MAINTENANCE INFORMATION MANAGEMENT
THE ROLE OF
MANAGEMENT INFORMATION SYSTE
IN
BUILT ASSET MANAGEMENT.

BY

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A THESIS SUBMITTED IN PART FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ARTS IN BUILDING MANAGEMENT IN THE DEPARTMENT OF BUILDING ECONOMICS & MANAGEMENT OF THE UNIVERSITY OF NAIROBI.

FEBRUARY, 1995 NAIROBI

DECLARATION

I, ERIC ALIGULA MAGOLO, hereby declare that this thesis is my original work and has not been presented for a degree at any other University.

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DECLARATION OF THE SUPERVISORS

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DEDICATION

Where GOD guides, he amply provides.

ACKNOWLEDGEMENTS

Early in 1990 when I began my course in Building Management, and as I began to think about the area and topic that would form my thesis, I received encouragement and help from various persons. It is not possible for me to name all of them.

I am indebted to the University of Nairobi who provided me with the scholarship that enabled me to undertake this course. To all the members of staff of the Faculty of Architecture, Design and Development who provided me guidance. Special mention to the lecturers of the department of Building Economics and Management and the department of Land Development for all the assistance they gave me. I am thankful to my supervisors Prof. P.M. Syagga and Mr. N.B. Kithinji for their incisive contributions that enabled me shape this study.

To all those research assistants who enabled me to collect and analyse the information needed for the study.

To the secretaries who assisted me by typing the manuscripts, I say thank you very much.

To members of the Life Alumni for all their prayers and encouragement.

To members of my family who supported me throughout the course of my study.

In making these acknowledgements I take responsibility for any errors that may be found in this document.

ABSTRACT

The construction industry plays a leading role in the development of any country by producing investment goods. These provide habitats for activities, economic or otherwise, in which people are engaged. They are aimed at increasing the infrastructural base of any nation desirous of meaningful development. In this regard, many countries have heavily invested in such facilities as roads, bridges and buildings of various types, amongst others. These facilities need to be adequately maintained. To be able to do so there is need for appropriate maintenance management systems. A crucial component of these systems is the maintenance management information system. Its role is to provide proper information that is required to ensure adequate maintenance.

The study was prompted by concern for the declining standards of maintenance of built assets in the country and the noticeable trend in the manner in which organisations were applying crisis as opposed to the more effective planned maintenance approach. This was despite evidence which indicated that crisis or response based maintenance was twice as expensive as the planned maintenance regime **(UNCHS, 1990 and UNCHS, 1991).** A survey carried out to determine the maintenance status of built assets established the fact that many residential buildings are in a declining state of repair **(Syagga and Aligula, 1993).** Some studies have also linked the poor maintenance state to the technical features such as the design parameters and labour productivity **(Syagga, 1985; Mbucua, 1988 and Rukwaro, 1991).** Other studies and authors have attributed this poor state of maintenance of built assets to different factors, namely: poor management, inadequate funds, staff and transport to name just a few **(Aloo, 1985; Syagga, 1985; Miles and Syagga, 1987; and Mbucua, 1988).** This study however, in addressing the poor state of the built environment stated that these were only symptoms of a more fundamental flow in the management of built assets: **the maintenance management information system**. In this respect the study's contribution was that it addressed an organisational problem rather than the technical issues which a number of the other studies dealt with.

The study is divided into six chapters. The first chapter deals with the background and problem definition and research methodology issues. Replication logic is the mode chosen to analyse the data collected in the field. In using this logic it was necessary to develop a theoretical framework which set out the conditions under which effective and efficient maintenance information management could be carried out. This is secured in chapters two and three. Chapters four and five describe the case study areas and discussed the nature of information management practices at the Nairobi City Commission and the Kenya Breweries Limited. It shows the four levels of the maintenance management personnel, the activities they undertook and the information that they needed to carry out this activities. It was seen that a lot of the information that they indicated that they required was not available to them. For instance, they did not have information relating to the maintenance backlog and the condition of the housing units. It was thus, impossible for them to effectively plan and execute their activities.

Chapter six provided the summary of findings, conclusions and recommendations of the study. The main findings were that their was a lack of a comprehensive maintenance policy which would not only define the roles of the participants but also focus the efforts of the maintenance personnel. Another finding was that there was under maintenance at the NCC and KBL running at 20.6 and 24.6 percent respectively. This was a conservative estimate. A more in-depth survey would definitely show a higher rate. When this was linked to the fact that around 70 percent of the interviewees for the user-reaction surveys indicated that their dwellings were not inspected at all or that it was not regular. It was clear that the maintenance personnel had no access to the information about defects in the dwellings until they are summoned. Maintenance request procedures were found to be bureaucratic and it was recommended that this be reviewed to make them simpler but still be able to ensure financial accountability. Data that was found in the maintenance departments in the study areas was found to be compatible with such useful techniques as Life Cycle Costing. This was made worse by the reluctance of the maintenance personnel to accurately complete the

forms from which such data could be retrieved. Use of computers was recommended given the large number of units and therefore the data to be handled. Changes in the manner in which the information was classified were recommended so that information could be easily retrieved and analysed. There was a distinct need to educate the maintenance personnel on the pertinent need to ensure that the forms, such as building work orders, needed to be properly completed. Last, but not least the study recommended that a review of the manner in which maintenance was organised be made so that tasks, information needs and the personnel are properly matched.

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CHAPTER ONE

BACKGROUND AND PROBLEM DEFINITION

Introduction

The construction industry plays a leading role in the development of any country by producing investment goods. These provide abode for activities, economic or otherwise, in which people are engaged. They are aimed at increasing the infrastructural base of any nation in need of meaningful progress. In this regard, many countries have invested massively in such facilities as roads, bridges, and buildings of various types, amongst others. **Mugenda (1991),** recognised that investment in constructed facilities tends to vary systematically with the level of advancement in any given country.

This investment process, by both the public and private sectors, requires huge amounts of resources to accumulate. The investment has a high replacement value, which is the cost incurred as a result of the obsolescence of the same. For instance, in Kenya, the replacement value of public property stood at K£800,000,000 **(Okwemba, 1991:2).** This is a conservative estimate given the prevailing high construction costs. The demand for these assets surpasses supply, increasingly forcing both sectors to work within limitations of existing ageing stock. In this case maintenance and rehabilitation work acquires a much greater significance because neglect accelerates the considerable loss of national assets **(UNCHS, 1990:1-2).**

The Problem and It's Setting

The construction process, a vast and complex undertaking in which continuous monitoring and control are essential, is a decision making process whereby communication is vital. Three factors make information a vital facet of the process. First, the nature of the process, the number of participants and their relationships. These are many and may be seen as systems of many interdependent parts combining in an interactive way in the process of achieving their goals and brought together by obligations specified in (a) contract(s).

Secondly, the nature of the construction product sets it apart in terms of size, use, quality and location. It is a made-to-order item. In the third instance, the assembly or construction process is itself complex. A construction project may be seen as an input-output system in which various parts are linked by a flow of resources (information, energy, skills, materials, and machines) which are converted into built assets **(Nguyo, 1988:37).** This construction process can be divided into three phases, viz.:

* ***Design***
* ***Production***
* ***Maintenance***

The design phase is where the design team, incorporating architects, engineers, quantity surveyors, inter alia, conceives the client/user's brief. It is essentially a problem-solving exercise in which decisions with far reaching repercussions are made. These decisions must be based on relevant information for good results. No decisions can be confidently taken and no advice authoritatively given if factual information is not available or is not used **(Robertson, 1977:143).** Participants in this phase include the design team, regulatory agencies and the client/user. Sources of information comprise, amongst others, the client/user, site analysis and other supportive analyses carried out by the design team **(Nguyo, 1988:45).** The supreme goal is to develop a design satisfying the client/user's requirements. Decisions arrived at during the design phase, determine the final product; its costs; productivity and ease with which it will be managed, operated and maintained **(Nguyo, 1988:44).** Once the design has been completed, tender documents subsequently prepared are used as a basis for selection of contractors for the production phase. The major task of the production phase is the consummation of the concept developed at the design phase. Participants comprise contractor(s), the design team, manufacturers, merchants, and regulatory agencies. These together with the complex assembly process create managerial problems in terms of information flow, communication and co-ordination amongst others.

Once the asset is constructed until practical completion and handed over to the client, the defects liability period begins. Practical completion is the date at which, inter alia, the

defects liability period begins and the constructors liability for insurance ends **(Powell-Smith and Chapell, 1985:343-46).** The defects liability period is that interval during which the contractor as part of the contractual obligations, is responsible for remedying any defect in the materials or workmanship that has become obvious and is not the result of carelessness in the use of the building or normal wear and tear. The period is specified in the contract **(Marsh, 1982:77).** With the lapse of this period, the client/user assumes sole responsibility for the maintenance of the built asset. It is a phase lasting as long as a facility remains useful to the client. It is important, first, because it enables the facility to continuously provide the service it was meant to give. **Aloo (1985),** says that it helps in optimising the benefits accruing from these expensive investments. Secondly, it preserves and even enhances the long-term value of built assets. Thirdly, it assists in closing the gap between supply and demand by prolonging the useful life of a built asset. Lastly in an era of environmental conservation concern, maintenance reduces the `destabilising' effect of built assets. `Destabilising' in the sense that for buildings to be put up, some part of the natural environment has to be done away with e.g. cutting down trees during site clearance.

Inspite of these recognised benefits, evidence put forth shows that maintenance is an often neglected aspect of the construction process. **Miles and Syagga (1987),** say that a casual stroll around a city, town, or village in almost any developing country suggests that many important national assets are run down beyond the point of economic repair. A visual survey of built assets in the country confirms this view, showing that they are not well maintained. The following newspaper quotations further illustrate the pervasiveness of such neglect sometimes threatening public health:

* The Kajiado District Commissioner,..., has decried the dirty and pathetic condition of Kajiado District Hospital...**(Daily Nation, Thursday, Jan. 21, 1988, No.8434, p.3)**
* Muguga High School was closed indefinitely yesterday for being unfit for human habitation,...because amongst other things the maintenance of existing facilities was poor **(Daily Nation, Friday, July 1, 1988 No.8573, p.1).**

Why is this the case?

Mbucua (1988), identified poor maintenance management as a major cause of inefficient and ineffective maintenance or the total neglect of the same. The decline of maintenance standards was attributed to *poor supervision; inadequate staffing and financial allocations; lack of user participation; deficiency of established channels of communication (no feedback) and lack of a data base embodying past maintenance experience* **(UNCHS, 1991). Aloo (1985),** describes the Ministry of Public Works as having a maintenance department whose structure was incapable of servicing its maintenance needs. Thus, maintenance management was found to be deficient, and hence the need for better practices.

The essence of management is decision making **(Thomas and Ward, 1974:59).** These decisions are made with a focus on the objectives to be achieved, a recognition of the problems to be solved, the alternatives available and their possible consequences **(Nguyo, 1988).** In order to do this, managers spend most of their time looking for information. Studies have shown that they devote between two-thirds and four-fifths of their time imparting or receiving information **(Horne and Lupton, 1965; Mintzberg, 1973; Kotter, 1982; Stewart, 1967).** To ease this task use can be made of management information systems (MIS). These typically provide a basis for integration of organisational information processing **(Davis and Olson, 1984:8).** The Institute of Cost and Works Accountants has defined MIS as systems through which defined data are collected, processed and communicated to assist those responsible for the use of resources **(Lee, 1987:178).** It basically aids management in making, carrying out and controlling decisions **(Kanter, 1984:1).**

A management information system is essentially divided into three parts, viz.; management, information and systems. Management can be defined as comprising the processes or activities describing what managers do in the operation of their organisations **(Murdick, Ross and Clagett, 1984:5).** In this regard an organisation can be divided into four levels of information users; strategic planning (top management), management control (middle management), operational control (operating management) and transactions

processing **(Kanter, 1984:2-3; Hutt, 1979:4-5).** Each of these levels has different information requirements. In considering which type of information, attention is given to the business as well as the technical dimensions of this information **(Kanter, 1984:8-13).** A system is a set of elements joined together for a common objective and the systems concept optimises output by connecting operating systems through information exchange **(Murdick, Ross and Clagett, 1984:6).** Therefore, a management information system is meant to integrate all levels of management by providing relevant information. It does so by managing information. A maintenance management information system (MMIS) must be able to provide relevant information to those who require it. Relevant information is that which is timely, accurate, and in the form that is required. The use of MMIS improves maintenance management practises by managing the information generated by and required for the maintenance management process. This helps in, amongst other things, management of maintenance operations to ensure efficiency, effectiveness, and control; providing design personnel with information on the performance of previous designs (feedback); providing a rational basis for decision making by maintenance managers in formulating budgets; staffing and scheduling of work; setting of standards and inventory control **(Bates, 1987:11-18).** It ensures that an organisation is able to prepare comprehensive asset registers, budgets, inventories of equipment and material, hire and motivate staff and at the same time prioritise its maintenance work. A system is put in place to assist in the collection, storage, analysis, retrieval, presentation, dissemination, and application of data and information. It is an important part of the management structure of a maintenance unit.

Such a systemised effort is, however, lacking in the management of maintenance information in most organisations in this country. The results of this deficiency are manifest in several ways. One, there is a lack of or total neglect of maintenance; lack of funds, staff, and materials all resulting in inefficient and ineffective maintenance of built assets. Two, a number of institutions in the country are engaged in `crisis' or breakdown maintenance as opposed to the preferred planned preventive regime **(UNCHS, 1991:3).** The major reason

advanced for this state of affairs is lack of funds. While it is appreciated that these are times of austerity, maintenance deserves better attention than is the case at present. The contention is that maintenance managers or their equivalents do not do enough to justify in economic terms why they need the funds. They are unable to do so because they lack the information base so vital to effective management of built assets **(Then, 1990:1213).** Three, the lack of data relating to maintenance of buildings in national statistics, making it difficult to assess trends in expenditures, is another indicator of the shortcomings in the maintenance management information systems. It is the argument of this study that three critical areas relating to the definition of, handling of and quality of the data are crucial. They are presently inadequately dealt with contributing to the current crisis.

The aforegoing discourse is indicative of a problem in maintenance generally and maintenance information management as an aspect of maintenance management in particular.

Study Hypothesis

Inappropriate management of maintenance information is a significant cause of poor maintenance management. Information systems (IS) will help in the management of maintenance information and hence improve maintenance management of built assets.

Study Assumptions

This study was based on the assumptions that:

a). Relevant information is essential for proper and effective management of built assets.

b). General principles of information management can be used to set up an appropriate information system for maintenance.

c). An information system is in place and information management is carried out.

Study Objectives

The purpose of this study was to examine the role of information management in the performance of maintenance management functions at the strategic planning, management control, operations control and transactions processing levels in pursuit of efficient and effective maintenance of built assets.

To achieve this objective the study concentrated on the flow of information for maintenance purposes. The following were the specific aims:

a). To determine the maintenance management functions at each organisational level and the activities performed under each level;
b). To determine the information needed to perform the activities at these levels in the study areas;
c). To determine the manner in which the maintenance information is collected, stored, analysed, retrieved, and applied in the study area;
d). Make a condition assessment survey of the built assets in the study area and draw a relationship with (c).

Scope of the Study

The study examined the role of information in maintenance and concentrated on the flow of information. In this regard it studied the information systems in place within the study areas. The study was not designing an information system as such but only examining the current information flows and identifying problem areas. In relating to information systems, the study sought out those features necessary in making an Information System effective and efficient.

Study Significance

This study was necessary, first, because it has kept alive the issue of maintenance. This is especially so for organisations with vast amounts of built assets. Secondly, previous studies concentrated more on technical rather than organisational issues. **Syagga (1985),** for instance studied the impact of building design on maintenance costs of residential housing. **Rukwaro (1991),** examined the influence of design parameters on the maintenance costs of

engineering services of office buildings. **Mbucua (1988),** inquired into labour productivity in the maintenance of public buildings. Amongst the recommendations he made was the need for better management practices and the provision of all the necessary support services and other resources to the maintenance department. **Aloo (1985),** delved into the organisation and execution of building maintenance works in which he examined the existing management practices and found them inadequate. **Thus, this study was important in addressing the issue of maintenance information as an aspect of maintenance management practice.**

The study is also significant in respect of the issue of integrating maintenance and design. Information systems (especially those having many kinds of information) may provide an integrative framework for multi-disciplinary work **(Nijkamp, 1984:4).** Maintenance is one such area needing skills ranging from business administration to technical knowledge in building trades. **Tuts (1991),** suggested that neglect of maintenance in developing countries could be attributed to lack of reliable statistical material and that for the concept of life cycle costing to be effective, it must be integrated into a maintenance management information system. Life cycle costing is a concept that offers a potentially comprehensive approach to evaluating all of the costs involved during a pre-defined life span of a building or structure **(Ashworth and Au-Yeung, 1987:141).** The importance of this concept is with regard to making choices between various materials and components. It is especially significant when resources for maintenance are being cut back. Hence, as part of the introduction of better management practices, maintenance management information systems will assist in making built assets more responsive to the evolving needs of their users **(Jones, 1990:1182).** Lastly, as the world enters the information age, the management of this resource becomes increasingly important. With the ever competing needs, society is always looking for improved ways of utilising its meagre resources. With respect to maintenance management, information is a resource useful in meeting this endeavour and the MMIS is central in this respect. In the next section the methodology used in conducting this study is discussed.

RESEARCH METHODOLOGY

Case Study Protocol

Research Methodology is the protocol that a researcher uses in logically answering the problem/s that they have identified. It is variously referred to as the research design. **Nachmias and Nachmias (1976)** define it as the plan that:

> ***guides the investigator in the process of collecting, analysing and interpreting observations. It is a logical model of proof that allows the researcher to draw inference concerning the causal relationships among the variables under investigation. The research design also defines the domain of generalizibility, that is, whether the obtained interpretations can be generalised to a larger population or to different situations.***

In preparing the research methodology several strategies may be adopted and in doing so, the researcher has to consider several issues about the study that they are undertaking. This is in order to select the most appropriate of the available strategies bearing in mind that these are not mutually exclusive. Table 1.0 below lists the various strategies and the considerations that would make each one most appropriate. The goal in applying these conditions is to use a strategy that is best suited for the study being undertaken **(Yin, 1984:15-16)**.

