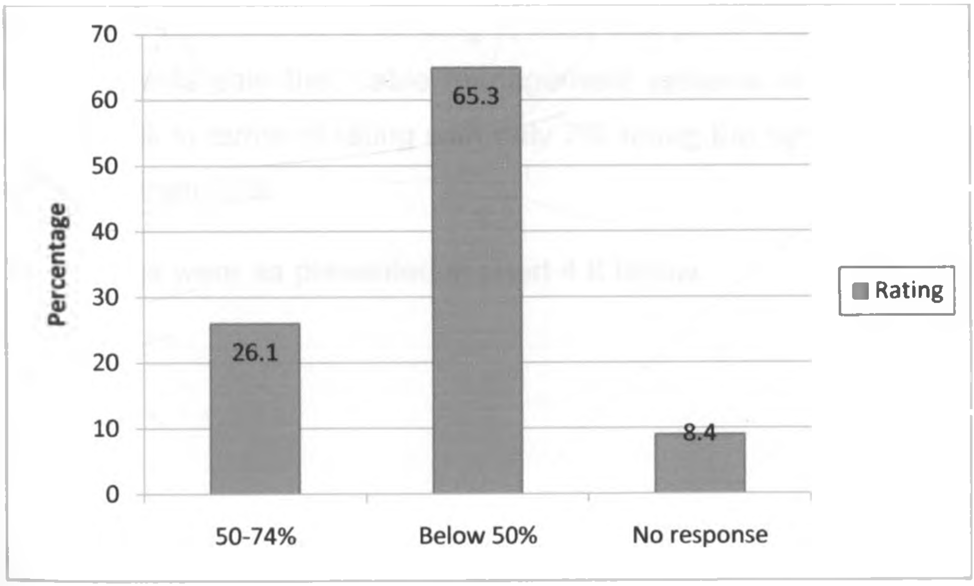
Source: Field survey, 2008.

The main reason was the use of solid immovable partition walls in the design (74%). Other architects termed it as the use of load bearing partition walls which refer to the same thing (61%).

4.5.6 Rating the flexibility of electrical infrastructure in the old blocks.

Electrical infrastructure in the old office blocks also got poor ratings. 65% of the architectural firms issued with questionnaires said that the infrastructure was below 50% while only 26% of them gave ratings above 50% but not more than 75%. The rest of the firms did not respond.

Chart 4.7: Rating flexibility in electrical infrastructure of old office blocks



Source: Field survey, 2008.

The reasons for the poor ratings on electrical infrastructure were (table 4.22 below):

Table 4.22: Reasons for poor flexibility in electrical infrastructure

Reason	Total	Frequency	Percent
Inadequate ducting and fewer power points	**31**	25	81
Solid structural elements without any spaces within them for cable runs	**31**	21	68
No response	**31**	11	35

Source: Field survey, 2008.

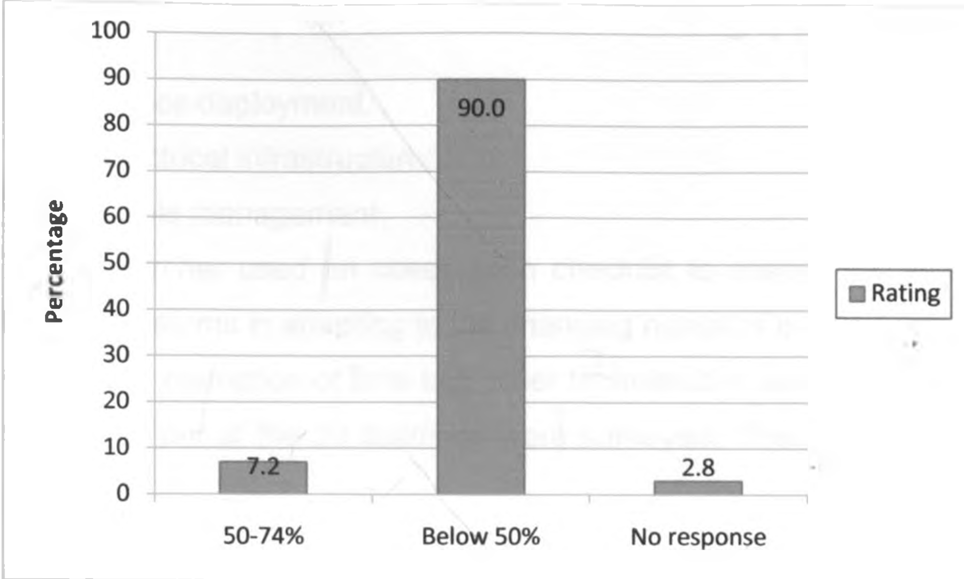
The main reason was inadequate ducts and fewer power points integrated within the structural elements (81%). The use of solid structural elements without any spaces within them to allow for cable runs was also given as one of the reasons (68%).

4.5.7 Rating cable management in old office blocks

Cable management as a building system was given the lowest ratings. 90% of the architects said that cable management systems in old office blocks were below 50% in terms of rating with only 7% rating the system as above 50% but not more than 75%.

The ratings were as presented in chart 4.8 below.

Chart 4.8: Rating cable management in old office blocks



Source: Field survey, 2008.

The reasons for poor ratings on cable management were (Table 4.23 below).

Table 4.23: Reasons for poor cable management in old office blocks

Reason	Total	Frequency	Percent
Cabling hidden within the structure hence difficult to upgrade	**31**	21	68
Inadequate allowances	**31**	24	77
Lack of service floors and ceilings	**31**	19	61

Source: Field survey, 2008.

The main reason for poor cable management was inadequate allowances for cabling (77%). The other reasons specified were that cabling in the old buildings was hidden within the structure hence difficult to upgrade (68%) and that the buildings lacked service floors and ceilings to provide room for additional cable runs (61%).

4.6 Survey of selected buildings

The physical survey was carried out on the following systems.

a) Space deployment.
b) Electrical infrastructure.
c) Cable management.