Table 1.0. Relevant Situations for Different Research Strategies

Strategy	Form of Research Question	Requires Control over Behavioural Events	Focuses on Contemporary Events
Experiment	how, why	yes	yes
Survey	who, *what, where, how many, how much	no	yes
Archival analysis (e.g. economic study)	who, *what, where, how many, how much	no	yes/no
History	how, why	no	no
Case study	how, why	no	yes

** "What" questions, when asked as part of an exploratory study, pertain to all five strategies.*

Source: Yin, R.K. (1984). pp. 17

As indicated in table 1.0, "what" type of questions can lead one to utilising any of the five strategies indicated above depending on whether the question is exploratory or outcome identification. Outcome identification questions favour surveys or archival analysis. This is

similar to "who", "where" questions and their derivatives. These type of questions have the goal of describing the incidence or prevalence or can be predictive **(Yin, 1984:18)**. In this study the condition survey was aimed at describing the incidence of under maintenance in the study areas. Case studies, historical studies and experiments are favoured when the questions asked "how", and "why". Questions of these type are more explanatory dealing with operational links that need to be traced rather than with frequencies or incidence **(Yin, 1984:18).** In this respect this study was not dealing with the frequency or incidence but rather with the requirements for good maintenance information management. With respect to the extent of control over behavioural events, the case study strategy distinguishes itself from the experimental strategy to the extent that the researcher has no control over the relevant behavioural aspects of the study area. Also it focuses on contemporary events, issues that are of concern today, in this era. Case studies utilise ***primary documents (sources); secondary sources; cultural and physical artefacts; direct observation and systematic interviewing as methods of data collection*** (emphasis mine) **(Yin, 1984:19-20).** **Yin (1981a, 1981b),** defines a case study as an:

> ***empirical enquiry that focuses/investigates contemporary phenomenon within its real-life context; when the boundaries between the phenomena and context are not clearly evident; and in which multiple sources of evidence are used.***

The case study methodology is in this sense an important one in the sense that it allows a researcher in their investigation,

> *to retain the holistic and meaningful characteristics of real life events- such as individual life cycles,* ***organisational and managerial processes****, neighbourhood change, international relations and the maturation of industries (emphasis mine)* ***(Yin, 1984)****.*

This study investigates the issues of maintenance and information management within the rubric of maintenance management. Maintenance management is an aspect of the overall organisational process and is important in ensuring the effective and efficient achievement of organisational objectives. It is an issue that was investigated within the organisational context maintenance operated within. This means that the maintenance activities were

investigated within the framework of the organisations that they were located in. However, the other departments were not studied. It is also a very contemporary issue given the fact that built assets are deteriorating and resources with which to replace or repair them are increasingly scarce. This issue is discussed in the section of the problem and its setting as well as that on the significance of the study in chapter one. The study utilised multiple sources of evidence. This included the records of the maintenance sections/departments, interviews of the occupants of the built assets and the maintenance operatives, personal observation by the researcher and his assistants.

Figure 1.0 illustrates in summary the procedure in carrying out a case study. In conducting a case study, a procedure such as the one outlined can be followed. The process can be simply divided into three main stages namely: ***design; single-case data collection and analysis*** and ***cross-case analysis***. Initially a theory must be developed through which the collected data can be analysed. Subsequently the cases are selected while at the same time design of the data collection protocol is developed. In doing so use is made of formal data collection techniques. Also the likely outcomes are identified. In this study the design of the data collection tools is indicated in the data collection section of this chapter. Subsequently data is collected using tools such as interviews, questionnaires and so on. After the data has been collected it must then be analysed and reports written. This is initially done on a case by case basis. As will be indicated later, in analysing the data collected, particularly for this study use is made of replication logic as opposed to the more familiar sampling logic. After this has been done a cross-case analysis is undertaken, conclusions are then drawn and policy implications developed. The cross-case analysis is done showing replication that occurs between the cases. From this analysis generalisations can then be made based on the literature reviewed as well as the theoretical framework. Subsequently, recommendations are made. In this study cross-case analysis is provided in the summary of findings which is located in the last chapter of the study.

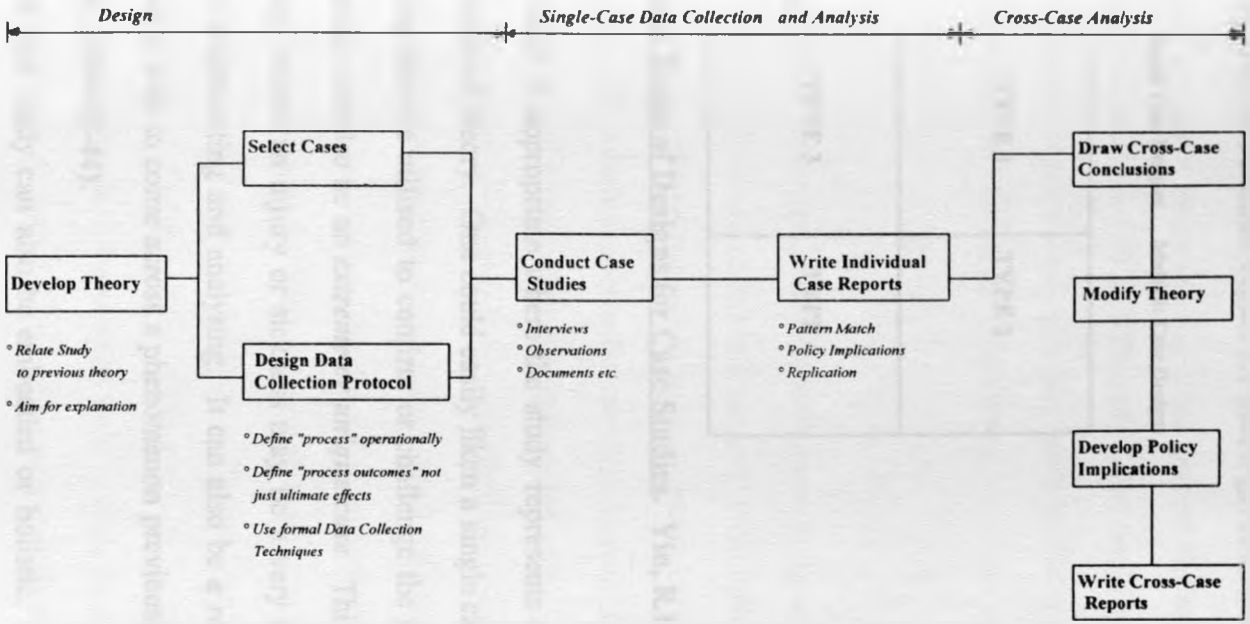

Figure 1.0: **Case Study Method, (adopted from Yin, R.K. 1984, p. 51)**

Single- and Multiple-Case Studies

Case studies can be single- or multiple case studies. This can be further classified creating 4 major types of case studies. Figure 1.1 below gives an overview of these.

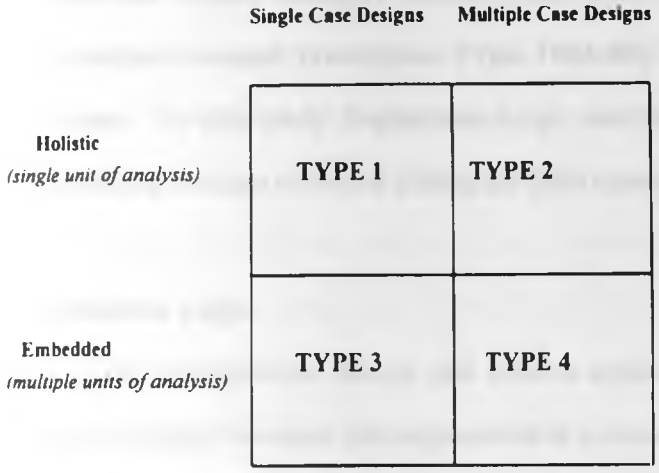

Figure 1.1: Basic Types of Designs for Case Studies. Yin, R.K. 1984, 41.

The single case study is appropriate where the study represents one single ***critical*** case in testing a well formulated theory. One could easily liken a single case study to an experiment. The single case can then be utilised to confirm or challenge the propositions of the theory. The single case study can also be an ***extreme or unique case***. This is common in the field of clinical psychology, where an injury or sickness may be a very rare one. So that when it occurs it is worth documenting and analysing. It can also be ***a revelatory case*** in the event that an investigator is able to come across a phenomenon previously inaccessible to scientific investigation **(Yin, 1984:42-44)**.

The single case study can also be embedded or holistic. This is to say that it may involve *more than one unit of analysis* **(Yin, 1984:44)**. For example while investigating one single public programme e.g. the Low-Cost Housing Programme in Kenya, the analysis might include the outcome from several individual projects within it. This design would be called an *embedded case study* as opposed to a single global study, which we can call a *holistic design* (example mine).

A multiple case study design occurs when we have more than one case. The advantage of multiple case studies is that their results are often considered more compelling, and the overall study is regarded as being more robust. However the conduct of multiple case studies can require extensive resources and time beyond the means of a single student or independent research investigator **(Yin, 1984:48)**. The logic in these studies is also often different. In this study Replication Logic was used as the main mode of analysing and interpreting the data collected during the field survey.

Replication Logic

In multiple-case studies one follows replication logic as opposed to sampling logic which is utilised to select the respondents in a survey. This replication logic is similar to that used in multiple experiments **(see Hersen & Barlow, 1976).** The logic underlying the use of multiple case studies is that each case must be carefully selected so that it either:

a) predicts similar results ***(literal replication)*** or

b) produces contrary results but for predictable reasons ***(theoretical replication)***

It is in this respect similar to multiple experiments. If all the cases turn out as predicted, then they have provided compelling support for the initial set of propositions. If the cases are contradictory in some way then the initial prepositions need to be revised and retested with another set of cases. This logic is similar to the way in which scientists deal with contradictory experimental findings **(Yin, 1984:49)**. In utilising replication logic it is imperative that **a rich theoretical framework** under which a particular phenomenon is to be found (a literal replication) as well as conditions under which it is not likely to be found (a theoretical replication) be provided. This theoretical framework becomes a vehicle for generalising new cases, similar to the role played in cross experiment designs **(Yin, 1984:49)**.

Replication logic is distinguished from sampling logic. Sampling logic demands an operational enumeration of the entire universe or pool of potential respondents and then a statistical procedure for selecting the specific subset of respondents to be surveyed. This logic

is applicable whenever an investigator is interested in determining the prevalence or frequency of a particular phenomenon and when it is too expensive or impracticable to survey the entire universe pool. This is misplaced logic when conducting case studies because, first case studies should not generally be used to assess the incidence of a phenomena. Second a case study would have to cover the phenomena of interest and its context, yielding a large number of potentially relevant variables which would be difficult to statistically analyse **(Yin, 1984:49-50)**. This study was studying the factors that are conducive to good maintenance information management. It was not documenting the incidence of poor information management. Therefore, use of replication logic justifies the selection of the two cases utilised in this study.

The definitions of the units of analysis and therefore the case/s, is done closely in relation to the manner in which the initial research questions have been formulated **(Yin, 1984)**. It can be an individual, a group of individuals or an organisation. This study was a multiple case study in which two organisations were the cases. The ***units of analysis were the maintenance departments/sections*** within these organisations. The respective organisations were ***the Kenya Breweries Limited*** and ***the Nairobi City Commission***. These were chosen, first, because of their accessibility to the researcher. Second, they have been in existence for a long period of time and provided the researcher with the requisite data. Third, they are drawn from two very important sectors of the nations economy: Local Government and the Private Sector. In many ways the private sector is seen and expected to function better than the public or local government sector. Thus, this study of the two cases enabled comparison and provided pointers on the efficacy of the practises adopted by each.

DATA COLLECTION

Need for Fieldwork

The fieldwork helped in determining the organisational structure of the maintenance departments and how they related to the overall organisational structure. Secondly, it enabled

the researcher to determine the activities at various levels in the maintenance department and the consequent information needs. In this regard the fieldwork enabled fulfilment of study objectives (a) and (b). Thirdly, it assisted in collecting the data essential in the determination of delay-times to maintenance requests. In undertaking the condition survey of the built assets in the study areas, objective (d) of the study was partly fulfilled while the results were linked to objective (c) of the study.

Preparation for the Fieldwork

After some background reading, an initial list of proposed questions to be addressed in the study was compiled and sent to my supervisors for their perusal and comments. A user-reaction survey was conducted in each of the cases and the results are presented in chapters detailing the cases individually. The set of questionnaires for this survey was directed to the users/occupiers of the built assets. It was aimed at determining the existing information link between the user/occupier and the maintenance department of each organisation. Further, the research split each organisation into four levels namely; strategic planning, management control; operations control; and transactions processing. A set of questions was compiled for each of these levels. At the strategic planning level, the questionnaire was intended to collect data on: the assessment of the maintenance management structure; the functions and activities performed under each and the information collected, stored, analysed, retrieved, disseminated and applied. The respondents opinion on the state of maintenance practice within the organisation was also sought. The second group of questionnaires comprising three sets collected data relating to:

a) Functions and activities performed under each function and information needed;
b) Collection, storage, analysis, retrieval, application and dissemination as well as sources of the information needed.
c) Respondent's opinions about problems they face in executing their responsibilities.

These aimed at the management control; operations control and the transactions processing

levels. An observation chart was used to conduct the condition survey and the results were used to determine the degree of under maintenance. These questionnaires were agreed upon with my supervisors and samples of these form appendix `A'.

Execution of the Field Survey

The questionnaires discussed were administered to the study areas and in this report execution of the field survey is detailed in two parts corresponding to the study areas. These were the Nairobi City Commission and the Kenya Breweries Limited. At the Nairobi City Commission several problems were encountered including:

a) Delay in getting research authority from the Town Clerk for about 6 weeks;
b) Dispersal of sites within the study area;
c) Uncooperative attitude amongst some of the interviewees; and
d) People to be interviewed were at times unavailable or the researcher would find newly posted personnel not familiar with the job.

While at the Kenya Breweries Limited the major problems were:

a) Long commuting distances.
b) Sites were dispersed.
c) Estate manager took long to answer my questionnaire and this greatly affected my schedule.

DATA ANALYSIS

The method of analysis used in this study utilised the principle of replication logic in the cross-case analysis. In this endeavour the literature review assisted in making the analysis. Descriptive analysis was used in writing the case reports. Data from the field survey helped or was utilised to comprehensively describe the manner in which the maintenance process in each of the study areas was initiated and completed, the various maintenance management responsibilities at each level, information needs and the sources of such information. The reporting mechanisms were also analysed.

The questionnaires utilised for the user-reaction survey and the observation charts for the condition survey were analysed using the **Statistical Package for Social Sciences (SPSS) version 4.0** together with an **IBM Personal System model no. 55X.** They were first coded and these codes were then inputted into the computer. The resulting analysis was produced as frequencies and percentages which are represented in the form of tables and charts.

Analysis of the maintenance records was done manually. With respect to NCC, the various dates collected from the works requisition orders, and building work orders were transferred to the analysis sheet (see appendix 'E'). Using this sheet average response times were computed manually on a district by district basis and for the NCC as a whole. With respect to KBL, I was able to compute only the response time (time or delay between reporting of a defect and action being taken). I then went ahead and described the procedure without quantifying delay times which I was unable to get data on.

SUMMARY

This study dealt with the problem, the hypothesis of the study, the significance of the study, its scope and area of reference and the research methodology used. Also of importance were the objectives which were relevant to the study.

The next chapter deals with literature relevant to the study. In particular it discusses the Maintenance Management Information System (MMIS) which formed the basis for discussing maintenance information management in the study areas. These areas include the need for a methodology that enables maintenance personnel to define the data that they need for effective and efficient management of maintenance, identification of techniques for handling data with emphasis on those relevant to maintenance, and the characteristics of good data. With respect to the data definition methodology, the necessity of a clear and comprehensive maintenance policy, maintenance procedures and economic aspects of

maintenance are discussed. The third chapter reviews literature on information, information systems, information management and maintenance. It discusses the nature of information and the distinction between data and information. Information management and its nature are dealt with in this chapter and the sundry tasks involved in management of maintenance information are detailed. The implications of lack of adequate information management on the state of the built environment are discussed.

The analysis in chapters 4 and 5 details the organisation of maintenance activities in the study areas. It describes the flow of information by describing the structures of these departments and analysing past maintenance records. A maintenance condition survey of the built assets is discussed and the results used to describe the level of under maintenance. Also the results of a user reaction survey are described.

The study concludes in chapter six. Amongst the findings is the fact that the maintenance information systems in the organisations surveyed are flawed to the extent that they are unable to ensure that the built assets are effectively and efficiently maintained. They were not useful in ensuring that the data stated as required by the maintenance personnel was collected, analysed and retrieved for use when necessary. The study recommended among other things that a comprehensive and clear maintenance policy and strategy for both organisations be formulated. This is especially so with regarding to the definition of the roles of the participants in the maintenance process and the way in which the data and subsequent information is handled.

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CHAPTER TWO

THE MAINTENANCE MANAGEMENT INFORMATION SYSTEM (MMIS)

The MMIS is an information system that caters specifically for the estates/maintenance department. In making this observation it should be noted that information systems ought to have an organisational bias. The MMIS in this regard caters for a particular functional area. The maintenance management information system (MMIS) will in this respect assist in ensuring that asset management activities, broadly and specifically, are efficiently and effectively carried out. Broadly, in the sense of ensuring that the utility and value of built assets are retained and enhanced. Specifically, to ensure that the assets serve the primary purpose for which they were built.

Jones (1990), identifies three main ingredients and several characteristics of an estate management information system that aid in the important task of information management. These would equally apply to a MMIS. The reason for this is that maintenance is the actual or one of the tasks entailed in estate management. Thus, the MMIS must be able to define the data needed for proper asset management. Secondly, these data should be accessible, manageable, secure, durable and usable. Thirdly, the MMIS must have the necessary techniques for collecting, processing, storing, and presenting the data within it and without it. Such a framework would enable the maintenance department or section to provide relevant information to the strategic planning, management control, operations control and transactions processing levels of the department. It would also serve the other sub-systems of the organisations. Therefore, in studying the information systems of various organisations the study concentrated on three main areas namely:

(i) Data definition methodology for asset management.
(ii) Data handling techniques;
(iii) The Data.

Under each of these, various important areas are addressed.

DATA DEFINITION METHODOLOGY FOR ASSET MANAGEMENT

A means must be put in place enabling the maintenance department to identify what aspects of the assets under its charge need to be addressed. Then, it will be able to decide exactly what type of information it needs to execute its responsibilities. In this regard there is a great need of interaction with the other organisational units. To do this it has to know exactly how it fits within the overall organisational structure, its responsibilities, how these are to be fulfilled and at the same time assist in achieving the basic objectives of the organisation. This calls for an effective strategy. Strategies are the means by which organisational goals are met **(Scott, 1986). Koontz and Weihrich (1988),** define them as programmes of objectives of an organisation and; resources used to obtain these and policies governing the acquisition, use and disposition of these resources. With respect to maintenance strategy it should deal with maintenance policy, maintenance economics and maintenance procedures **(Miles and Syagga, 1987).** If these three issues are adequately addressed, they will enable maintenance management to accurately define what data/information its MMIS should provide.

Maintenance Policy.

Policy is concerned with what is relevant and critical to the enterprise as a whole and it provides this focus by integrating the relevant content of the functional disciplines within the context of 'organisational purpose' **(McCarthy, Minichielo, and Curvan, 1975:14).** A maintenance policy should therefore ensure that organisational goals are met at the least resource cost with respect to the organisation. According to BS 8210:1986, a maintenance policy should ensure that: ***asset and resource values of property are protected, value for money expended is obtained and the owner/occupier is protected against breaches of legal and statutory obligations.*** Apart from these, the owner/occupier should be closely involved in the asset management process. **Miles and Syagga (1987),** say that there is a growing awareness that human society depends primarily on personal responsibility rather than public

contribution for the full and proper use of resources, a view consistent with that of **Turner (1976)**, which indicated that management and maintenance of dwellings and their surroundings and, therefore, their longevity depends greatly on the residents and users. Thus, in addition to the factors previously stated, maintenance policy should be clear on the role(s) of users/occupiers of built assets in their maintenance and management.