The researcher used an observation checklist to assess the adequacy of the building systems in adapting to the changing needs of building users.

Due to the restriction of time and other technicalities encountered in the field, a total of 28 out of the 39 buildings were surveyed. This gave a success rate of 72%.

4.6.1 Space Deployment

The aim of the researcher under this section was to look at the floor layout of the buildings. Two forms of layout were identified:

i. Open floor with demountable partitioning and
ii. Floor permanently subdivided with immovable walls.

The findings were tabulated in table 4.24 below

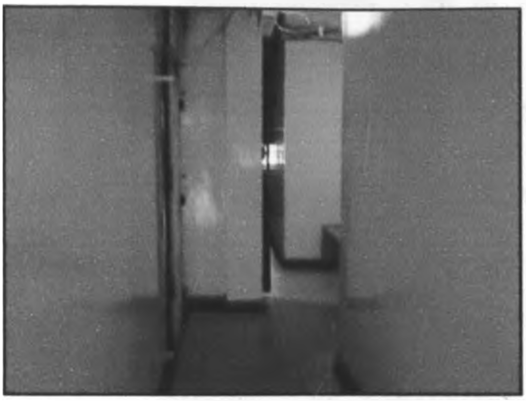
Table 4.24: Building floor layout

Layout	Number of buildings	Percentage
Open floor	8	29
Floor permanently subdivided	20	71
Total	**28**	**100**

Source: Field Survey, 2008.

Most of the buildings surveyed (71%) were permanently subdivided into small awkward rooms with immovable walls. Some of the uses that these rooms accommodated included private offices, electronic shops, music shops, boutiques, tailoring, printing and photocopying, just to mention. Permanent wall partitioning do not allow for adjusting room sizes as they are fixed and rigid in nature.

Plate 4.1: Permanent subdivisions



Source: Field Survey, 2008.

Source: Field Survey, 2008.

Only 29% of the buildings surveyed, had open floors with light demountable partitions. Imenti House located along Moi Avenue on Cabral Street is an example. This type of layout allows for rearrangement of floor spaces to achieve various space sizes as may be required.

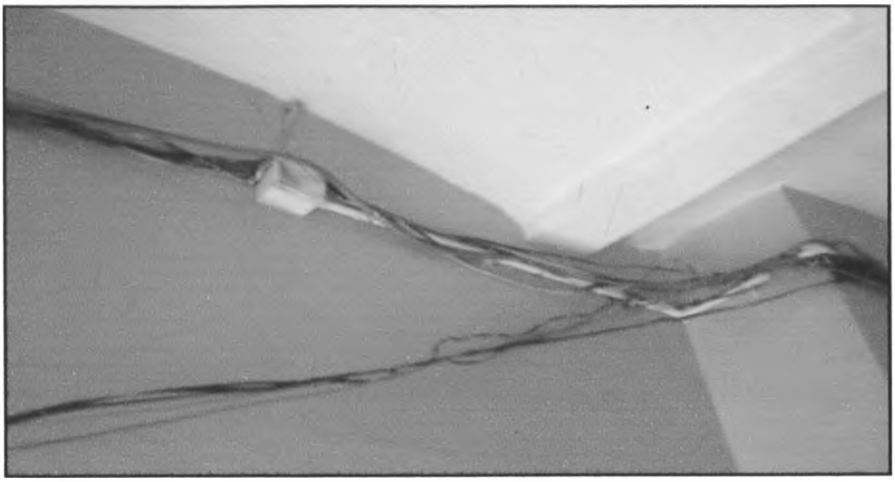
Plate 4.2: Light and movable partitioning made of timber products

Source: Field Survey, 2008.

4.6.2 Cable Management

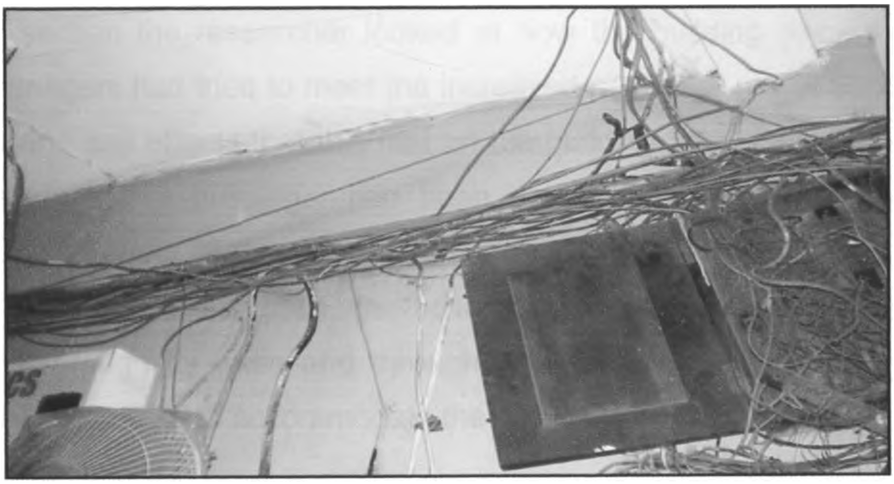
Under this section, the researcher was mainly concerned with assessing the allowances provided for cabling. The allowances considered included ducts, risers and wiring closets. Out of the 28 buildings surveyed, 19 (68%) had inadequate ducts and wiring closets. This resulted in cables being left loose on walls degrading the aesthetic value of the walls.

Plate 4.3: An existing duct not able to accommodate extra cables



Source: Field Survey, 2008.

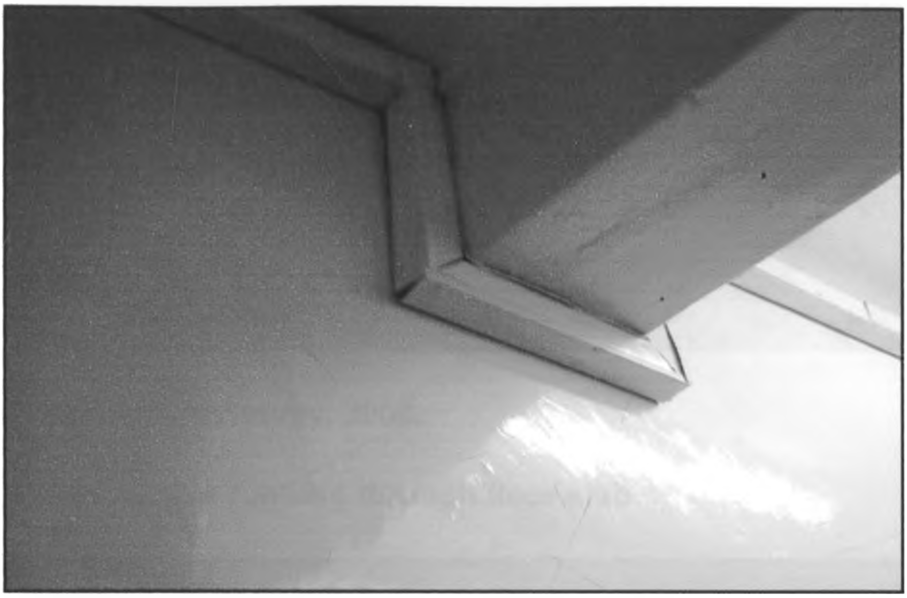
Plate 4.4: Cables hanging loose on walls



Source: Field Survey, 2008.

32% of the buildings, on the other hand, had embedded infrastructures fixed on the walls, under beams or ceilings to enclose the cable. This measure also damages the appearance of the walls and ceilings.

Plate 4.5: An embedded conduit system for cables

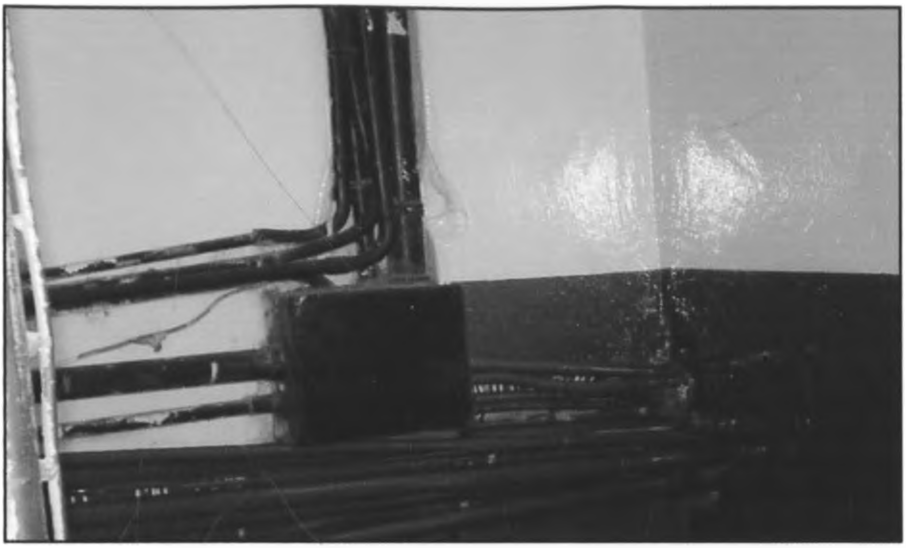


Source: Field Survey, 2008

4.6.3 Electrical Infrastructure

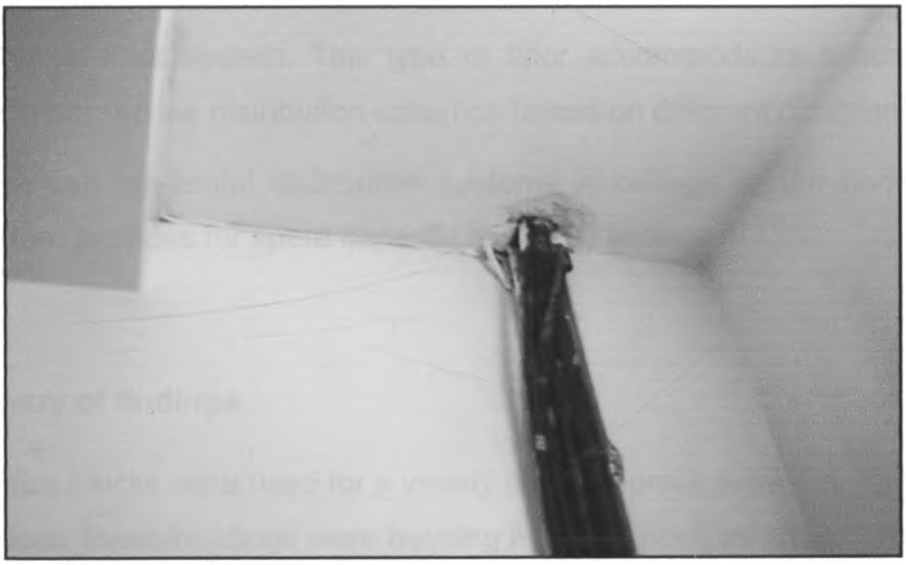
Under this section the researcher looked at how the building owners and/or property managers had tried to meet the increased needs for power supply and distribution and any effects that this had on the building form. Only 30% of the buildings surveyed (9 buildings) had been upgraded for power supply and distribution. The effect of the upgrading process was evident in some of the buildings. In one particular case, the building had its new power cables run against and through its walls and through its floor slabs. Holes were made through these elements to accommodate the cables.

Plate 4.6: Power cables running against and through a wall



Source: Field Survey, 2008.