James (1972), sets out several factors that need to be considered in formulating an organisation's maintenance policy:

i) aims of the parent organisation - especially the effects of such aims on built assets;
ii) the standards required - influenced by the aims of the organisation and the types of built assets in place;
iii) legal liability - compliance with statutory obligations,
iv) method of work execution (maintenance) with particular attention to their effect on primary organisational goals, and
v) financing of maintenance - decisions based on predetermined criteria.

The aim here is to have a systematic manner in the management of assets because a framework for decision making has been set. This is the purpose of policy and of the aforementioned five factors. It is only available when a systematic arrangement of asset management is in place. Amongst other benefits is the fact that it leads to a more realistic assessment of expenditure levels in asset management. Such systematic asset management as advocated by **Lee (1987)** involves:

a) **Compilation of a detailed property data base.**

This data base will contain data relating to the asset location, age, function, size, construction of the asset, floor areas, element areas, services provided, space usage (plus viable alternative uses), occupation costs, life of asset (design or otherwise), residual life of asset, replacement value, constraints on the asset (e.g. listed building), and the maintenance log. The maintenance log provides details of any work done on a built asset for maintenance purposes. Sources of these information are various ranging from designers, contract documents, building maintenance manuals, inspection reports (condition surveys) and other special surveys (e.g. valuation reports).

A detailed database would greatly assist in the one area where maintenance management is deficient i.e. planning. Spillover benefits of planned maintenance would be a better usage of organisational resources and also providing user/occupiers better environments.

b) **Determination of the Maintenance Status of the Asset**

Basically this is a condition survey. It is an essential aspect of asset management. It acquires an even more crucial role given "the changing legislation and demands faced by public sector property owners; a greater awareness of building economics by private sector property owners; evidence of substantial waste in present efforts at maintenance as a result of a serious knowledge gap of the assets being managed, and the need for pursuit of `value for money' **(Then, 1992).** Condition surveys are a great help in meeting these challenges.

c). **Analysis of the usage and performance of building spaces.**

This is a very important but often neglected aspect. It acquires even more significance given the fact that maintenance or asset management budgets face the slash everywhere and that funds for putting up new assets are increasingly scarce. Such an analysis ensures that all optimally utilised spaces, and those bringing the highest returns or those that influence the esteem in which the organisation is held receive their due attention. Also, alternative space usage's can be considered in the light of market trends.

d) **Application of Life Cycle Costing techniques on all resource implications.**

The aim here is to have an adequate and concrete decision making base given various choices faced by asset managers. Such would include repair/replace, alterations, conversions and other such like decisions. Although it gives a quantitative decision base, qualitative influences must not be rejected out of hand. For example, an asset may have ceased serving any economic purpose and the site could yield more financial returns if put to other uses. However, the historical sentiments attached to the asset

would outweigh any conceivable financial rewards. Thus in using life cycle costing techniques it is crucial that both qualitative and quantitative issues be pondered in making decisions. With respect to quantitative issues, accurate data relating to costs and benefits must be available. This will only happen if a deliberate and conscious decision is made to collect and maintain data.

e) **Formulation of a Works Programme.**

These programmes will set out the resources required and the timing of the various tasks that have been identified which will obviously depend on the scale and prioritisation of the work involved. These programmes will range from daily cleaning schedules through routine repairs and replacements to major capital investments. In formulating the works programme the MMIS acts as a co-ordinating tool.

The management information needed for this process is gleaned from various sources, internal and external. What information management (maintenance) does is to reduce the dependence on external sources by ensuring that the maintenance management information system provides relevant information when needed.

Maintenance Economics.

It assists in allocating the organisational resources availed to the maintenance department efficiently and effectively: to maintain the structural safety of the buildings, provide a reasonable return on capital assets and provide an acceptable living or working environment for the occupants **(Miles and Syagga, 1987:17-18).** It requires a planned approach. Use is made of appraisal techniques such as life cycle costing, costs-in-use and cost-benefit analysis. The objective being to compare different alternatives available and make informed decisions. These appraisal techniques require an accurate data base with such information as initial and running costs for various elements and components in various situations.

It should be noted, however, that data collected will be influenced by very many factors such as the type and kind of the building. But the usefulness of such data is in its being a guide in the allocation of resources. The interdependence and interrelationship of initial and user costs are of prime importance in planning maintenance expenditure and the relationship is often an inverse one **(Seeley, 1976:19).** It also has been, shown that decisions on the ratios of initial to future maintenance costs are influenced by time preferences and commercial judgement **(Wright, 1973).** When total occupancy costs begin to exceed the net returns from the assets, then a decision has to be made on the continued usefulness of the assets. This can only be undertaken where accurate and complete data on the assets is maintained.

Maintenance Procedures

These lay down and classify the maintenance that is carried out, how it is carried out and when it is carried out. Prioritisation criteria are stated in these procedures. **Miles and Syagga (1987),** contend that for management purposes maintenance could be usually classified into any of the following:

a) Size and nature of the works executed.
b) An expenditure budget.
c) The maintenance process.

These procedures are important in the management and accounting of maintenance resources. They assist in ensuring that the management of built assets is done in an accountable and transparent manner. This is possible because the procedures reduce the number of grey areas by providing decision criteria that has been determined as appropriate for various situations.

a) <u>Size and nature of work executed</u>.

In classifying maintenance by size and nature of works executed, the criteria for such division may be monetary, technical or both. Thus, an organisation may have classified its work into minor, major and essential services maintenance. These can then be costed after execution of work or before. It is a very useful division for

budgetary purposes because it enables monitoring of maintenance budgets (expenditure) and can lead to better financial control. However, its efficiency is questionable especially when it comes to design feedback and justifying whether the expended amounts were accompanied by commensurate returns in terms of quality of maintenance work. Also, the prioritisation of work becomes difficult. It inevitably is so because of the fact that maintenance funds are easily cut back in austere times. It leads to `crisis' or `ad-hoc' maintenance work.

b) **An Expenditure Budget**

Classification of work through an expenditure budget requires a commitment to planning for it to be effective. Items of work crucial to the organisation are identified and costed and these are used as a basis for developing budgets. These items of work may be occasional or cyclical. The latter are those that must be undertaken to maintain the structural or otherwise, integrity of the building. The former will arise through a reporting system for defects or through condition surveys. The resulting information will be crucial in determining the usefulness of the expenditure budget. An accurate and well prepared expenditure budget is not only useful to the maintenance manager in justifying their budgetary needs but also is a crucial tool for financial control purposes. On the negative side, it still does not address the issues of quality, value for money and design feedback.

c) **The Maintenance Process**

It can be planned or unplanned and be classified as such. BS3811:1984 divides maintenance in such a manner as seen in Fig. 2.0. These two complimentary and interactive systems make up the maintenance management process, although the extent to which one is emphasised more than the other varies from one organisation to another. Also the effects of such emphasis will be varied. Unplanned maintenance, on the other hand is dependent on receipt of complaints.

Technical assessment of a built asset's maintenance needs is not properly done as most of the occupiers are ignorant of their maintenance needs and will only report what they feel requires action or when the situation has deteriorated to crisis levels. However, unplanned maintenance *per se* I submit will not result in poorly maintained built assets in which case the reporting system is crucial. Another determining issue will be finance. If it is in short supply then proper maintenance of the built asset will be difficult.

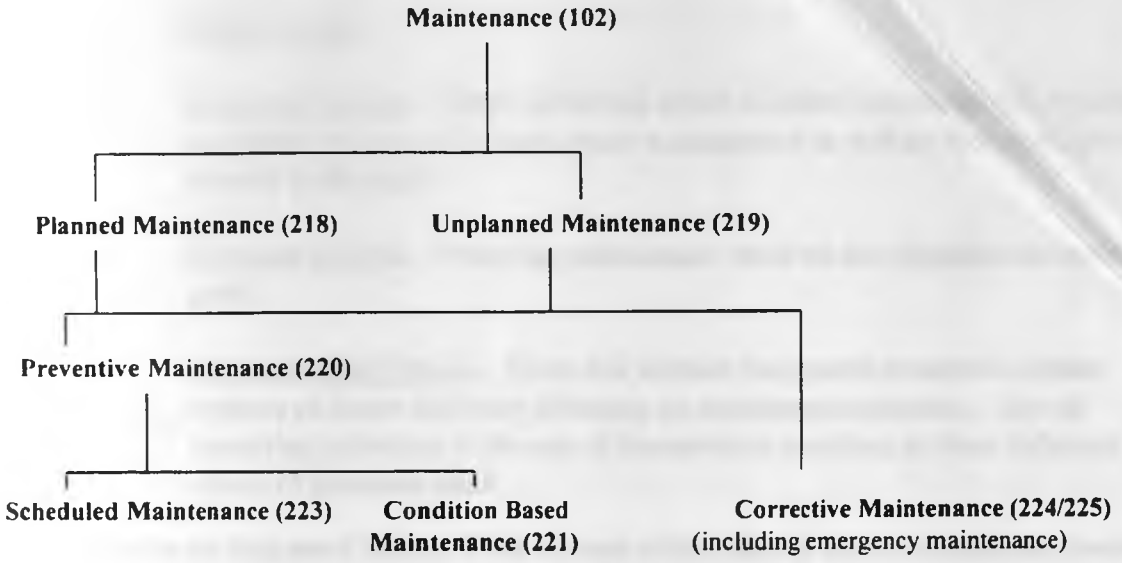

Fig 2.0 : Relationship between Various Forms of Maintenance, BS 3811 : 1984,3.

Planned maintenance cannot be effective in the absence of information which will assist in planning the work, assessing the results and also providing a guide for future policy **(Miles and Syagga, 1987; Clifton, 1974).** The initial cost of implementing a planned system is high but such costs are surpassed by such benefits as greater and more efficient utilisation of labour; higher levels of output, quality of work, performance and efficiency of people because of regular, planned servicing of facilities and equipment, cheaper than stop-gap repairs; fewer breakdowns of essential or other equipment; and more efficient control of stocks **(Clifton, 1974).** There will also be improved budgetary control and a rationalised hiring of manpower requirements.

Maintenance Criteria

The Bath University of Technology in the UK, in several studies, identified some six technical and non-technical criteria that determine maintenance budgets. These are:

a) Technical Criteria. The physical characteristics of a building.

b) Organisational Criteria. These relate to factors such as hierarchy; demeanour and knowledge of the building maintenance in-charge; detail and convention of the budget process.

c) Policy Criteria.

d) Economic Criteria. These reflect the extent to which maintenance is regarded as a factor in the total property/asset management as well as the organisations attitude to the assets.

e) Financial Criteria. Financing maintenance vis-à-vis the organisations main goals

f) Environmental Criteria. These will include the general economic climate; systems of tenure and their influence on maintenance practices. Also of increasing relevance is the role of conservation practices as these influence the choice of materials used.

These criteria are important in that, if the concept of ***the duty of care*** is considered, levels of care can be established and these are then useful in determining the necessary resources in terms of equipment and manpower **(Miles and Syagga, 1987:47).** In establishing these ***levels of care*** maintenance generators, such as climatic exposure, technology change, user/occupier activities and trends in tastes, must be considered under environmental criteria. Other factors in this regard include the environmental effect on users which is vital when addressing the issue of maintenance standards **(Miles and Syagga, 1987:44-45).** Thus the basis for maintenance budgeting according to **Miles and Syagga** should be:

a) Demand for maintenance- determined by a technical assessment,
b) Availability of resources- determined by overall resources available to the organisation;
c) Standards of service- should also be determined by the technical needs for each building and also what the maintenance manager considers most appropriate given the circumstances he faces;

d) The need for regular maintenance - determined by legislation, manufacturer's instructions, resources available users/occupiers and the organisations objectives;
e) Standard costs- usually repetitive costs which assist in improving the accuracy of budgetary forecasts. These include such items as daily cleaning costs, and
f) Productivity of available resources.

If these items are to form the basis of maintenance budgets, then data on the same should be collected, analysed, applied and disseminated. In other words it must be properly managed.

TECHNIQUES FOR HANDLING DATA/INFORMATION

In an effort to reduce the deluge of data and information to meaningful levels use is made of the following techniques:

a) Classification
b) Coding
c) Databases

Classification

Whichever method of classification is used it must be able to adequately meet the information requirements of the users. It has been established (see chapter two) that no one classification system is appropriate or universally applicable. However, for the construction industry the two systems are potentially useful in the classification of maintenance information: construction industry/samarbetskommitten for Byggnadsfragor (CI/sfB) and faceted classification.

Construction Industry/Samarbetskomitten for Byggnadsfragor (CI/sfB)

This system is derived from the Universal Decimal Classification (UDC) system which classifies all knowledge into ten primary groups with each group being divided into ten secondary groups which are further sub-divided into ten tertiary groups assuming a tree-like structure **(Lee, 1987:196). Bakewell (1978),** contends that the UDC system is very limiting since activities such as sorting and comparison are difficult because regrouping is impossible.

Thus, processing or analysis of data is hampered. The CI/sfB scheme divides construction into five recognisable groups, in the form of tables (0,1,2,3,4) shown in figure 2.1:

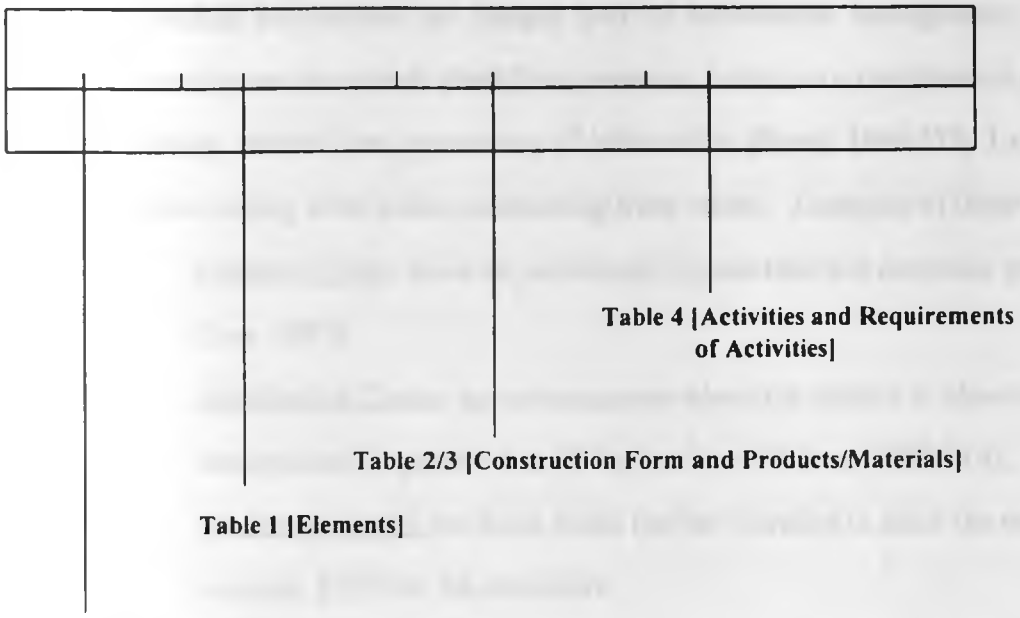

Fig 2.1: **Arrangement of Reference Tables, Reginald Lee Building Maintenance Management London BSP Publications Books, 1987. 3rd ed. 197-198.**

Each of these sub-divisions can be further expanded to incorporate new developments as well as the addition of specific maintenance facets **(Lee, 1987).** Filing using this scheme utilises open ended filing boxes or ordinary card folders with some simple form of binding **(Nguyo, 1988).** Information can also be arranged to suit particular projects or assets.

Faceted Classification

Lee (1987), says that this scheme is more suited to processing purposes because it creates a series of general concepts, such as colour, products; finish; etcetera which are mutually exclusive and it enables combinations of new aspects as new concepts are formed. This makes it quite useful for maintenance especially of newer assets where new technologies and materials are being employed.

Coding

Classification of the data is but one aspect of data management. With the advent of computers coding has become an integral part of information management. Codes are identification schemes that attach identifying numbers, letters, or a combination of the two to facilitate storage, retrieval and processing of information **(Scott, 1986:373; Lee, 1987:212-13).** Therefore, coding is the action of attaching these codes. Examples of these are:

i) Numeric Codes: these are convenient for machine and computer processing **(Lee, 1987).**

ii) Alphabetical Codes: are advantageous where the number of classes to be distinguished is greater than 10 but less than 26 **(Lee, 1987:213).**

iii) Mnemonic Codes: are those codes that are intended to assist the memory. For example, STNWK for stonework.

iv) Alpha-numeric Codes: are easier for visual recognition **(Lee, 1987:213).** [See Fig 2.2]. An example of an alpha-numeric code field in an organisation is shown in fig.2.2 classifying costs in terms of location, element, and operation.

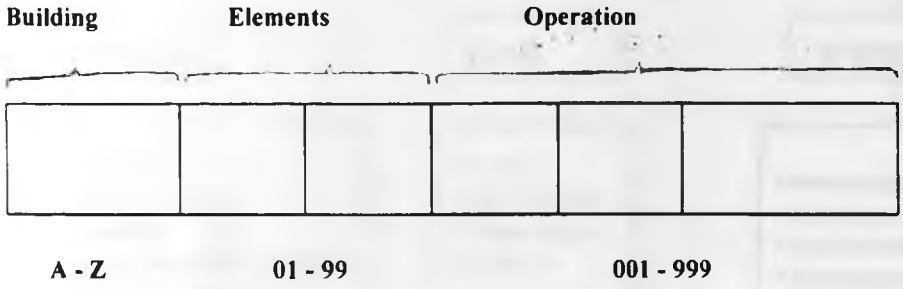

Fig 2.2: **Example of an Alpha-Numeric Code. Reginald Lee, 1987. Building Maintenance Management. 213.**

The techniques mentioned would be useful in ensuring that maintenance information is properly managed. Other important tools in the handling of data are databases.

Property Database (Asset Register)

Property databases are where all the information pertaining to each individual asset is to be found. The British Computer Society defines a database as,

> ***a collection of structured data which is independent of any particular application (Lucey, 1991:263).***

Lucey (1991), goes further to say that a database has several important features, namely: data independence-data items are stored for their sake; data integrity-avoidance of conflicting duplicated data and; data flexibility- data can be assessed in many different ways and for many different purposes.

Thus, the database becomes a very important aspect of the maintenance management information system. This is because maintenance management applications are a question of sorting and presenting information in response to ad-hoc enquiries or regular reports **(Bates, 1987:15).** Fig 2.3 provides a simple example of what a property database would contain.