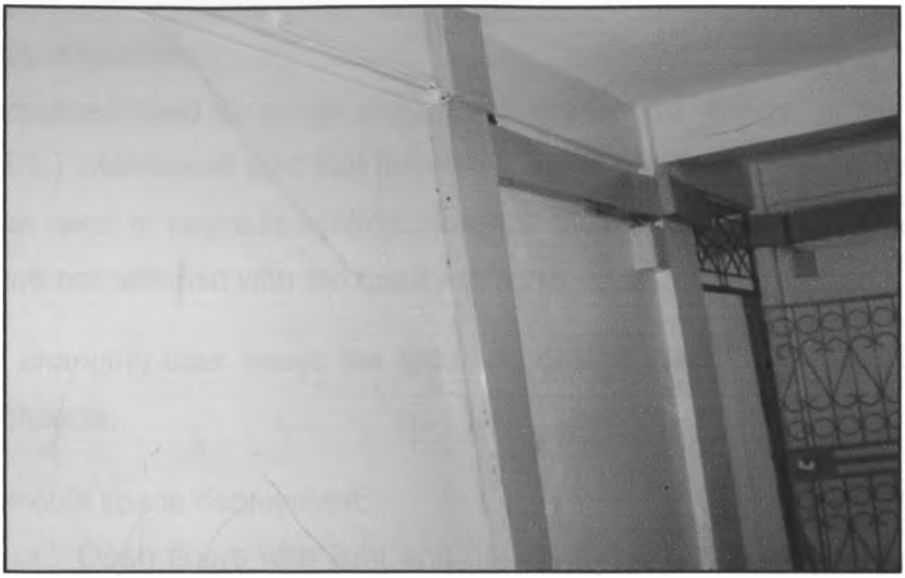
Plate 4.7: Power cables running through floor slab



Source: Field Survey, 2008.

In most (89%) of the buildings upgraded, the new power cables were enclosed in embedded infrastructures fixed on the walls and ceilings with screws. The infrastructure that was commonly used was the rectangular metallic conduits fixed with screws.

Plate 4.8: Rectangular metallic conduits fixed on walls



Source: Field Survey, 2008.

None of the buildings surveyed had;

- A raised floor system. This type of floor accommodates a number of electrical service distribution schemes based on different occupancies.
- Pre-wired horizontal distribution systems in ceilings and/or floors. This system provides for spare capacity and easy access.

4.7 Summary of findings

The old office blocks were used for a variety of commercial activities. Apart from private offices, these buildings were housing activities such as shops (electronic and music), boutiques, fashion shops and cyber cafes just to mention. These commercial activities presented different functional requirements to the buildings. The requirements included:

- The need for cable management systems. This was stated by 63% of the property managers and 30% of the tenants.

- The need to accommodate different space requirements in terms of sizes. This was evidenced by tenants opting for different space sizes if they relocated.
- Increased need for power supply and distribution. Almost all the tenants (90%) interviewed said that their businesses required power supply.
- The need to upgrade lighting systems. 50% of the tenants, on overage were not satisfied with the quality of lighting.

To adapt changing user needs the following design measures were proposed by the architects:

- Flexible space deployment:
  - Open floors with light and demountable partitions which are non load-bearing.
- Flexible electrical infrastructure:
  - Redundant power points integrated in the structural elements for example columns, beams and slabs.
  - Use of service floors and ceilings.
  - Centralization of service lines.
- Flexible cable management:
  - Service ducts.
  - Service floors and ceiling.
  - Allowances for cabling integrated in the structural elements.

Most of the old office buildings studied were, however, rated as below 50% in terms of their ability to meet the needs. A summary of their design attributes were as follows.

- Most of them have permanent internal wall partitions as opposed to open floor plans.
- Lack of extra power and lighting points.
- Inadequate cable allowances.

- Solid structural elements without any spaces within them that can accommodate cable runs.
- Cabling hidden within the structure.
- Lack of service floors and ceilings.

The field survey, on the other hand, shows manifestations of inadequate provision of cable allowances, i.e.

- Cables hanging loose on walls.
- Embedded infrastructures fixed on walls and under ceilings.
- Ducts fixed on walls and also run through the slabs.

4.8 Interpretation of the findings

It has been shown from the data analysis that most of the old office buildings are less adaptable to changing needs in terms of space deployment cable management and power supply and distribution systems. This is because the systems contain little or no flexibility. As a result most of the tenants' needs are not adequately met.

The above inferences have tested the alternative hypothesis of the study and proven it to be true. The Alternative hypothesis, H_1, stated that;

- Old office blocks are less adaptable as their systems of space deployment, cable management and electrical infrastructure contain no or little flexibility.

The alternative hypothesis was confirmed by rejecting the null hypothesis which stated that old office blocks are adaptable as their systems of space deployment, cable management and electrical infrastructure contain flexibility.

4.9 Problems encountered in the field

The problems encountered during field survey were as follows.

(a) In some buildings, the researcher was not allowed to get any information. These were mainly those buildings managed by their owners. The main reason was suspicion on the use of the information. To go around the problem, the researcher had to explain with a letter from the Department of Real Estate and Construction Management at the University, that the information was solely for research purposes. This however dragged the research exercise by delaying the completion the field survey.

(b) In other buildings, the photographing activity was faced with mixed security reactions. The researcher was allowed to take photos of only specific areas of the buildings according to the discretion of the property managers/building owners. This reduced the quantity of information collected through photography. As a solution to the problem, the researcher conducted interviews with the respective respondents on the same matters.

(c) There was also the problem of communication. Some of the respondents had problems with the English language and therefore could not adequately answer the questions in the questionnaires. In order to obtain the correct data, the researcher had to translate some of the questions in Kiswahili, for easier understanding. Kiswahili is a local language and hence its preference.

CHAPTER FIVE

CONLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the study, conclusions and recommendations of the study made in the light of the study objectives.

The objectives of this study were as follows:

1) To establish the adequacy of the buildings' design in adapting to the new needs.

2) To assess the building performance in relation to the occupants needs.

3) To examine any challenges faced in meeting these needs and their effects on the building form.