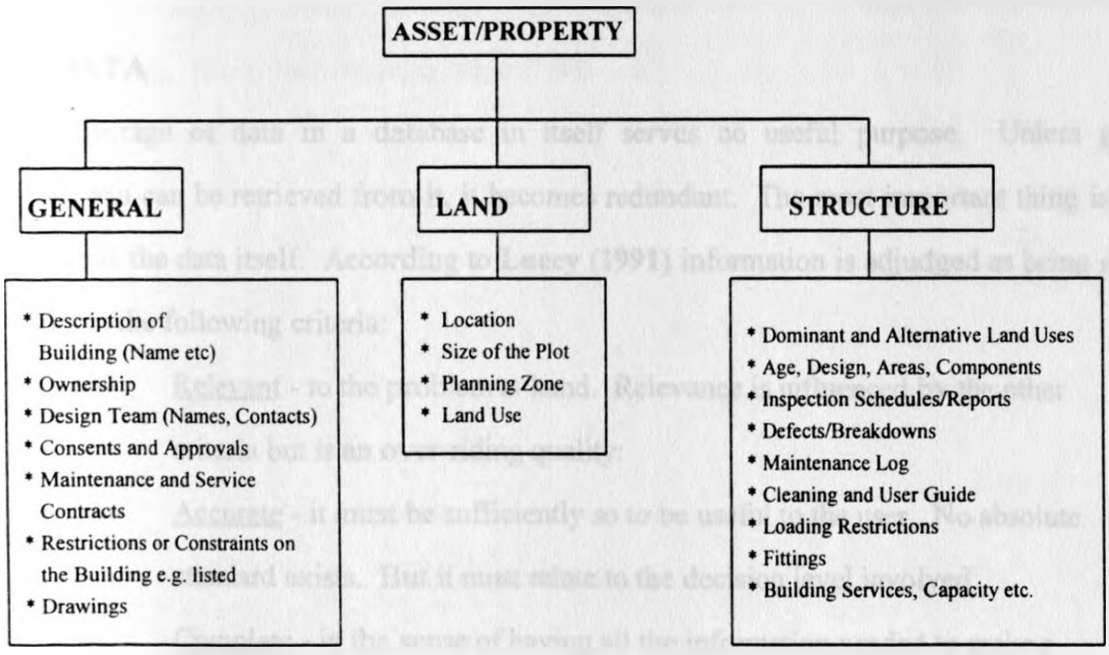

Fig. 2.3: **Contents of an Asset Register or Property Database. Bates, R.A. 1987, 16; Okwemba, R.A. 1981, 32-33.**

This database should provide information about each individual asset/property. The data should relate to the various aspects of the built asset such as the land, the structure itself and so on. Such data would be useful for a variety of purposes. **Okwemba (1981),** lists the uses of such databases as a basis for planned maintenance of the assets and the mechanical and electrical devices within; comparison with other organisations; for purposes of budgetary control; as an aid to cyclical maintenance; as an aid to improved labour productivity; as a tool for stock control; as a database for computer use; and as a source for feedback information. It also forms the beginning of a standardised system of information management in the organisation as well as the country and eventually the whole world.

The data base can either be a building maintenance manual or a computer file. It can also be centralised or otherwise. If it is decentralised there must be scope for quick and easy access to any relevant data requests. To ensure data security certain data classes can be made accessible to only certain categories of personnel staff e.g. drawings to security officials only.

THE DATA

Storage of data in a database in itself serves no useful purpose. Unless good information can be retrieved from it, it becomes redundant. The most important thing in the database is the data itself. According to **Lucey (1991)** information is adjudged as being good if it meets the following criteria:

a) Relevant - to the problem at hand. Relevance is influenced by the other criteria but is an over-riding quality:

b) Accurate - it must be sufficiently so to be useful to the user. No absolute standard exists. But it must relate to the decision level involved.

c) Complete - in the sense of having all the information needed to make a decision available. Since this is not always the case, completeness in this instance would refer to key issues of the problem at hand.

d) Confidently sourced - this means that the source of the information should be reliable. This will arise from past reliability of the source and the level of communication between the source and user. This is why at certain organisational levels cross-checking of reports and such has to be done.

e) Communicated correctly - to the right person and must relate to their sphere of activity in executing their tasks.

f) Well Timed - so that when it is needed for use it is available. However, the need for speed must not conflict with the need for accuracy. Timing will depend on the activity or decision to be made.

g) Correctly Detailed - such that it is sufficient for decision making. This will reduce the costs incurred due to the extra processing, storage and assimilation needed as well as the consequences of wrong decision making.

The data on top of all these should be readily available in enabling the various decisions and tasks, at the strategic planning; management control; operations control and transactions processing levels, to be made or done, respectively.

SUMMARY

This chapter dealt with three vital parts of an effective and efficient maintenance management information system which include the need for a methodology enabling maintenance personnel to define the data that they need for asset management, identification of techniques for handling data with emphasis on those relevant to maintenance, and the characteristics of good data.

With respect to the data definition methodology a clear and comprehensive maintenance strategy addressing and clarifying maintenance policy, maintenance procedures, and economic aspects of maintenance decisions was deemed essential. It also identifies data handling techniques relevant to maintenance as well as clarifying the characteristics that make data useful to those who need it.

These three areas of a maintenance management information system together with the literature review in chapter 3 form the basis upon which the case studies outlined in the chapters four and five are analysed. Chapter 3 discusses information systems, information management and how these relate to maintenance and its management.

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CHAPTER THREE

INFORMATION SYSTEMS, INFORMATION MANAGEMENT AND MAINTENANCE

INFORMATION SYSTEMS

The Nature of Information.

The terms `data' and `information' are frequently used interchangeably but in principle a substantial difference exists between the two terms **(Burch et al, 1979 and Lucey, 1991:14)**. Data are numerical representations or symbolic surrogates that characterise people, organisations, objects, events or concepts. Information means data that is structured (by way of modelling, organising or converting) so as to improve insight or knowledge regarding a certain phenomenon **(Nijkamp, 1984:4).** Data, therefore, is the raw material for information. However, the mere fact of processing or structuring the data either by an extraction or compression process does not create information **(Martino, 1969:25).** Processed data becomes information only when it influences the decision making patterns of the recipient **(Lucey, 1991).** This introduces the user's perspective and assists in focusing the efforts of those concerned with managing information. The aforegoing discussion shows that information can be variously defined depending on ones emphasis. ***This study takes a decision-making perspective in that data collected becomes information only when it affects the decision making patterns of the maintenance officials.*** This information is increasingly being seen as an economic resource as well as a commodity both by society and individuals. It has several characteristics that set it apart from the other traditional resources such as land, man and capital. Information is expansive, its limits being set only by time and human cognitive abilities. This is attributable to three reasons: it is naturally diffusive, it reproduces rather than is consumed during transactions and it can only be shared not exchanged during use. In addition it is compressible, it is transportable at high speeds using information technology, and can be substituted for other economic resources **(Goetz, 1990:553-54).**

Information technology (IT) has been defined by the Department of Trade and Industry as, *the acquisition, processing, storage, and dissemination of vocal, pictorial, textual and numeric information by a microelectronics based combination of computing and telecommunications* **(Lucey, 1991:232).** Items such as computers, fax machines, telephones, satellites and so on are individually and concertedly improving the speed and ease with which data and information are stored, processed, disseminated and applied. Thus, they are major tools in information management considerations. Among others, **Cleveland (1982)**, identified a similar set of characteristics that make information a unique resource from a user's perspective. **Rich (1980)**, had argued against such a perspective saying that a broader view, the increase of citizen well being, should be operative instead. **What is evident is that the value of information can be assessed from different view points**. **Repo (1986)**, reckoned that the philosophical and practical values were ignored by the economic perspective and suggested that there was no need of trying to count the total value of information due to different viewpoints and observation levels leading to varying emphasis, and that an organisation measuring the value of information in a particular situation has to get the users opinion about their information needs and study information use contexts. In my opinion this is a plausible argument given that different organisations are influenced by different sets of circumstances, chief of which are the organisational goals and resources, the operative words being efficiency and effectiveness. This has a significant influence on information management in the sense that collection, storage, processing and dissemination or application of information must lead to the organisation undertaking the tasks at hand in an efficient and effective manner.

The view of information as a commodity has led to the rapid growth of the information service sector. It is this rapidly growing sector that provides a range of information products and services; reduces information to manageable levels, protects information and intellectual property rights; replaces labour with automata; replicates rare expertise through computer software; and provides consultancy in all walks of life **(Goetz,**

1990:554). In the United States for example, this growth has surpassed that of other economic sectors within the same time period as evidenced by Table 3.0.

Table 3.0: **LABOUR DISTRIBUTION (%) IN THE UNITED STATES 1880- 2000.**

	1880	1920	1955	1975	2000 (est.)
Agriculture and Extractive	50	28	14	4	2
Manufacturing, Commerce and Industry	36	53	37	29	22
Information, Knowledge, and Education	2	9	29	50	66
Other Services	12	10	20	17	10

Source: Mollitor, Graham T.T, 1990.

It is these characteristics that have made information the base of such societal concerns as research, education, publishing, marketing and even politics **(Goetz, 1990:550).** This information doesn't find use in a vacuum but within the confines of an information system.

Historical Development of Information Systems.

Information systems are means through which society or its components are able to collect, organise, store, process and display information in all its forms (raw data, interpreted data, knowledge and expertise) and formats (text, video and voice) **(Goetz, 1990:561).** This definition is all encompassing but definitely not conclusive. It does not seem to include the organisational structure as a significant aspect of information systems. However, the theme of the definition is record-keeping. Thus, any record-keeping system may be regarded as an information system **(Goetz, 1990:561).** Record-keeping systems through the ages have been aimed at providing information. From the Phoenician merchants of Ugarit and Byblos in the times of the Greek civilisation, through the Persian and Roman empires into the present millennium priests, scribes, administrators and merchants kept records **(Darlton, 1969).** Modern information systems have developed basically out of management's' realisation of a gap in the formal information systems. Pacioli is reputed to have developed double-entry book keeping in the late 15th century and his system was more interested in providing information about indebtedness than profits **(Tricker, 1976:245).** Present accounting

information systems, provide or try to avail as much information as is needed by people or organisations including indebtedness, profitability, profits, and projections.

The growth and development of the electronics industry has greatly influenced the evolution of information systems. The extent of this has been such that information systems are often seen as computer systems. There is, however, a distinction. Information systems are aimed at producing information and computers are facilitators in the production of information **(Lucey, 1991:1).** The influence of this electronic dimension has set apart the modern information system which has evolved in six stages. The first three- introduction, expansion and control of computerised functions- reflect a technological emphasis. The last three- functional integration, allocation of responsibility over information and system maturity - manifest a distinct user-oriented focus. These developments contrast greatly between developed and developing countries. While in the former development is in the fourth moving to the fifth stages, in the latter information systems appear to be in transition between the second and third stages **(Goetz, 1990:561).** The movement towards a more integrated (user-oriented approach) was a result of disillusionment with the over emphasis on computer systems **(Lucey, 1991:2).** Computer systems are basically processing systems and will only benefit an organisation if its information is organised. **This study concurs with the view that the initial step should be aimed at organising the information of an organisation.** Thus, the lag in evolution of information systems between developed and developing countries should benefit the latter. The perception is that this is not the case because the distinction between information and computer systems is unclear. The purpose and role of information systems is to support organisational functions, by way of information to aid analysis, planning and decision-making at all organisational levels **(Davis and Olson, 1984:10-11).** Computer systems should aid in the production of the requisite information.

Types and Categories of Information Systems.

Information systems are diverse in terms of structure and function and are continually evolving. Structural distinctions between them are various - manual versus automated, interactive versus off-line, real-time versus batch processing - but a more useful differentiation would be in terms of application **(Goetz, 1990:563; Hutt, 1979:3).** This is a functional distinction and information systems can then be split into two classes of organisational systems and public information utilities **(Goetz, 1990:563).**

Organisational systems can be further split into those that purposely support managerial and administrative functions and others that aid operations and services. The former support or serve internal functions of the organisations, while the latter support the purposes for which the organisations exist **(Goetz, 1990:563).** Examples of management-oriented information systems are executive information systems which aid top executives in their most important function by gathering, analysing and integrating internal and external data into dynamic profiles of key corporate indicators. Others include, in the military, command and control systems whose main aim is to maintain control over a certain area and if necessary initiate corrective action. This system is real-time in nature. Both executive information systems and command and control systems use computational aids for data modelling, classification and simulation. This is also evident with decision support systems (DSS) which support decision making in relatively unstructured problem situations **(Goetz, 1990:563).**

Those information systems which support administrative functions in an organisation, aim at husbanding and optimising corporate resources, viz. employees and their activities; inventories of materials and equipment; facilities and finances. They are commonly called management information systems (MIS) and focus on resource administration and data provision to management **(Goetz, 1990:563).** A maintenance management information system such as the one discussed in chapter two is a good example of this. Typically they consist of a number of modules normally financial information systems, personnel

information systems and project management information systems which may be separate or extensions of other parts of the organisation and are generally centred around a common database increasingly supported by computer software modules and programs **(Goetz, 1990:563-64).**

Service-oriented information systems aid the operations or services that organisations perform for society. Rather than addressing management and administrative functions, they support activities and processes that are the reasons for the organisations existence e.g. manufacturing, health, financial, education, entertainment etc. **(Goetz, 1990:564)**. Public information utilities were realised with the development of new information technologies that enabled the public to make use of the numerous electronic data bases that became available during the 1970's. In many countries, these public information utilities have become a source of revenue in need of control (see Information Management) **(Goetz, 1990: 563-65).** Examples of such include transaction processing systems such as brokerage services, home banking to pay bills and transfer funds etcetera **(Goetz, 1990:565).** All these are aimed at easing human effort as well as enabling people making better informed decisions. However, while such a situation obtains in the western hemisphere, in the preponderance of the developing nations people and organisations are only just beginning to come to grips with such developments, especially regarding technology. These information systems help in information management. But, what really is information management? The next section discusses what information management is and what is required to make it effective and efficient.

INFORMATION MANAGEMENT

What is information management?

Information management is about,

> ***getting the right information, in the right form, to the right person, at the right cost, at the right time, in the right place, to take the right action*** **(Woodman, 1985: 97).**

It is still unclear whether information management exists as a `discipline' and if so for how long this has been the case. **Vickers (1985)**, says that it can only be defined theoretically because it has not been practised long enough. **White (1985)**, on the other hand asserts that information management has been in existence for at least two thousand years under the guise of the title `military intelligence'. Be that as it may information management is becoming an increasingly important topic given the great importance being attached to information nowadays. Information is increasingly being touted as an organisational as well as societal resource that needs to be better utilised. Like any new development there are opponents and proponents of it. The traditional view is that if you cannot hold it in your hand it is not real **(Vickers, 1985).** Those holding such a view say that because information cannot be quantified and reduced to profit/loss terms, it cannot figure in the accounts. The other side says that the importance of information is in the indirect benefits of information management which are significant. **White (1985)**, concluded that improved handling of the information resource would have greater impacts on productivity than improvements in manufacturing techniques etc. Implied here is the conclusion that the effectiveness of information management can be measured by determining improvements in productivity. This makes it easier to convince those concerned on the importance of information **(White, 1985:24).** Jonscher's work was endorsed in a study conducted by the *Wall Street Journal/Europe,* where 98% of the respondents said that improved information management was a priority. One of them was reported to have said that:

Productivity improvements are no longer just a question of saving money or cutting costs, but a question of getting and using the best information possible **(White, 1985:24-25).**

Therefore, ways must be found to manage this resource so as to benefit organisations and consequently mankind.

The information problem felt at the organisational level can also be identified at the national level. In the United States for instance, steps were taken to deal with this problem, especially as it related to paperwork through various statutes such as the Brooks Act on automatic data processing, P.L. 89-306 of 1985 and *the Paperwork Reduction Act of 1980* **(White, 1985).** With increased sophistication and availability of information technology, availability of information has created legal problems relating to intellectual property rights. But it has also enabled cross-boundary, national and organisational, information flows bringing with this new sources of revenue **(Goetz, 1990).** Thus, this untapped resource could go a long way in enabling more efficient use of the other resources available.

Techniques of Information Management.

Vickers (1985), sees the characteristics of information management as:

> ***acceptance of information as a resource to be properly managed; designation of someone to be responsible for managing it; responsibility for planning and co-ordination of the use of information handling skills, information technology, information sources and stores; maintenance of awareness of new developments; contributing to better management of information; co-ordination of all expenditure applied to information systems and resources; and an understanding of the patterns of information flow within the organisation.***

Some of these characteristics may not apply to all organisations alike. For instance in small organisations it may not be possible to employ one person to be in-charge of managing the information resource. Rather, information management is carried out as part of the other organisational activities. It is carried out by people, through systems and procedures, in information media, within the organisation structure and by the management.

The techniques of information management are, therefore, a composite of ***systems and procedures; mapping tasks, duties with information needs and use of information technology.*** Systems and procedures enable information to be collected and dealt with in a

manner enabling its use to meet the tasks at hand. These will invariably relate to the organisational structure and they reflect to a large extent the kind of organisation one is dealing with. Also it is systems and procedures that indicate the tasks that individuals perform and implicitly their information needs. Classification has been described as:

> ***the actual or ideal arrangement of those objects which are alike and the separation of those which are unlike. The categories should be meaningful to the user and sufficient in number to allow relationships to be built between relevant groups of information; to identify resources with regard to performance, availability and price; and to facilitate preparation of relevant documents*** **(Vickery, 1965).**

Indexing systems help in identifying items of information so that they can be easily retrieved in response to user needs and with maximum efficiency **(Anderson, 1990:12)**. Classification and indexing are terms that may be used synonymously, referring to essentially the same process. A classification or indexing scheme provides a search pattern facilitating quick and easy access to information because subjects are grouped together according to how related they are, each subject or group of subjects being described using appropriate concepts and symbols, thus, assisting in economic storage, transmission or manipulation of information **(Burch, 1984:15).** Information technology enables faster and cheaper storage, access, retrieval and manipulation of this information.

With respect to built assets, **Then (1992),** sets out the following as the major tasks in maintenance information management:

* To gather up-to-date information on the extent, construction and condition of the built assets.
* To develop suitable comprehensive data bases to hold data that can be easily accessed and be kept up-to date.
* To provide relevant information to aid decision making.

The accomplishment of these tasks will greatly assist maintenance management in ensuring that built assets are well taken care of. Information and its management are thus crucial aspects in the maintenance of built assets especially on a large scale.

MAINTENANCE

Importance of Built Assets and their Maintenance.

Built assets are an important resource, economically and socially, to organisations as well as countries. They are also extremely complex and valuable, diverse and tend towards natural obsolescence which requires that they be properly managed in a manner assisting the organisations or others to achieve their primary goals **(Jones, 1990:1183-1184).** It has been said that,

> ***the built environment expresses in physical form the complex social and economic factors which give structure and life to a community. The condition and quality of buildings reflect public pride or indifference, the level of prosperity in the area, social values and behaviour and all the many influences both past and present which combine to a community its unique character (Lee, 1987:1).***

This environment is, however, in a pathetic state. Studies in various countries and by many persons have revealed a litany of neglect and dissimilar reasons have been advanced to explain this state of affairs. A report entitled *Growth, Employment and Equity: a Comprehensive Strategy for the Sudan*, referred to the apparently rapid deterioration of buildings and other structures due to inadequate regularity and standards of repair and maintenance **(ILO, 1976). Wahab (1980),** reported that ignorance, wrong priorities, preference of new projects, immorality of contracting resulting in contract awards to incompetent contractors, undue favouritism and erroneous feelings that whatever is maintained is invariably inferior to new buildings, contributed to the neglect of maintenance. **Amonoo (1982),** attributed this neglect to high costs of repair and maintenance coupled with low rental values. Others, have suggested that neglect of maintenance has been probably due to the fact that the consequences of such neglect are not immediately manifest **(Aloo, 1985; Ogunjobi, 1990).** What becomes evident is that assets that have taken a lot of time and resources to accumulate are being left to run down. Their maintenance is not given the priority it deserves. Yet, especially for developing countries, more built assets are needed not only for developmental purposes but also for purposes of wealth creation all aimed at improving the lives of people. Another very important reason for maintaining built assets is

economic. This is with respect to the spin-off benefits that accrue. Good maintenance relieves the demand that is placed upon land, capital and labour because people are less inclined to abandon well maintained buildings, especially residential units, effectively reducing the number of people who require totally new buildings. Just on this basis alone maintenance of built assets should be better than it is. Other intangible, but nonetheless important benefits, are those of having environmentally friendly facilities as well as increased user satisfaction. Thus, maintenance and its management are crucial aspects of the wealth creation process.

Maintenance management of built assets can be practised at different levels each with a different emphasis. It could be planned, unplanned, contingency, scheduled, crisis, or a combination of one or more of these. The manner in which an organisation carries out its maintenance function is greatly influenced by the organisational objectives. Planned maintenance is the ideal scenario but in many instances this is not the case.

Maintenance Management and the Need for Information.

Building maintenance has been defined as:

> **work undertaken in order to keep, restore or improve every facility, that is every part of a building, its services and surrounds to a currently acceptable standard and to sustain the utility and value of the facility (HMSO, 1972).**

It is essentially a 'service' to an organisation in the sense of enabling it achieve, efficiently and effectively, its primary purposes. Its importance runs in as far as it assists or inhibits the achievement of these purposes. Thus, built assets as organisational resources are optimised by ensuring that they are well managed. As already discussed this does not seem to be the case. **Miles and Syagga (1987),** intimated that three main failings were at the root of the problems: inadequate finance, bad management and poor building design.

Finance, especially in these times of austerity, is a problem in all spheres of human endeavour. Those that are able to prove not only their need for it but also an ability to

effectively use it stand a better chance of securing the same. The contention with respect to maintenance managers, is that they do not do enough to secure the funding they require. They must justify their needs in economic terms, and to do so:

> ***presupposes a sound administrative structure with appropriate information back-up to determine both short and long term needs; establish priorities; programme and control the execution of identified workload; and measure performance against set targets. The information base to assist in such areas is, therefore, vital to effective management of built assets*** **(Then, 1990:1213).**

This management structure, where it exists, is deficient in as far as the informational aspect is concerned. It, thus, makes the implementation of planned maintenance difficult or impossible. **Aloo (1985),** described the Ministry of Public Works maintenance structure as inadequate reflecting an ad-hoc system whereby all operations were carried out with no attempt to relate them to the future. This relation can only be made on the basis of an analysis of past information.

Such an analysis of past information is also important in the reduction of design defects and hence maintenance costs. The design defects arise principally because of inadequacy in the client briefs, leading to deficiencies of design construction error and defects in materials and components **(HMSO, 1972).** Good maintenance records would go a long way in ameliorating the situation. **Lee (1987),** says that the usefulness of the information from such records will depend on the extent to which it distinguishes work:

1. Regarded as normal in relation to the constructional materials and conditions of use;
2. Resulting from design faults in relation to either technical errors concerning in appropriate constructional details or materials or errors of lay-out in relation to size, arrangement and juxtaposition of working spaces,
3. Made necessary by a demand for higher standards or a change in the pattern of use which could not have been foreseen at the time of initial design.

Evidently a set of records cannot produce such information except a conscious and deliberate effort is taken by those concerned. However, maintenance records of many organisations are lacking in this aspect. **Brifett (1987),** says that design feed back can be able to reduce design defects to a minimum, but only if there is an incentive to prepare it, expertise to analyse it, a

system and a readiness to store it. This has been lacking and could be a reason as to why maintenance is neglected as evidence put forth shows.

Decisions taken at the design stage control upto seventy percent of project costs **(Ganesan, 1984:2).** Yet, maintenance 'experience' is rarely, if ever, used by the design team. This is in-spite of the fact that design parameters have been shown to strongly influence cost **(Syagga, 1985; Miles and Syagga, 1987; Fagg, 1987; Rukwaro, 1991). Rukwaro (1991),** asserted that the concept of maintenance and feedback was ignored and designers concentrated more on function and aesthetics of buildings. Feedback is an informational input into a system, transmitting messages of system operation to indicate whether the system is operating as planned, information concerning any type of planned operation relayed to the responsible person for evaluation **(Koontz and Weihrich, 1988:657).** Thus, opportunities for designing for maintainability are lost. This neglect of past experience could be attributed to the fact that designers consider their task complete at practical completion after which maintenance becomes someone else's problem **(Ogunjobi, 1990:94).** Studies have also indicated that the data collected is not in the form of enabling use at the design stage, say in the form of elemental expenditures and thus becomes only useful for budgetary purposes **(Miles and Syagga, 1987; Syagga, 1985). Tuts (1991),** suggested that such a lack of reliable statistical material (database), which is integrated into a maintenance information system and is necessary for life cycle costing to be effective, could be a reason for neglect of maintenance. This ignorance of feedback has been such that in national statistics, the contribution of maintenance activity to overall construction output is not available. This is with the exception of roads maintenance.

The management of maintenance or asset management involves a number of important steps. **Lee (1987),** opined that a systematic approach to asset management involves the following steps:

(i) Compilation of a detailed property data base.
(ii) Determination of the condition of the building(s).
(iii) Analysis of the usage and performance of building space.

(iv) Application of life cycle costing techniques to optimise all resource implications.

(v) Formulation of an investment programme itemising the expenditure requirements of the various activities and stating how the money is to be raised.

(vi) Preparation of an integrated action plan.

Such an approach will work only if it has the requisite information. However, evidence adduced to previously indicates lack of such necessary back-up. Bad management aggravates an already deteriorated situation compounding the effects of inadequate finance and poor building design. This calls for improved information systems.

Therefore, the effectiveness of maintenance data hinges upon relating the same to performance of materials; organisational patterns, budgetary control systems; and work and method studies. Provision of building maintenance manuals has been alluded to as a useful tool as a starting point in the systematic collection of data **(Okwemba, 1981:3).** However, the basic problem with regard to information management is the lack of a coherent strategic maintenance policy amongst other reasons **(Then, 1992).** This notwithstanding building classification, indexing and coding of building data, is not standardised making it difficult to disseminate the same. In the construction industry in Kenya there is a great need for consensus with regard to classification. Evidence by **Nguyo (1988)** indicated lack of a standard or uniform scheme or even staff to effect it which is a great obstacle towards achieving the often stated goal of linking design and maintenance and in the management of information in the industry.

Maintenance information is derived from diverse sources which dictates that the maintenance department should have a comprehensive database for management and other information. **Miles and Syagga (1987),** say that systematic collection and dissemination of such information is essential allowing for classification and ease of retrieval of the information. Such premeditated action will go a long way in ensuring the efficient management of maintenance information and consequently maintenance itself.

SUMMARY

This chapter basically reviews literature on important aspects of this study namely: information, information systems, information management and maintenance. It throws light on the nature of information showing the difference between information and data. Something is judged to be information when it affects the decision making pattern of the one receiving it. It also adduces to the characteristics of information that have lent this age the label of the `information age'. The development of information systems and the various types thereof are identified, as well as the role these play in the management of information.

The chapter also briefly states what information management is and the various techniques that are useful in doing this. It talks about why there is a need for management of maintenance information and the implications of lack of adequate information management on the state of built assets and their environment.

The next two chapters provide the analysis of the data that was collected during the field survey.

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CHAPTER FOUR

CASE STUDY I - THE NAIROBI CITY COMMISSION

INTRODUCTION

In the year 1900 the colonial government established a township committee to run the services of Nairobi, then a small centre for railway workers **(Makibia, 1974).** Since then Nairobi has grown rapidly both in terms of coverage and population. This rapid population growth is evident from Table 4.0.

Table 4.0: **Population Trends.**

Year	Population
1906	11,000
1946	110,751
1962	343,500
1969	509,286
1979	827,775
1992	1,500,000

Source: Government of Kenya, 1989 and Makibia, I.W., 1974.

As the population of the city has grown so has the demand for residential housing in the city. Statistics have shown that a significant proportion of the residential housing that is available in the city is managed by the Nairobi City Commission. The most recent data available from the Urban Housing Survey (1986) indicated that there were a total of 244,202 dwelling units in the city. The preponderance of this, 65.57 per cent, were rental units **(Government of Kenya, 1986:40, 44).** Therefore, the Nairobi City Commission provides city residents with a total of 18,247 units representing 11.4 per cent of the rental housing in the city **(Government of Kenya, 1986).** This coupled with the fact that the country is facing a deficit in the production of housing means that the manner in which the commission maintains its housing is crucial **(Syagga and Aligula, 1993).** The reason is that if these residential housing units are inadequately managed the consequences for the already serious housing shortage in the country, especially so in the city of Nairobi are not good.

RESULTS OF THE SURVEY

A preliminary investigation of the Nairobi City Commission established that its operations are split into several functional departments, viz.:- Town Clerks, City Engineers, Social Services and Housing, Public Health, Housing Development and Management, City Inspectorate and City Planning and Architecture. Those departments relating to the maintenance of built assets were the City Engineers, the Town Clerks, the Social Services and Housing, and the Housing Development and Management departments.

Within the Town Clerks department it was found that the chief valuer's section dealt specifically with the maintenance of senior staff housing. The Housing Development and Management department concerned itself with tenant purchase housing and was autonomous with respect to the maintenance of these houses. The Social Services and Housing department dealt with the maintenance of rental housing. The City Engineer's department, it was established, acted as an implementing arm of the Nairobi City Commission. That is to say that it carries out the actual maintenance work on the built assets at the request of other departments with the exception of the Housing Development and Management department.

These departments manage a wide array of built assets ranging from hospitals, markets, social halls, schools, through to housing. The preliminary survey established that the 18,247 rental units were under the Social Services and Housing Department . The study concentrated on two departments namely, the City Engineer's and the Social Services and Housing. The reason for this course of action was that studying all these departments required more resources than were available to the researcher. In the following sections a description of the operations of these departments with regard to maintenance is given.

THE CITY ENGINEER'S DEPARTMENT

This department is split into various sections such as the parks section, the electrical section and the building works section. The study focused on the building works section.

The Building Works Section

The section is charged with the maintenance of built assets at the request of the various departments. It however, does not undertake electrical repairs which are carried out by the electrical section. The electrical section was not studied for two main reasons. First, the bulk of maintenance work was done by the building works section. Second, the procedures applied in requesting for maintenance were the same.

The operations of the building works section are headed by the building works superintendent. The section has divided the city into four operational districts as shown in Figure 4.0. As seen here, each district is headed by an assistant building works superintendent, who has his own supporting staff with respect to the maintenance of built assets within his jurisdiction.

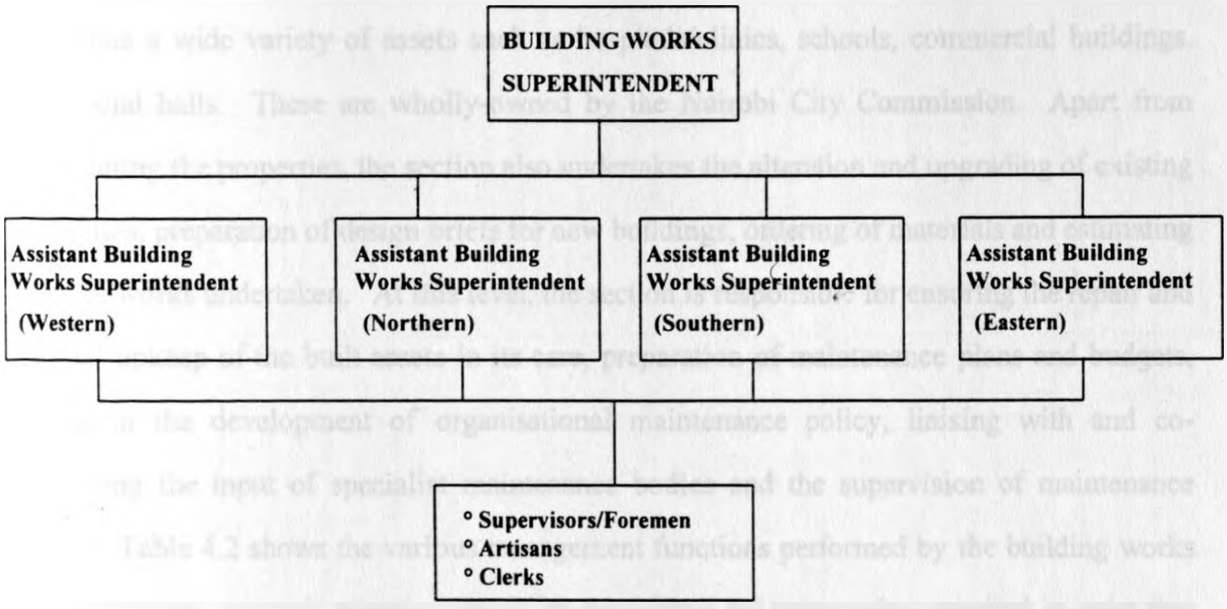


Fig 4.0: Structure of the Building Works Section, Field Survey, 1992.

The researcher went through the records of filled work orders that had been completed in each district office. Data was collected from building work orders dating back to 1988 through to 1992 on maintenance response time sheets (see appendix `B'). Distribution of the works orders sampled was as shown in table 4.1.

Table 4.1 : Number of Building Works Orders per District

DISTRICT	NUMBER
Western	81
Eastern	1357
Northern	328
Southern	348

Source: Field Survey, 1992

Not all data was available for each year. In some districts e.g. northern, the researcher found that a large number of the records had been destroyed due to lack of storage space. In the Western district only two files, containing records related to rental housing were available.

Building Works Superintendent (BWSpt).

As indicated earlier the BWSpt. is in-charge of the building works section which maintains a wide variety of assets such as hospitals/clinics, schools, commercial buildings, and social halls. These are wholly-owned by the Nairobi City Commission. Apart from maintaining the properties, the section also undertakes the alteration and upgrading of existing properties, preparation of design briefs for new buildings, ordering of materials and estimating costs of works undertaken. At this level, the section is responsible for ensuring the repair and general upkeep of the built assets in its care, preparation of maintenance plans and budgets, aiding in the development of organisational maintenance policy, liaising with and co-ordinating the input of specialist maintenance bodies and the supervision of maintenance works. Table 4.2 shows the various management functions performed by the building works superintendent (strategic planning level). It also shows the information required in order that the activities listed can be performed. In formulating the maintenance budget, the building works superintendent needs information about user requests, inspection reports on the assets, maintenance funds allocated, the productivity of the resources at his disposal and the standard costs of materials, labour and other necessary inputs. The building works section does not maintain a property data base or assets register.

MANAGEMENT FUNCTION		STRATEGIC PLANNING	MANAGEMENT CONTROL	OPERATIONS CONTROL	TRANSACTIONS PROCESSING
PLANNING	Activities performed	* Preparing inspection and conclusion survey plans * Preparing specifications and standards * Liasing with the design team *Preparing budgets *Deciding on work execution modes	* Preparing short term budgets *preparing detailed inspection plans *Liasing with the finance department *Labour allocation *Transportation of workers and material to site	*Scheduling of maintainace tasks	
	Information needed	*Inventory Records, Staff Records *Nature, location and spread of work load *Inspection reports, Space usage Patterns *Maintenance Responsibilities, Users of Assets, *Organisational Objectives	*Budgets, User Requirement, Analysis, Inspection Reports *Space Usage patterns, Maintance Procedures, Nature, location and spread of workload *Staff availability, work execution methods *Specification and standard, Elemental cost analysis for properties *material prices and costs	*Maintenance Tasks to be done	
ORGANISING	Activities Performed	*Allocating maintenance responsibility *Setting up adminstrative routine *Delegating of authority and setting up a supervisory system *Providing suitable office accommodation and facilities * Setting up a job execution system *Establishing an appropriate information system and communication channel ensuring coordination and effective feedback for control purpose *Availability of staff and their qualifications *Maintenance responsibilities, work execution methods, Supervision patterns *Providing suitable office accommodation and facilities	*Allocating specific tasks to supervisors *Coordinaung workforce	*Ordering of materials *Allocation of jobs to Artisans	
	Information needed	*User patterns / space usage patterns *Volume of workload, its nature and location *Availability of resources *Maintenance Responsibilities *Work Execution modes, supervision patterns, Technical requirements of work *Timing of work *Policy governing assets	*Maintenance procedure *Nature location and spread of workload *maintenance responsibility *Staff availability, Property maintainace schedule (manuals) *Work execution methods *Specification / standard *labour costs *Material prices / costs	*Materials / Equipment needed *Maintenance tasks to be done	
STAFFING	Activities Performed	*Selection of personnel determination of qualification levels *Assisting developments of schemes of service for maintenance personnel *Motivation ,Recruitment and training of personnel *Secondment of personnel	*Recommending personel for promotion and training *Recomending to building works supritedant on staff requirments		
	Information needed	*Maintenance standards required *Nature and volume of workload needed *Modes of work Execution *Financial Resources available *Qualification levels for staff cadre available in the market *Approved established and future requirements	*Number of vacant posts *Staff availability *Nature, location and spread of workload		
DIRECTING	Activities Performed	*Supervision and meetings with personnel	*Supervision	*Supervision of Artisans	
	Information Needed	*Maintenance workload *User and space usage patterns *Drawings, Specifications and standards required *Manufactures maintenance manuals *Property maintenance manuals *Organisations traditions and current policies	*Reports on job progress *Availability of materials *Maintenance procedures *Maintainace workload, maintainace Responsibilities *Staff Availability *Maintenance profiles, Property maintenance Manuals, work execution methods *Specification and standards	*Plans schedule of executing work	
CONTROLLING	Activities Performed	*Measuring work or job progress *Caculating or evaluational performance measures *maintaining feedback system *Quality, Budget, and materials and equipment control *Evaluating a Job progress Report	*Financial and Quality control *Preparing Specifications *Material control *Measuring job or work progress *Analysis of work progress	*Ensuring satisfactory Standards *Ensuring compliance with statutory requirements *Keeping Record of work undertaken	*Carrying out inspections *Preparing Job Progress Reports *Reporting to supervisors
	Information needed	*Maintenance programmes and Budgets *Performance measures *Maintenance manuals *Standards and specifications *Response time analysis *Elemental Cost Analysis	*Maintenance procedures *Property maintenance Manuals *Financial resources available *Specifications and Standards *Maintenance Responsibilities *Maintenance Profiles *Material Resources	*Job progress *Specifications / Standards required	*Location of Units

However, the survey found out that the department has a list of assets it should maintain. A notable aspect was that this list had to be compiled from the files or from the memory of the respondent. In prioritising maintenance work, the section used the following criteria:-

a) Risk to the occupants and/or contents of the property, and to the asset itself.
b) Effect of the maintenance work on organisational activities.
c) Availability of personnel
d) Cost of the work
e) Volume of the work
f) Complexity of the work

These criteria are listed in order of importance. In monitoring and evaluating job progress, staff performance, back-log status and the asset condition several documents were used.