5.2 Summary

1) The findings established that the old office buildings' designs are less flexible. The buildings' space deployment, electrical infrastructure and cable management systems contain no or little flexibility. Inflexible designs accommodates changes with difficulty hence discourages adaptability.
2) As a result of this inability to effectively adapt to the changing needs, the performance of old office buildings was poorly rated by all the respondents.
3) The findings also shows that the main challenges that were faced in trying to meet the needs, included rigid structure and high cost. Some of the effects that the design had on attempts to accommodate changes were: loose cables on walls; cable ducts fixed on the surface of the walls

and through the walls and slabs; and use of wall-embedded infrastructures for electric power lines.

Summary 1, 2 and 3 show evidence for the realization of the three objectives of the study.

5.3 Conclusions

From the findings presented in chapter four, it has been shown that most of the old office buildings have inflexible designs which discourage adaptation: their systems of space deployment, electrical infrastructure and cable management contain little or no flexibility. As a result most of the functional requirements presented by the changing user needs cannot be easily provided by the buildings.

In such designs a change in the nature of business for example expansion or contraction or a change in the mode of operation cannot be easily accommodated. A change in the nature of a business or mode of operation may be necessitated by new technology that is geared to increase productivity. A workspace which cannot support such changes kills the productivity of its users.

Few buildings exist today that have been intentionally designed for adaptability, and put to the test of time. Traditionally many designers and owners have preferred to work from the assumption that their buildings will never experience significant change. But even when the inevitability of change is fully appreciated, the marketplace offers little incentive for developers and owners to invest in long-term adaptability. The initial developer who invests in a more adaptable building structure is unlikely to ever realize the economic benefits. For these reasons there are few older buildings purposefully designed for adaptability.

5.4 Recommendations

From the findings and conclusions that have been made, the following measures are recommended;

1. For future developments of office buildings considerations should be made to flexibility of space deployment, electrical infrastructure and cable management. These considerations should be made at the design stages to avoid the high costs and inconveniences of subsequent modifications. To achieve the flexibility the following measures should be incorporated in the design:

    - Open floor plans with light and demountable partitions.
    - Multifunctional spaces
    - Partitionable spaces
    - Redundant power and lighting points integrated in the building elements.
    - Adequate cable allowances on the building structure.
    - Cabling systems should be located in accessible areas and not hidden within the structure.
    - Adequate storey heights to allow for service ceilings.
    - Raised floor system that allows for under-floor cabling. This will accommodates a number of electrical service distribution schemes based on different occupancies.

2. In order to the promote the principles of adaptability at the design stage, the costs of incorporating the principles of adaptability in a design should be significantly less than the avoided costs of traditional alterations associated less adaptable buildings.

    If so, the cost savings can be balanced against the uncertainty of when and what alterations will be required. One way of realizing this is to

5.4 Recommendations

From the findings and conclusions that have been made, the following measures are recommended;

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    If so, the cost savings can be balanced against the uncertainty of when and what alterations will be required. One way of realizing this is to include incentives in the public policies directed at sustainable u development.

If adaptability is embraced in public policy, it may be necessary to re adaptability to basic principles of sustainable development, such stewardship and intergenerational equity. From this perspective, responsibility of the designer or developer is to meet the client's ne and expectations without compromising those of future building own and users.

3. For the existing old office buildings, alteration and improvements will required to meet the changing needs of occupants. However, this come at cost since the buildings are less flexible and hence le adaptable. A number of rehabilitation strategies may be adopted:

   a) For space deployment;

      i. Retention of the entire existing external envelope, includ the roof with minor internal structural alterations, whi might involve the demolition of some interior subdivisions create larger floor spaces.

      ii. The retention of the entire existing external envelop including the roof, with major internal structural alteratio which involves extensive demolition of interior structur walls to create an open floor.

include incentives in the public policies directed at sustainable urban development.

If adaptability is embraced in public policy, it may be necessary to relate adaptability to basic principles of sustainable development, such as stewardship and intergenerational equity. From this perspective, the responsibility of the designer or developer is to meet the client's needs and expectations without compromising those of future building owners and users.

3. For the existing old office buildings, alteration and improvements will be required to meet the changing needs of occupants. However, this will come at cost since the buildings are less flexible and hence less adaptable. A number of rehabilitation strategies may be adopted:

a) For space deployment;

i. Retention of the entire existing external envelope, including the roof with minor internal structural alterations, which might involve the demolition of some interior subdivisions to create larger floor spaces.

ii. The retention of the entire existing external envelope, including the roof, with major internal structural alterations which involves extensive demolition of interior structural walls to create an open floor.

b) For adequate cable management, any of the following may be implemented;

i. Raised floor system.
ii. Service ceilings.
iii. Trunking.

4. On sustainability;
   a) Increase the awareness amongst planners, developers and estate managers of the practical measures that can be taken to plan 'sustainability' into a development
   b) Provide a framework for assessing the sustainability issues relating to buildings and infrastructure
   c) Provide developers with a method of demonstrating to planning authorities that sustainability has been systematically addressed in their proposals
   d) Help planners to specify 'sustainability' in supplementary planning guidance/development codes

5.5 Areas of further studies

1. This study was done mainly on commercial buildings. A further study may be done on residential buildings to assess the adaptability of the buildings to the changing needs of their occupants. People's needs change as they grow old and the buildings should therefore be able to accommodate the new needs.

2. Due to time and financial constraints, the study was limited to space deployment, electrical infrastructure and cable management only. A

study should be done on the adaptability of old commercial buildings to changing needs in relation to:

- Sanitary facilities
- Heating, ventilation and air-conditioning systems

3. Further studies can also be done on how public policies directed at urban development can be used to promote the concept of adaptability in Kenya.