Table 4.3: Information needed for Monitoring and Evaluating.

ASPECT TO BE EVALUATED	INFORMATION NEEDED/SOURCE
Job Progress	Work Orders User Reports Work Progress reports
Staff Performance	Work Orders Performance Measures
Backlog Status	User Requests Work Orders
Inventory Status/Condition Survey	Inspection Reports

Source: Field Survey, 1992.

Table 4.3 shows certain aspects of maintenance management and the information or source of information needed to evaluate it. Performance measures are those that are utilised to evaluate the planning and working methods and may include, e.g. service efficiency factors, productivity measurements and so on. These are derived from records maintained by the section. Their records provided two kinds of information: budgetary control and management control information. The former were useful in producing annual or other periodic sums which needed to be set aside to cover for operations and maintenance. The latter allowed day to day control over maintenance expenditure. These records were neither classified nor coded and information indicated as required fell into three categories: it was not available at all, not readily available or incorrectly formatted making any attempt at analysis not worthwhile.

Assistant Building Works Superintendent

The Building Works Section divides the city into four operational districts each headed by an assistant building works superintendent who reports to the building works superintendent.

Table 4.4: District by Operational Area (in terms of Rental Housing).

DISTRICT	OPERATIONAL AREA
Eastern	Kaloleni, Shauri Moyo, Jericho/Lumumba, Mbotela, Maringo, Bahati, Buru-Buru, Kariobangi South, Outer Ring Road, Embakasi, Jerusalem, Uhuru, Ofafa 1, Harambee, Hamza Road, Makadara.
Northern	Kariobangi North, Bondeni, Gorofani, Pumwani, Ziwani, Kariakor, Huruma
Southern	Mariakani, Joseph Kangethe, Jamhuri, Madaraka
Western	New Ngara, Old Ngara, Landhies Road, Jevanjee, Bachelor Quarters, Quarry Road, Pangani

Source: Field Survey, 1992.

Table 4.4 shows the district by operational area in terms of rental housing. It can be seen that in terms of maintenance some districts have more workload than others. The responsibilities of the assistant building works superintendent were as shown in table 4.5.

Table 4.5: Responsibilities of the Assistant Building works Superintendent.

RESPONSIBILITIES

° Monitoring Maintenance activities in their districts
° Reporting to the Building Works Superintendent
° Prioritising maintenance work in their district
° Allocation of Tasks to supervisors
° Initiating Inspection of Properties
° Analysis of Work Orders and Allocation Sheets
° Procurement of Materials, Equipment and Tools
° Costing of Maintenance Works
° Administration of Maintenance Personnel, Plant and transport

Source: Field Survey, 1992.

The Assistant Building Works Superintendent performed four main management functions viz. planning, organising, directing and controlling the activities in their district. As seen from Table 4.2 certain activities were performed in each management function which

required certain information. According to two assistant building works superintendents the information required is located at central locations both within and outside the Nairobi City Commission. One indicated that this information was available at a centralised location within the organisation while the other failed to respond to the query.

Table 4.6: Sources of Information at the Management Control Level.

MANAGEMENT LEVEL	SOURCE
Management Control	° Users/Occupiers of Premises ° Maintenance Records ° Codes of Regulations ° Maintenance Manuals ° Property Asset Register or Data Base ° Inspection Reports ° Catalogues, Drawings ° Manufacturers ° Statements from upper Management ° Merchants (Hardware) ° Research Institutions

Source: Field Survey, 1992.

The information had different sources whether within or without the organisation as seen in table 4.6. It was collected manually and verbally and two assistant works superintendents each, said that the information was classified while the other two said it was not. It was observed that information was classified in the operational areas according to the type of asset. That is to say that maintenance information was classified according to housing estates, schools, and so on. The respondents at this level indicated that the information they collected is analysed. The results of this analysis are utilised by their seniors, and the supervisors/foremen. This information was not accurate, and was not received on time or in the correct format to assist in the maintenance of assets in an effective and efficient manner.

Table 4.7 shows the formats in which the information was handled at various stages.

Table 4.7: Format of Information.

STAGE	FORMAT
Collection	° Reports - standards ° Codes of Practice ° Regulations ° Unit Costs ° Specifications ° Trends in the Industry
Stored	° Reports ° Specification ° Unit Costs ° Codes of Practice ° Catalogues
Analysed/ Processed	° Reports ° Unit Costs ° Processed ° Codes of Practice ° Standards ° Procedures ° Regulations ° Specifications ° Trends
Disseminated/Applied	° Unit Costs ° Codes of Practice ° Standards ° Procedures ° Specifications ° Trends

Source: Field Survey, 1992.

Supervisors/Foremen

These formed part of the operations control management level. They are found in each district of the building works section. As seen from table 4.8 the supervisor allocates tasks and orders materials for those tasks. Amongst the groups of tradesmen or artisans that were found in the building works section were plumbers/fitters, carpenters, masons, painters, glaziers, cleaners and also general labourers. The survey showed that on average each supervisor reported to the assistant building works superintendent whilst artisans and labourers reported to them.

Table 4.8: Responsibilities of the Foremen.

DESIGNATION	RESPONSIBILITIES
Supervisors/Foremen	° Supervision of artisans ° Allocation of jobs to artisans ° Keeping records of work undertaken ° Ensuring safety of work being undertaken ° Ensuring satisfactory work standards ° Ordering of materials ° Ensuring Compliance with contract and statutory requirements

Source: Field Survey, 1992.

In executing their responsibilities the supervisors need certain information, which is obtained from various sources and is to be found in various formats as shown in Table 4.9. The information received is at times accurate. In the cases where it is not or in the event of suspicion the supervisor will go ahead and check on these themselves. They also check to see that reports submitted to them are in the correct format. From the survey of the Building Works Orders it was very doubtful whether this was indeed the case given the low level of usable BWO's as seen in Table 4.11.

Table 4.9 : Information Needed/Sources/Format.

INFORMATION NEEDED	SOURCES	FORMAT
° Maintenance Tasks to be done ° Location of Tasks ° Materials & Equipment needed ° Personnel Required ° Plans/Schedules for executing the Tasks	° Users/Occupiers ° Artisans/Technicians ° Upper Management ° Regulations ° Procedures ° Visits to Places of Work	° Reports ° Verbal ° Procedures ° Standards ° Specifications ° Catalogues

Source: Field Survey, 1992.

The supervisor's also submit summaries of the kind of work that they do. Daily allocation schedules are prepared and these are submitted on a daily basis. Progress reports showing the progress of the work allocated are made on a weekly basis on every Friday of every week. They also prepare monthly reports at the end of every month. These reports are sent to their superior officers as well as kept in the offices for reference. There were standard forms for daily jobs allocation and also for the work orders. But, it was ascertained that the reports made by the supervisors were made on foolscap sheets at the time of the survey.

Artisans/Technicians

These represented the transactions processing level. They are the group which actually performed the maintenance work. Of the artisans surveyed 7.7 per cent were plumbers and fitters, 61.6 per cent were masons and carpenters, 23.0 per cent were blacksmiths. The survey also indicated that 7.7 per cent of artisans surveyed had the government trade test grade I, 38.5 per cent and 30.8 per cent had trade test grades II and III respectively. Those with the craft certificates accounted for 7.7 per cent of the sample. The remaining 15.3 per cent of the respondents failed to state their qualifications. The duties of these artisans are specific and are to:

a) Carry out repairs
b) Carry out inspections when ordered to.
c) Preparing job progress reports.
d) Reporting to the supervisors/foremen.

Specific to carpenters is that they also undertake out the making of furniture for offices. Artisans also carry out minor construction work, especially the masons. These duties are allocated to the artisans by their supervisors.

Table 4.10: Information Needed/Source/Format

INFORMATION NEEDED	SOURCES
° Location of Defects	° Supervisors/Foremen
° Nature of Defect	° Users
° Specifications of work to be done	° Work Orders
° Time during which affected premises is available	

Source: Field Survey, 1992

This is achieved through building works orders in order that they execute these duties they need certain information which is sourced from various places as shown in table 4.10

In executing their duties the artisans also collect information which is related to:

a) Materials needed or used
b) Equipment/Tools needed
c) Nature of the defects
d) Time spent in executing job
e) Number of personnel required

Some of this information e.g. (a), (b), and (e) are collected prior to the execution of a job while (d) is collected after. This information is then taken to the supervisors and is used to order materials. These group of personnel form the operating arm with respect to the maintenance of built assets within the City Commission. They act at the behest of other client departments such as the social services and housing department which is responsible for rental housing, amongst others.

THE DEPARTMENT OF SOCIAL SERVICES AND HOUSING

The department is headed by the Director of Social Services and Housing. It is responsible for provision of social services and housing to the city residents. In its endeavour to fulfil this responsibility, the department was divided into several sections as shown in Figure 4.1.

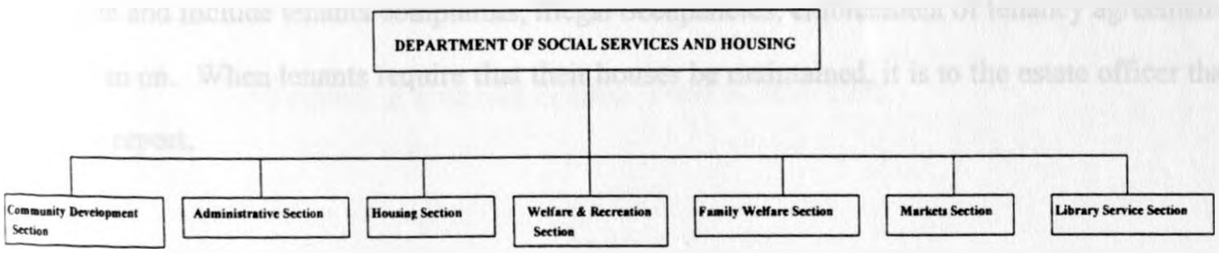


Fig. 4.1: Organisational Structure of the Department of Social Services and Housing, Field Survey 1992.

Each of the sections shown takes care of its own built assets in so far as they initiate the maintenance. The study was primarily concerned with the rental housing which was administered by the housing section. The housing is rented to city residents by the Nairobi

City Commission. This section was responsible for a large number of the city's rental housing and the task of maintaining these is onerous.

The housing section under which rental housing falls is headed by a superintendent of estates and is structured as shown in fig 4.2. The rental housing was placed in two zones as shown in fig 4.3. Each of the zones is administered by a housing officer whose duties were basically related to the allocation of rental units to the applicants under the guidance of the superintendent of estates. However, the survey revealed that because of a shortage of personnel some estate officers were in-charge of several estates. The housing officer was also assisted by the estates officers. These estates officers are in-charge of individual estates. A group of estate officers was supervised by a supervisor of estates. The estates officer is the field officer on the ground and is responsible for the general management of the estate. Estate officers are responsible for the co-ordination of the various sections from the sundry city commission departments whenever they are needed for one reason or the other in an estate. These sections include the building works section, the parks section, the electrical section, the cleansing section, the communicable diseases control section, and the water section amongst others. The estate officers submit weekly reports to the supervisor of estates who forwards them to the superintendent of estates. The reports detail all the activities that take place in an estate and include tenants complaints, illegal occupancies, enforcement of tenancy agreements and so on. When tenants require that their houses be maintained, it is to the estate officer that they report.

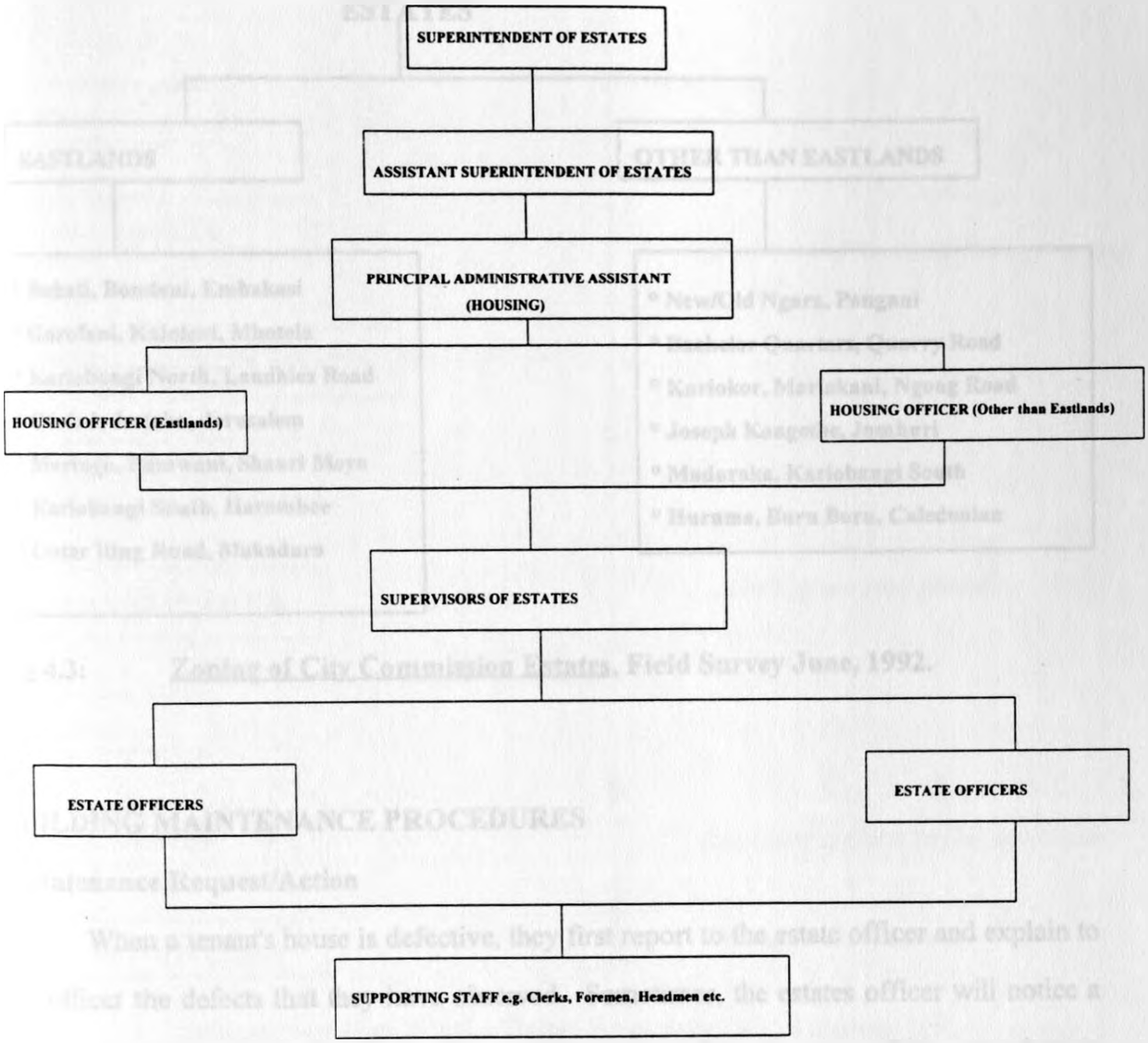


Fig 4.2: Structure of Housing Section, Field Survey 1992.

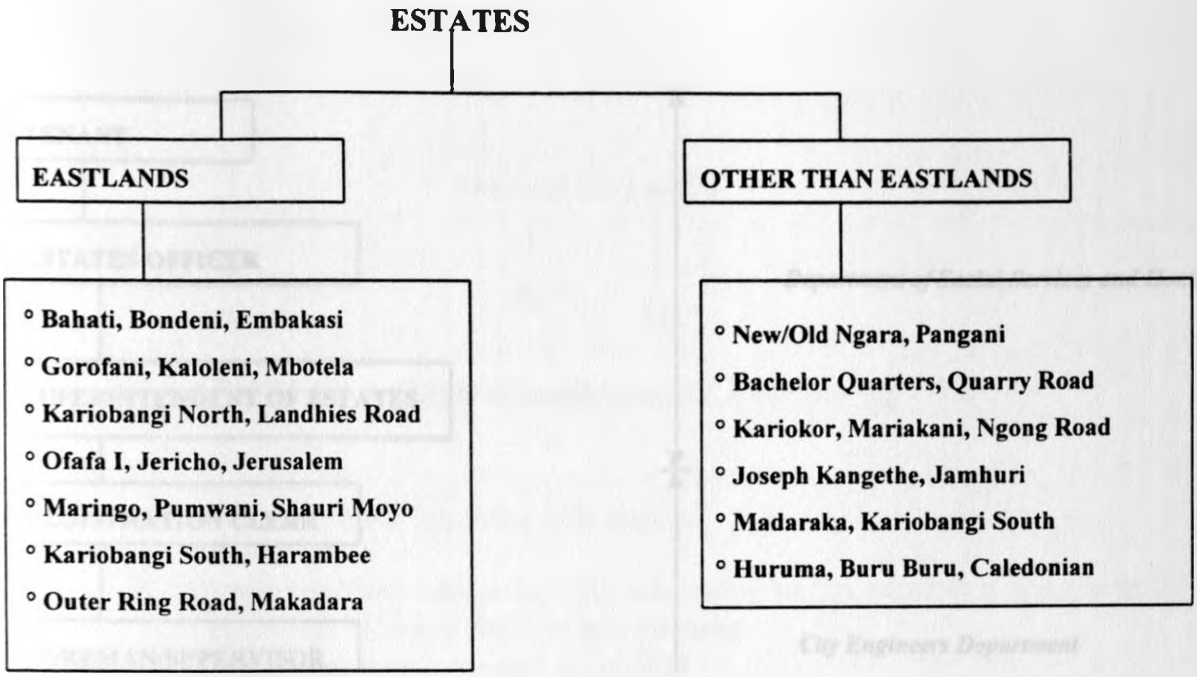


Fig 4.3: Zoning of City Commission Estates, **Field Survey June, 1992.**

BUILDING MAINTENANCE PROCEDURES

Maintenance Request/Action

When a tenant's house is defective, they first report to the estate officer and explain to the officer the defects that they have observed. Sometimes, the estates officer will notice a defect and act upon it, but this is the exception rather than the rule. This procedure is illustrated in Figure 4.4.

The estate officer then draws up a building works requisition order (see appendix C) which must then go up the chain to the superintendent of estates for his approval before it can be forwarded to the city engineer's department. The reason for this process is that each department has funds allocated to it for the purpose of maintenance. The superintendent of estates stamp is therefore, an indicator to the building works section that funds are available. Once the works requisition order (WRO) has received the superintendent of estates (SOE) assent, it is sent to the relevant assistant building works superintendent's (ABWS) office.

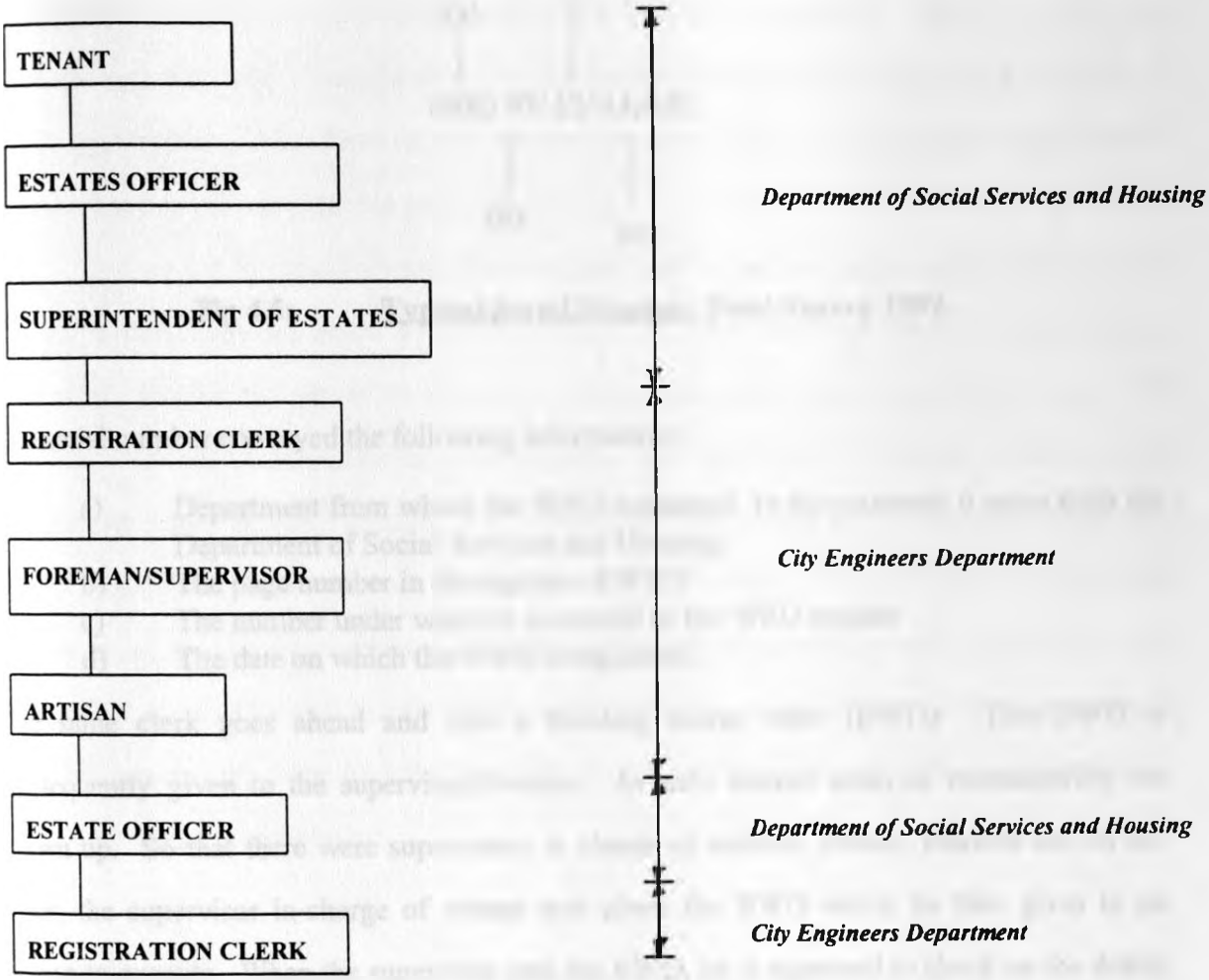


Fig 4.4 : Information Flow when a Defect is reported, Field Survey 1992.

In the ABWS's office, the WRO lands on the desk of a receiving clerk. On receipt of the WRO the clerk enters or registers it in a register of works requisition orders. The registration is done on the basis of urgency of a job. This is at the sole discretion of the clerk (not a trained builder in any of its trades) or in the event that the WRO is stamped 'urgent' it is entered or registered first. There were no criteria established for the registration of the WRO. Any WRO marked urgent takes priority over the rest. Once registered, the WRO was given a serial number (alpha-numeric code) as shown in Figure 4.5.

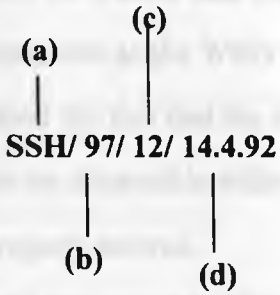


Fig 4.5: Typical Serial Number, Field Survey 1992.

The serial number conveyed the following information:

a) Department from which the WRO emanated. In this example it came from the Department of Social Services and Housing.
b) The page number in the register of WRO
c) The number under which it is entered in the WRO register
d) The date on which the WRO is registered.

The same clerk goes ahead and fills a building works order (BWO). This BWO is subsequently given to the supervisor/foremen. In each district areas of responsibility are drawn up. So that there were supervisors in charge of schools, estates, markets and so on. Thus, the supervisor in-charge of estates was given the BWO which he then gives to an artisan to execute. When the supervisor gets the BWO, he is supposed to check on the defect in order to determine their resource requirements. This is before they hand over to the artisan. If any materials are required they proceed to fill in stores issue vouchers (SIV's) indicating their requirements. The SIV's are then sent to the city treasurer's department where the materials are costed and this cost checked off against the departments maintenance vote for availability of funds. This procedure is used where materials are available in the stores. It is the supervisors duty to follow-up an SIV to ensure that their requests are fulfilled.

Once the materials are provided where required, the BWO is executed and is supposed to be countersigned by the estate officer as proof that work has been done. Before signing the estate officer must have seen that the work was properly done. The initialed BWO is then sent back to the same clerk who registered it and who on receiving the signed BWO, is

supposed to indicate in the register of WRO's that the BWO has been executed. This is supposed to be indicated on the same row as the WRO was registered. The survey indicated that this was not done. It established the fact that the clerks did not consider it necessary to make such entries. Also there was no discernible effort on the part of upper management to ensure that this information was properly entered.

Before the foreman forwards the executed BWO, they must ensure that correct details of the artisan/labourers hours used, the number of days used and the materials used are indicated. During the survey, it was observed that these details were rarely indicated. The building works order form does not indicate when the work began. The estate officer does not indicate in numerous cases the date at which the information such as the workman's' name, the WRO number, the financial code of the asset and the location of the property are indicated. However, as noted previously these details were treated as though they were more of a bother rather than as an avenue of ensuring efficient and effective maintenance of built assets. So, in many instances they were not properly or clearly recorded and the authenticity of some of the information given was suspect.

Response Times

During the survey, it was possible to calculate some response times. These related to the differences or delays between the time a tenant reports a defect and the time that the defect is made good. As shown in table 4.1, use was made of building works orders in the districts to compute the statistics detailed herein. Fig 4.4 shows the flow of information from the tenant to the registration clerk when they are supposed to record that a building works order has been executed and properly so. During the survey the data collected was analysed and the results documented as shown in table 4.11. This was done on a district by district basis. In each district building work orders were selected that related to rental housing. Of these, a survey was done to check for certain details which would render them useful in calculating delay times and eventually the duration it took the BWS before it reported defect.

The criteria used in selecting the BWO's for use in the analysis were as follows:

a) That the WRO could be located
b) That the WRO was signed by the estates officer giving not only the signature but also the date of signing.
c) Presence of the serial number on both the BWO and the WRO
d) It must have been for rental housing.

Table 4.11: Results of Analysis of BWO's.

DISTRICT	No. of BWO's Relating to Rental Housing "A"	Usable BWO's "B"	"C" = B/A	"D" (days)	"E" (days)
Northern	328	160	0.49	26	106
Eastern	1357	56	0.04	17	125
Southern	348	34	0.10	16	9
Western	81	38	0.47	14	145

Source: Field Survey, 1992.

Column `A' details the number of building works orders relating to rental housing that could be collected from the files. Column `B' gives those which conformed to criteria set out above. The ratio `C' shows relatively how well kept the records were in each of the districts. It indicates that the northern district had better kept records than all the others because the ratio of those usable to those available was higher. However, the low ratios are indicative of how in general the record keeping system in the building works section was not up to par. Column `D' details the average delay in terms of days (including weekends) that a works requisition order took before it was registered in the register of WRO's at the building works section. As can be discerned this delay ranged from about 2 weeks in the western district to approximately four weeks in the northern district. The western district is located in the centre of the city as are the superintendent of estates offices. However, the offices of the other districts are found in the residential estates. This was the main reason why these delay times were so long. Column `E' on the other hand shows the duration lapsing from the time a defect is reported until the time when repairs are effected. When the delay time in column `E' is taken as a ratio of that in `D' we see that it is highest in the western district and lowest in the

southern district. The offices of the northern district are however, nearer to the superintendent of estate office than those of the other districts. Thus, the data in table 4.11 shows that the bureaucratic delay in the housing section takes up a significant proportion of the time delay before repairs are effected on built assets.

Condition Survey

The rental units were surveyed with the aim of determining the condition of the units. This subsequently assisted in determining the degree of under maintenance of the same as shown in Table 4.12. In this table the degree of under maintenance is shown in the column on frequencies. In calculating the frequencies it was assumed that each fault occurred in one house and to that extent demonstrated the extent of under maintenance. Therefore, from these figures it was estimated that 20.6 percent of the NCC housing units were under maintained.

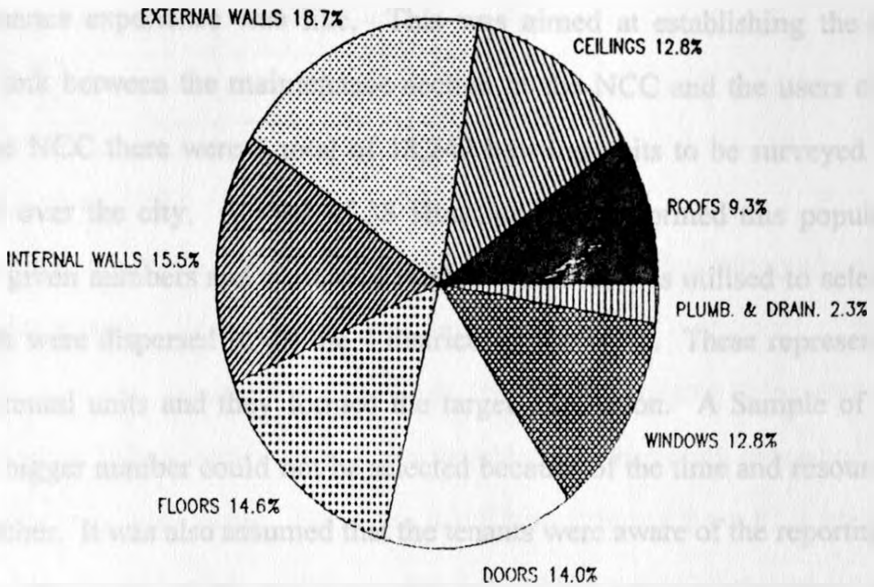
In respect of these under maintenance it was found out that faults on external walls accounted for 18.7 percent of the faults surveyed in the case study. This is indicated in Figure 4.6. When these are combined with the results from floors, ceilings and roofs, it is clear that simple inspection would reveal such faults and consequently remedial action undertaken. But because this was not implemented in the study area this is the consequence. Plumbing and drainage faults accounted for 2.3 percent of the faults observed during the survey. Internal walls accounted for 15.5 percent. Together with external walls the proportion rose to 34.2 percent.

Table 4.12: Types of Faults in Each Element and their Frequencies

ELEMENT	TYPE OF FAULT	FREQUENCIES	
		Number	Percentage
Roofs	Leaking Roof, Sagging Roof, Missing Tiles	58/288	20.1
Ceilings	Stained Boards, Splitting at Joints, Boards falling off, Discoloration of ceilings	86/288	29.9
Walls (External/Internal)	Cracking, Dampness, Loss of Adhesion of Render/Plaster, Efflorescence on walls, Fading Paint work, Discoloured Paint	245/792	30.9
Floors	Cracking Floors, Faded Paint work, Missing Tiles, Lifting of Tiles	95/432	22.0
Windows/Doors	Twisted Components, Missing or Damaged Ironmongery, Corroded Frames, Cracked or Missing Panes	177/1296	13.7
Plumbing/Drainage	Missing/Malfunctioning taps, Blocked Drains, Missing/Damaged Sanitary Fittings	30/432	6.9

Source: Field Survey, 1992.

Fig. 4.6: Condition Survey (NCC)



Source: Field Survey, 1992

User Reaction

At the same time that users premises were being surveyed they were asked about what their maintenance experience was like. This was aimed at establishing the nature of the information link between the maintenance section at the NCC and the users of the housing units. At the NCC there were a total of 18,247 housing units to be surveyed. These were dispersed all over the city. A total of 38 Housing Estates formed this population. These estates were given numbers and a table of random numbers was utilised to select 13 housing estates which were dispersed in all the 4 districts of the NCC. These represented a total of 50% of the rental units and they formed the target population. A Sample of 74 units was selected. A bigger number could not be selected because of the time and resource constraints of the researcher. It was also assumed that the tenants were aware of the reporting mechanism which was uniform for all the NCC housing units. Therefore this exercise was aimed at confirming whether this was correct or otherwise. Table 4.13 below gives the sampling process for the user reaction survey at NCC.

Table 4.13: Sampling Process for the User Reaction Survey at NCC.

Randomly Selected Housing Estate		Zone in which the Estate is Located	Sample Size
Estate	*No. of Units*		
Mbotela	904	Eastlands	7
Kaloleni	650	"	5
Huruma	586	Other than Eastlands	5
Kariobangi South	747	"	6
Uhuru	886	Eastlands	7
New/Old Pumwani	601	Eastlands	6
Jericho Lumumba	3004	"	24
Ziwani	552	Other than Eastlands	4
Jamhuri	72	"	1
Joseph Kangethe	286	"	2
Mariakani	240	"	2
Madaraka	600	"	5
	9128		**74**

Source: Field Survey, 1992.

Table 4.14: Length of Occupying House.

Length/Period of Occupying House (Months)	FREQUENCY	
	Number	%
1 -96	35	47.3
97 - 192	28	37.8
193 - 288	7	9.5
289 and over	4	5.4

Source: Field Survey, 1992.

Table 4.14 shows the periods of occupancy of the premises surveyed and the various groups in these periods. It is evident that approximately 85.1 per cent of the people or occupants surveyed had occupied the premises for periods ranging from one month to 16 years. When asked if they were aware of the maintenance requesting procedure 85.1 percent of them said that they were aware. But when asked how this was done 81.1 percent indicated that this was done orally/verbally, 10.8 percent said that they filled standard forms, while 7.1 percent had no response to the query.

Table 4.15 shows that 63.5 per cent of the tenants surveyed indicated that they reported to the estates officer in the event that they had a maintenance problem on their premises. This is in agreement with what the estates department stated was the proper procedure.

Table 4.15: Response of NCC Tenants when asked about the Maintenance Procedure

RESPONSE	FREQUENCY	
	No.	*%*
Report to the Estate officer or the maintenance depot	5	6.8
Report to the Estate Officer	47	63.5
Report to the Housing department	1	1.4
Do not know where or how to report	13	17.6
Report to the maintenance department at City Hall	2	2.7
Report to the landlord who is the rightful tenant	5	6.8

Source: Field Survey, 1992.

Table 4.16 shows the response to the question, how long it took before the tenants maintenance request was acted upon. In this table only 10.8 per cent of the seventy-four (74) tenants interviewed indicated that the response depended on the defect. From the same

sample 45.9 per cent said it took a long time, 17.6 per cent indicated that response was slow. These results are consistent with table 4.11 which indicates that on average it took approximately 17 weeks for a job to be completed

Table 4.16: Response to the question "How long did it take before your maintenance request was acted upon?"

Response of the Tenant	FREQUENCY	
	Number	Percentage
It depends on the defect	8	10.8
Response is Quick	3	4.1
Response is Slow	13	17.6
It take a long time	34	45.9

Source: Field Survey, 1992.

When NCC Housing occupants were asked how regularly their premises were inspected 78.4 per cent of the respondents said that their dwellings were never inspected, 6.8 per cent said that it was done irregularly or on request while 5.4 per cent said their premises were regularly inspected failed to indicate the intervals during which these were done. They accounted for 9.4 per cent of the respondents.

Table 4.17 : Maintenance Responsibility of Tenant (NCC)

Responsibility of the Tenant	FREQUENCY	
	Number	Percentage
Carrying out minor repairs	64	86.5
Cleaning of Premises	66	89.2
Internal Painting	51	68.9
Approving work carried out on the House	19	25.7

Source: Field Survey, 1992.

In terms of the tenants maintenance responsibilities, 86.5 per cent said that this included carrying out minor repairs, 89.2 per cent said it included internal premises, 68.9 per cent included internal painting as part of their responsibilities while only 25.7 per cent said that approving of maintenance work carried out on their premises was their responsibility as

indicated in table 4.17. These showed that there was little user-participation in ensuring the proper maintenance of built assets through approval of work done by other agencies. However, the results also indicate scope for greater user participation by letting users do their own internal maintenance works. It is worth nothing that 74.3 per cent of the respondents became aware of these responsibilities on their own.

In terms of keeping maintenance records only 21.6 per cent of the NCC tenants indicated that they kept records. Of these 20.3 per cent indicated that they kept records relating costs, number of artisans used and the time taken to execute the job. Twenty-three per cent of these said that they took these information to the maintenance department, 2.7 per cent claimed for refunds from the maintenance department while 16.2 per cent kept the information to themselves. Also only 16.2 per cent of the respondents said that approved the maintenance work done on their houses. The figures obtaining above indicate a low level of user-participation in the maintenance of the houses.

During the survey there were however cases whereby due to the failure of the authorities to perform tenants took it upon themselves to maintain their premises. A notable example is that of a tenant who spent over Kshs. 30,000.00 on the repair of the dwelling unit. When asked why, the tenant said that the commission took a long time to respond to a maintenance request and that he was not willing to wait for that long.

SUMMARY

At the NCC the framework for the management of maintenance information exists. This is to say that the tools, however rudimentary, are in place. However, the lack of a clear and comprehensive maintenance policy is a major stumbling block as the study found out. It was evidenced by the clear lack of a systemised approach to maintenance of built assets. It was reflected in the manner in which the maintenance operatives were not sure of what information they needed to maintain the built assets under their care. Inspite of the fact that they indicated that they required certain information, for example, a property data base, this was clearly lacking. In terms of budgeting use was made of previous years expenditures on maintenance to make estimates. It was not based on information such as the built assets technical requirements. This clear lack of guiding policy is patently responsible for the poor manner in which maintenance information is managed at the NCC.

The artisans did not see the importance of correctly filling out the building work orders and no effort was made to make sure that they did so. Therefore the upper levels of management was not able to benefit from feedback.

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CHAPTER FIVE

CASE STUDY II - KENYA BREWERIES LIMITED

INTRODUCTION

The Kenya Breweries Limited is a manufacturer of alcoholic beverages. The company can have its history traced back to 1923 when there existed three breweries namely: Tusker Brewery, the Allsopps Brewery, and the City Brewery. The Tusker Brewery expanded rapidly enough to purchase the other two breweries. Consequently the Kenya Breweries Limited came into existence. This led to a rapid expansion of buildings and other landed property which was further boosted by the merger of the Kenya Breweries Limited with the East African Breweries. It is from this point that the history of the estates department can be traced **(Muchanga, 1992)**.