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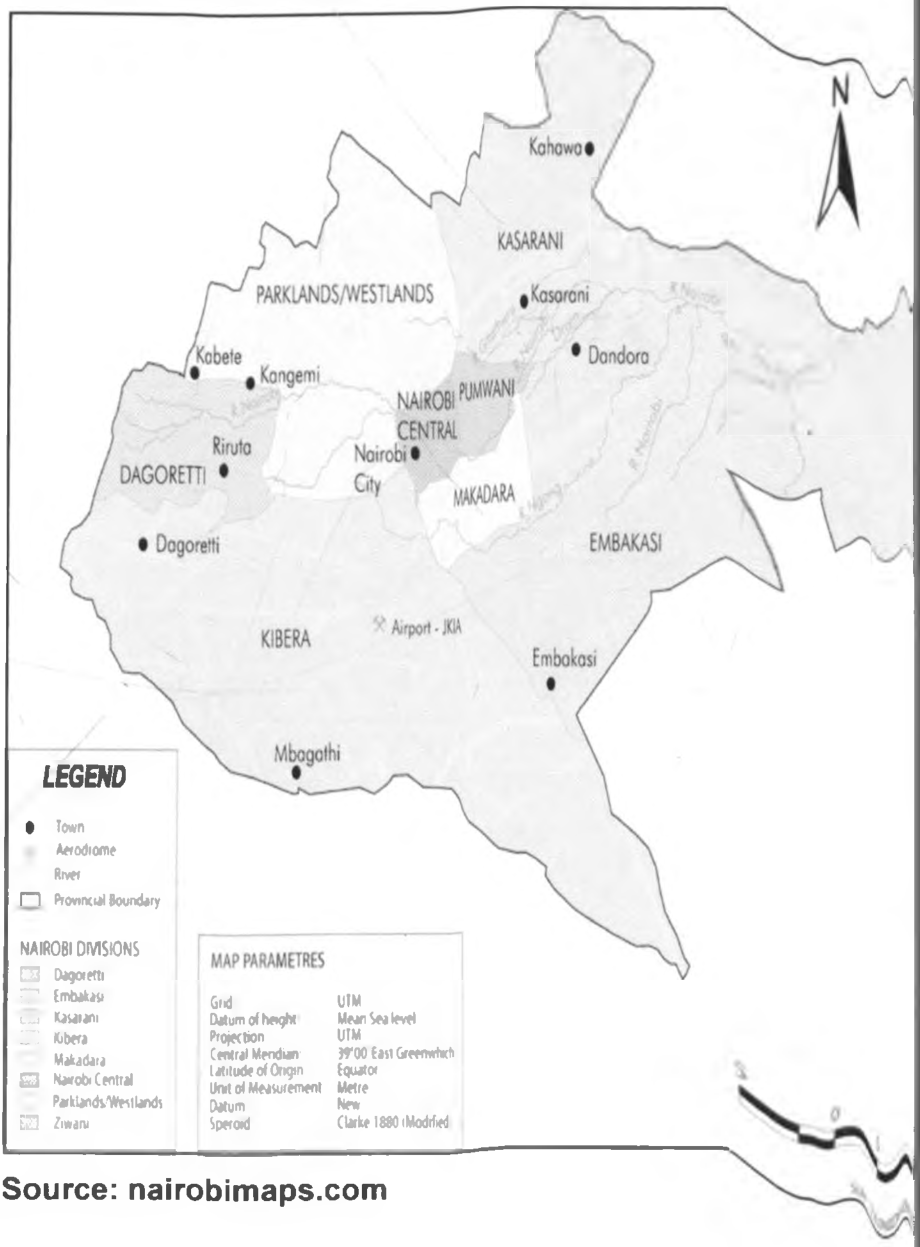
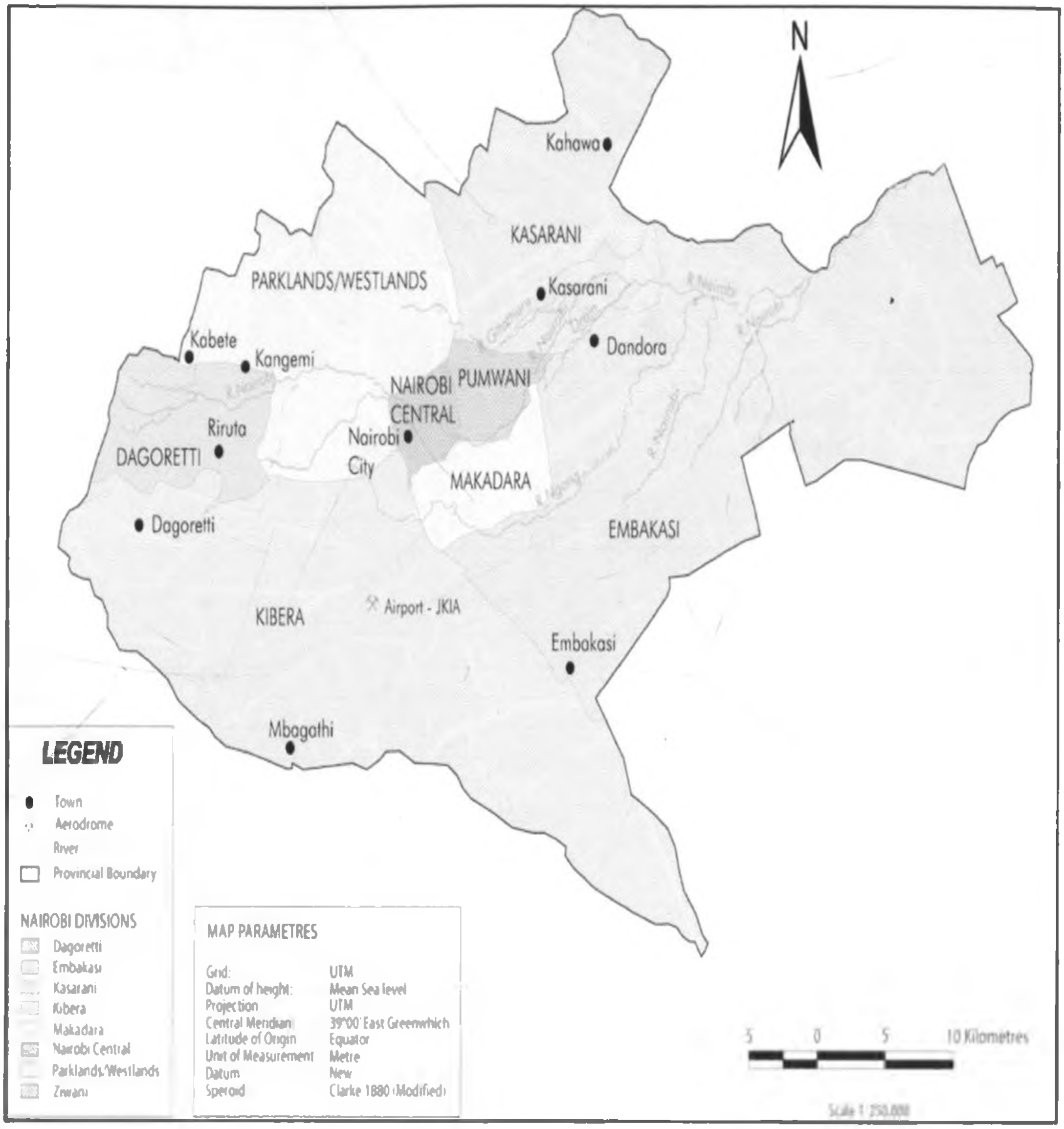
Appendix 1: Map of Nairobi.



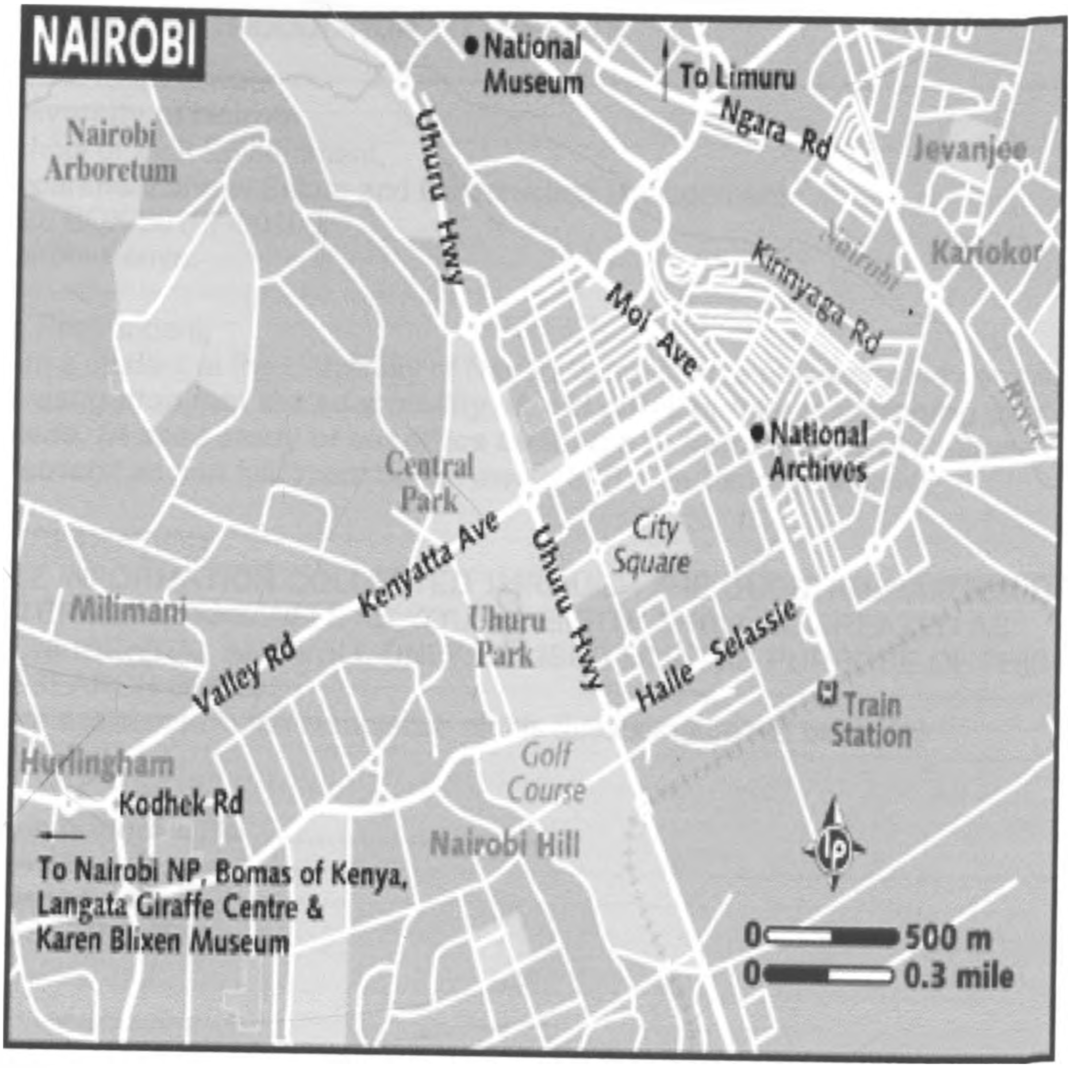
Source: nairobimaps.com

Appendix 1: Map of Nairobi.



Source: nairobimaps.com

Appendix 2: Map of Nairobi central business district



Source: nairobimaps.com

Appendix 3: Questionnaire to tenants

LETTER OF INTRODUCTION TO TENANTS

Otieno Eddie Owuor,
University of Nairobi
School of Built Environment,
Department of real Estate and Construction Management
P.O. BOX 30197-00100,
Nairobi-Kenya.

To Respondent,
I am a student at the University of Nairobi conducting a research study on ***"An investigation into the adaptability of old office blocks to changing user needs, (A case study of old office buildings in Nairobi Central Business District)"*** as part fulfillment for the award of B.A Building Economics.

DECLARATION:
THE INFORMATION COLLECTED THROUGH THE QUESTIONNAIRE(S) OR INTERVIEW(S) AS WELL AS YOUR IDENTITY SHALL BE TREATED AS CONFIDENTIAL AND WILL ONLY BE USED FOR THE PURPOSE OF THIS RESEARCH ONLY.
Your assistance in the completion of this questionnaire will be highly appreciated

Questionnaire No..................
Thanks.
Otieno Eddie.
RESEARCHER.

QUESTIONNAIRE TO TENANTS

INSTRUCTIONS:

Please tick (✓) and/ or state the appropriate answer in the spaces(s) or box (es) provided. More than one answer may be ticked or stated where applicable. Indicate with the abbreviation (N/A) where a question does not apply to your case. (N/A) means Not Applicable.

Your assistance will be highly appreciated.

1.0 General information:

1.2 How long have you occupied this building?

....

2.0 Space needs:

2.1 Is the space you are occupying adequate for your current activities?

Yes { } No { }

2.2 If you were to change your premises, what would you go for?

Similar space { } Bigger space { } Smaller space { }

2.3 Does the nature of your business require electric power supply?

Yes { } No { }

2.4 Is the number of sockets in your workspace adequate for your activities?

Yes { } No { }

2.5 Are there any extra power points apart from the ones in use?

Yes { } No { }

2.6 Does the nature of your business require cable distribution?

Yes { } No { }

2.7 Are there any allowances for cabling in the space you are occupying?

Yes { } No { }

2.8 Are the existing allowances adequate for additional cables?

Yes { } No { }

2.9 Is the electric lighting provided adequate for your work?

Yes { } No { }

2.10 Are there any other extra lighting points apart from the ones in use?

Yes { } No { }

2.11 Generally, to what extent does the building satisfy your needs?

a) 75% and above satisfactory { }

b) 50-74% satisfactory { }

c) Below 50% { }

Thank you

Appendix 4: Questionnaire to property managers/building owners

LETTER OF INTRODUCTION TO PROPERTY MANAGERS/BUILDING OWNERS

Otieno Eddie Owuor,
University of Nairobi,
School of Built E nvironment,
Department of real Estate and Construction Management
P.O. BOX 30197-00100,
Nairobi-Kenya.

To Respondent,

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Your assistance in the completion of this questionnaire will be highly appreciated

Questionnaire No..................

Thanks.

Otieno Eddie.

RESEARCHER.

QUESTIONNAIRE TO PROPERTY MANAGER/BUILDING OWNERS

INSTRUCTIONS:

Please tick (√) and/ or state the appropriate answer in the spaces(s) or box (es) provided. More than one answer may be ticked or stated where applicable. Indicate with the abbreviation (N/A) where a question does not apply to your case. (N/A) means Not Applicable.

Your assistance will be highly appreciated.

1.0 Current building uses and needs:

1.1 What are the current uses of the building?

Offices { } Shops { } Cafeteria { }
Stores { } Boutiques { }

Any other (Please state)

....

1.2 Which among the following user needs do you face as the building manager?

a) Increased demand for electric power { }

b) Need for cable distribution system { }

c) The need to upgrade lighting systems { }

d) Any other (Please state)

....

2.0 Coping with space needs:

2.1 Do all tenants have the same space requirements in terms of space areas?

Yes { } No { }

2.2 What is the nature of the internal partitioning of the building?

a) Light and demountable { }

b) Solid Immovable partitions { }

3.0 Coping with power needs:

3.1 Has the building been upgraded in terms of power supply and distribution?

Yes { } No { }

3.2 Were there any challenges faced during the upgrading process?

Yes { } No { }

3.3 What was the nature of difficulties faced?

....

....

....

4.0 Cable management:

4.1 Does the building have adequate cable management system?

Yes { } No { }

4.2 Does the building have allowances for cabling?

Yes { } No { }

5.0 How would you gauge the ease with which the building is able to accommodate changes to address space needs, power needs and cabling needs?

a) Above 75% { } **(b)** 50-74% { } **(c)** Below 50% { }

Thank you

Appendix 5: Questionnaire to architects

LETTER OF INTRODUCTION TO ARCHITECTES

Otieno Eddie Owuor,
University of Nairobi,
School of Built Environment,
Department of real Estate and Construction Management
P.O. BOX 30197-00100,
Nairobi-Kenya.

To Respondent,

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Your assistance in the completion of this questionnaire will be highly appreciated

Questionnaire No..................

Thanks.

Otieno Eddie.

RESEARCHER.

QUESTIONNAIRE TO ARCHITECTS

INSTRUCTIONS:

Please tick (√) and/or state the appropriate answer in the spaces(s) or box (es) provided. More than one answer may be ticked or stated where applicable. Indicate with the abbreviation (N/A) where a question does not apply to your case.

Your assistance will be highly appreciated.

Note: In the context of this questionnaire, the term 'Office block' is used to mean commercial buildings housing retail activities and offices.

1.0 General information:

1.1 Does designing office blocks form part of your workload?

Yes { } No { }

2.0 Design of office blocks and the changing needs of users:

2.1 Which among the following are some of the current needs faced in the design of office blocks?

a. Flexible space deployment { }
b. Flexible power distribution system { }
c. Adequate cable management { }

....

..

2.3 In your opinion, how would you rate the flexibility of older office blocks(designed more than 40 years ago) in terms of:

i. Space deployment

{ } 75% and above { } 50-74% { } Below 50%

Comment/Reason for your rating:

....

....

....

....

....

....

..

ii. Infrastructure for power supply and distribution

{ } 75% and above { } 50-74% { } Below 50%

Comment/reason for your rating:

....

....

....

....

....

....

....

iii. Cable management

{ } 75% an d above { } 50-74% { } Below 50%

Comment/Reason for your rating:

....

....

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....

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....

....

Thank you