The initial buildings of the company came about as a result of the efforts to develop housing for the Asian communities at the Allsopps and Tusker Breweries. The Engineering Services department was then put in charge of certain aspects of repair until some thirty (30) years ago when a housing section was created to co-ordinate these functions. Experience at the organisation indicated that the engineers were not doing a satisfactory job and this led to the appointment of housing manager. With the expansion of the company and the concomitant acquisition of land and extension of housing estates, purchase of houses for senior management all over the city the need arose for a fully fledged department to deal with estate management functions that were split between the housing section and the company secretary and in 1974 a department of estates was created headed by an estates manager. Since that time moderate restructuring has been undertaken in the department to make it stronger **(Muchanga, 1992)**.

RESULTS OF THE SURVEY

A preliminary survey of the Kenya Breweries Limited was done within the organisation and it established that the maintenance function was split between two departments. These were the:

a) Engineering and Development Services Department

b) Estates Department

These dealt with specific areas but there was some consultation and co-ordination between them. The Department of Engineering and Development Services dealt with the production units of the company. These were dispersed in various parts of the country and included the Tusker Brewery (Nairobi), Barley Syrup Plant (BSP) (Nairobi), Maltings Plants (Nairobi), Mombasa Brewery, Molo Barley Drying Plant and the Kisumu Brewery. This department is headed by a Deputy General Manager, while each of the production units has a Chief Engineer. The latter was responsible for all routine and some specified building maintenance works. There was close co-ordination between the managers of production units and the chief engineers with respect to the preparation to the specifications, designs and the execution of maintenance plans.

The estates department on the other hand was responsible for building maintenance of all company owned and leased housing, offices, clinics, hostels, club houses, and sports pavilions, all found in various parts of the country. It is headed by a property/estates manager. As with the Nairobi City Commission the focus of this study was on the housing provided by the Kenya Breweries Limited. These were managed under the Estates Department.

THE ESTATES DEPARTMENT

As was previously stated this department was headed by a property/estate manager. The estates manager was in-charge of the maintenance of all the built assets of the company except those which fell under the department of engineering and development services. These

were mainly production buildings. The structure of the department is as shown in Fig. 5.0. In areas where KBL had housing such as Mombasa or Kisumu, there was a housing assistant who reported directly to the estates manager in Nairobi. The structure was not as disaggregated at KBL as it was at the Nairobi City Commission. Questionnaires were distributed thus:

a) Estates Manager - strategic planning level (1)
b) Housing Assistant - operations control level (1)
c) Housing Assistant - operations control level (1)
d) Artisans - Transactions processing level (5)

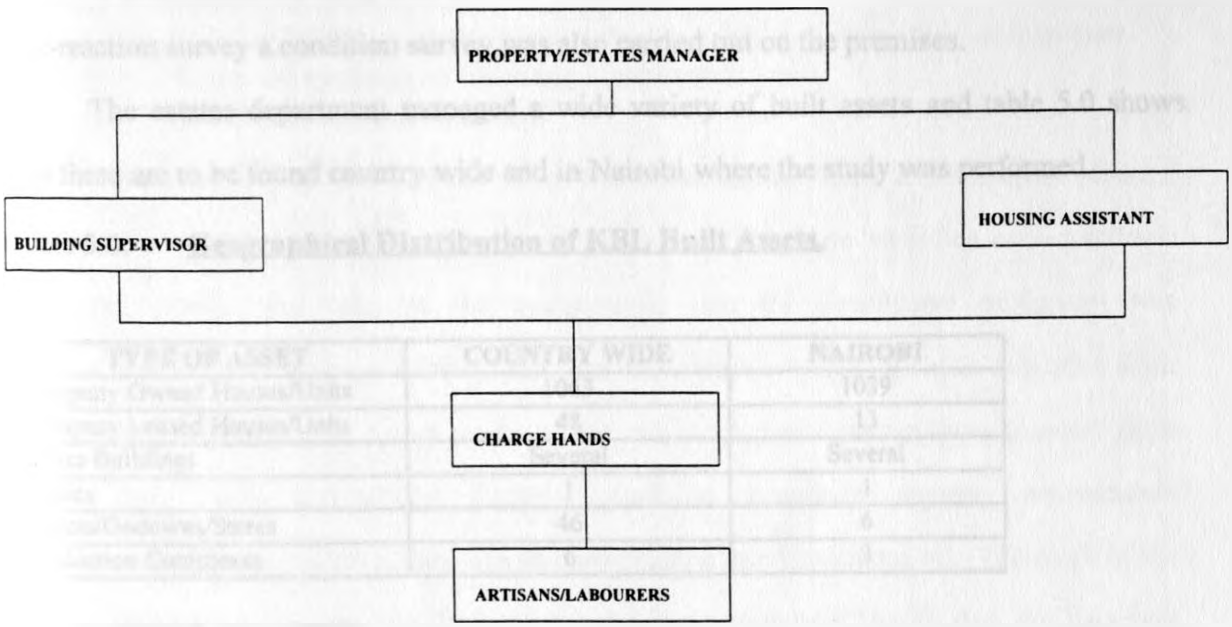


Fig 5.0: Structure of the Estates Department (KBL). Field Survey 1992.

With respect to the management control level, no questionnaires were issued. This was because there was no person working at this level. The duties of the person who would have answered this questionnaire were being carried out by the Estates Manager. However, the organisation was in the process of creating such a position at the time of the survey. The Estates Manager said that the reason why a person was being hired to this level was to relieve

him of some of the duties that he was carrying out which he declined to specify. The questionnaires issued were received back duly completed.

The researcher went through the records of maintenance requisitions. It was not possible to follow a requisition from beginning to completion. The weekly progress sheets (appendix D), which were the only records of requisitions that were accessible to the study, only showed when a job began. If the duration of the job was greater than a week, the progress sheets would only indicate `job in progress' and these were not detailed in subsequent weekly reports. It was only possible to determine the delay which was the time lapse between reporting of a defect and action being taken on it.

A user-reaction survey was done in which 72 households were surveyed. During this user-reaction survey a condition survey was also carried out on the premises.

The estates department managed a wide variety of built assets and table 5.0 shows how these are to be found country wide and in Nairobi where the study was performed.

Table 5.0: Geographical Distribution of KBL Built Assets.

TYPE OF ASSET	COUNTRY WIDE	NAIROBI
Company Owned Houses/Units	1063	1039
Company Leased Houses/Units	48	13
Office Buildings	Several	Several
Clinics	1	1
Depots/Godowns/Stores	46	6
Production Complexes	6	3

Source: Field Survey, 1992

As is evident from table 5.0 majority of the housing at KBL was located in Nairobi. This study focused on housing.

Estates Manager

The estates manager represented the strategic planning level. Apart from ensuring that the built assets were well maintained the department made the leasing arrangements, prepared design briefs for new buildings, alteration and upgrading of new buildings and buying and

selling of the properties. Other aspects of asset management the estates department executes are the valuation of properties and the administration of site rates and land rent. The estates department is guided by the organisations policy on maintenance as laid down by upper management. It is aimed at ensuring that buildings are maintained:

a) to a standard consistent with the type of building, age and funds available.
b) to standards complying with the legislation and funds available from the organisation.
c) using as far as possible maintenance free materials and fittings to maintain public image.

In arriving at organisational policy, KBL took into account the following factors, viz:

a) Organisational objectives
b) Maintenance standards
c) Legal liabilities or obligations of the organisation in respect of maintenance
d) Costs and methods of financing maintenance work.
e) Maintenance Plans (Outline).

Kenya Breweries Limited has adopted three maintenance strategies. It undertakes planned preventive, condition-based and crisis maintenance. Although no statistics were available during the survey, the bulk of the maintenance that the department performed was crisis/breakdown maintenance. The department was funded by funds made available from yearly approved budgets. These budgets are prepared from information sourced from property data bases, user-request analysis, condition assessment surveys, maintenance schedules, maintenance funds allocated and maintenance standards required. The work of the department was governed by the Registered Land Act, the Public Health Act, the Factories Act, the landlord and Tenants Act, the Building Code and the Occupiers Liability Act. These statutes affect the maintenance operations of the company in as far as they imposed maintenance obligations on it. Maintenance activity is guided by criteria such as the physical characteristics of the building, policy considerations, economic criteria and environmental considerations. In practice it was not possible to determine whether the criteria were utilised in planning of maintenance operations. It seemed that work on buildings was undertaken only at the request of the tenants and when an employee moved into new premises.

At this level, the estates manager is responsible for negotiating of leases for existing and/or new properties, and the repair and upkeep of the organisations buildings within their jurisdiction. Table 5.1 details the various responsibilities of the diverse levels of management within the estates department. In executing these responsibilities, the estates manager performs the functions of planning, organising, staffing and controlling. The estates manager performs various activities under each management for which he requires certain information as detailed in Table 5.1.

The Estates Department maintains a property data base which provides information as shown in Figure 5.1. These information was useful to the estate manager in preparing maintenance budgets for the department as well as being a 'one-stop' source of information on organisational properties. No evidence of this was availed to the researcher during the survey.

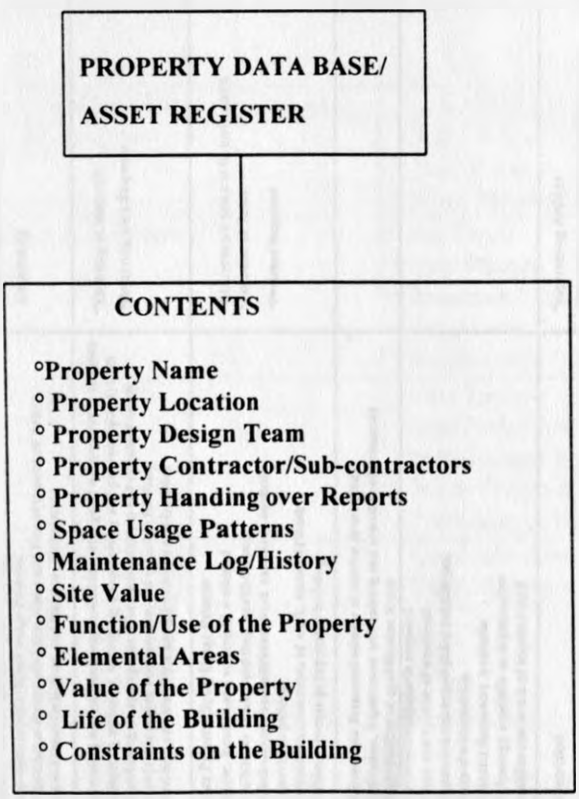


Fig 5.1: Contents of the KBL Asset Register. Field Survey, 1992.

Table 5.1: Management Functions, Information - Activity Matrix (MIM)

MANAGEMENT FUNCTION		LEVELS OF MANAGEMENT		
		STRATEGIC PLANNING	OPERATIONS CONTROL	TRANSACTIONS PROCESSING
PLANNING	Activities performed	* Preparing inspection and conclusion survey plans *preparing maintenance plans (short & long term) * Preparing specifications and standards *Preparing property / asset registers * Liasing with the design team *Designing / Institution of planning and control systems *Deciding on work execution modes	* Allocation of Tasks	
	Information needed	*Organisations maintenance policy and strategies *Asset Registers, User Request Analysis, Inventory Records, Staff Records *Nature, location and spread of work load *Inspection reports, Space usage Patterns *Maintenance Responsibilities, Users and Potential users of Assets, Organisational Objectives and Statutory Obligations	*Tasks (Maintenance) to be Undertaken	
ORGANISING	Activities Performed	*Allocating maintenance responsibilities settings up administrative routines *Delegating authority, setting up a supervisory and job execution system *Establishing an appropriate information system and communication channels that ensure coordination and effective feedback *Providing suitable office accommodation and facilities	*Ordering of materials *Receiving User Requests	
	Information needed	* User Patterns, Space Usage Patterns *Nature, location and volume of workload *Availability of staff and their qualifications *Maintenance responsibilities, work execution methods, Supervision patterns *Technical requirements of work, timing of work *Building Owners policy on the building	*Maintenance tasks to be undertaken *Location of Tasks *Personel Required	
STAFFING	Activities Performed	*Maintenance Personnel scheme of service development *Motivation, requirement and training and selection of personnel *Determination of qualification levels		
	Information Needed	*Maintenance standards required *Nature and volume of workload *Organisations maintenance policy and strategies, Modes of work execution *Financial Resources Available *Technology available to organisation *Qualification levels of required staff		
DIRECTING	Activities Performed	*Supervision	*supervising Artisian *Supervising / Carrying Out Inspections	
	Information Needed	*Drawings *Specifications and standards Required *Buildings/Property maintenance manuals	*Plans and schedule of executing the tasks *Specifications and standards	
CONTROLLING	Activities Performed	*Measuring Job or work progress *Maintaining Feedback systems *Maintaining Maintenance Programmes and plans *Evaluating Progress reports of Jobs at hand *Quality and Budgetory Control *Determining Performance measures	*Reporting to the Estates Manager *Keeping Records of work undertaken *Ensuring Safety of work undertaken and satisfactory standards	
	Information needed	*Maintenance programmes (short and long term) *Maintenance budgets *Performance measures *Maintenance manuals, Maintenance Profiles *Users Reports, Standards ad specifications *Monthly Statements of Expenditure *Variance Analysis *maintenance and elemental costs Analysis *Response Time Analysis *Maintenance Audits	*Weekly progress reports *Establishment summaries *Plans and schedules for executing the tasks *Specifications and standards *Housing Allocation Summary *Overtime Summary *Inventory Summary	

Source: Field Survey , 1992 .

In prioritising the maintenance work of the department, the department utilise the following criteria:

a) Complexity of the work
b) Volume of the work
c) Cost of the work
d) Availability of personnel
e) Effect of work on organisational activities
f) Risk to occupants and/or contents of the property.

In order to be able to evaluate its maintenance work, the department makes use of several documents as shown in table 5.2. These documents are used to monitor and evaluate job progress, staff performance, backlog status, inventory status and the condition of the assets. However, when asked about the backlog status of maintenance no information was forthcoming.

Table 5.2: Information Needed for Monitoring and Evaluating

ASPECT TO BE MONITORED/EVALUATED	INFORMATION NEEDED OR SOURCE
Job Progress	° Job Cards or Work Orders ° User Reports ° Work Progress Reports
Staff Performance	° Job Cards ° User Reports ° Response Time Analysis ° Analysis of Completed Work Orders ° Performance Measures
Backlog status	° User Reports ° User Reports and Analysis ° Maintenance Programmes ° Work Orders and Analysis ° Performance Measures
Inventory Status	° Condition Assessment Surveys ° Inspection reports

Source: Field Survey, 1992.

The Estates Manager was asked whether the department kept any past maintenance records to which he replied in the affirmative. These records were supposed to provide information that assisted in budgetary control, management control, design cost control and maintenance profiles i.e. how each asset consumed in terms of resources. The study was unable to cross-

check whether this was correct because the records were not available. The system for the collection, storage, analysis, and application of maintenance information had several sources for the information that the department utilised. These were User's Reports, Maintenance Records, Statutes, Inspection Reports, and Job Card's/works Orders. This information was not classified neither was it coded. Some of it was periodically updated when necessary by the supervisors.

Building Supervisor/Housing Assistant.

These two categories of personnel formed the transactions operating level of management in the estates department. Both had responsibilities some of which were similar as is evident from table 5.3. The responsibilities that were the same in both personnel were those of:

* keeping records of work undertaken
* Ensuring safety of work undertaken
* ensuring satisfactory work standards
* ordering of materials
* receiving use requests
* supervising/carrying out inspections
* reporting to the estates manager

However in-spite of this overlap it was evident that there was a clear sense of the duties of each category of personnel.

Table 5.3: Responsibilities at the Transactions Processing Level

DESIGNATION	RESPONSIBILITIES
Building Supervisor	° Supervision of artisans/tradesmen ° Allocation of jobs to artisans/tradesmen ° Keeping records of work undertaken ° Ensuring that work done complies to contract particulars ° Ensuring safety of work and work standards ° Ordering materials ° Preparing job cards and receiving user requests ° Supervising/carrying out inspections ° Reporting to Estates Manager
Housing Assistant	° Keeping records of work undertaken ° Ensuring safety of work being undertaken ° Ensuring satisfactory work standards ° Ordering of materials ° Receiving user requests ° Supervising/carrying out inspections ° Reporting to Estates Manager

Source: Field Survey, 1992.

Table 5.4: Type of Personnel Superintended Upon

DESIGNATION	TYPE OF PERSONNEL
Building Supervisor	° Plumbers & Fitters ° Carpenters ° Masons ° Electricians ° Painters & Glaziers ° Cleaners ° Drivers
Housing Assistant	° Plumbers & Fitters ° Carpenters ° Masons ° Electricians ° Painters & Glaziers ° Cleaners ° Drivers

Source: Field Survey, 1992

The Building Supervisor

The Building Supervisor's main role was that of ensuring that the built assets in the keep of the estates department were in good maintenance order. In achieving this he superintended on a diverse group of tradesmen/personnel ranging from carpenters to cleaners.

This numbered forty-two personnel. Table 5.4 shows the type of personnel that the building supervisor dealt with. In executing his responsibilities the building supervisor needed information as detailed in table 5.5. This information had various sources amongst which were records kept by their office. These records that they maintained included:

* workforce records
* materials usage records
* work/job progress records
* specifications
* user's records

The information was kept and acquired in different formats as seen in table 5.5. According to the building supervisor although in many instances the information received was accurate there were numerous instances where reports on things to be repaired were:

* inaccurate
* untimely
* not in a format that enabled proper effecting of repairs

In the course of executing their duties the building supervisor compiled several types of reports and these included: requisition reports, jobs progress reports, tools inventory report, materials inventory report and inspection reports. These reports were produced at certain intervals as seen in table 5.6

Table 5.5: Formats of Information at the Transactions Processing Level

DESIGNATION	INFORMATION NEEDED	FORMAT
Building Supervisor	° Maintenance Tasks ° Location of the Tasks ° Materials and Equipment Needed ° Personnel Required ° Drawing and constructional details needed ° Specifications	° Reports ° Unit Costs ° Standards ° Specifications ° Drawings ° Verbal
Housing Assistant	° Maintenance Tasks ° Location of the Tasks ° Materials and Equipment Needed ° Personnel Required ° Plans/Schedules for executing the tasks	° Reports ° Unit Costs ° Procedures ° Verbal

Source: Field Survey, 1992

Table 5.6: Summary of Reports and their Handling (Building Supervisor)

TYPE OF REPORT	INTERVAL OF PREPARATION	SENT TO
° Requisition Report	° Weekly	° Stored in the Office
° Progress Reports	° Monthly	° To Estates Manager
° Quarterly Report	° Quarterly	° To Accounts Department
° Materials Inventory	° Monthly	
° Inspection Report	° When necessary	

Source: Field Survey, 1992.

These reports were sent to various departments of the Kenya Breweries Limited such as the accounts department and the estates manager. Also it was stored in their offices for future reference.

The information was utilised by the building supervisor for purposes of planning, organising, supervising and controlling.

Housing Assistant

The housing assistant only performed the administrative work in the department such as handling complaints of workers, issuance of cleaning materials, workers promotions, overtime and other allowances. However, when the building supervisor was away, the housing assistant carried out the duties and responsibilities of the building supervisor. In executing the responsibilities as detailed in table 5.3, the housing assistant superintended upon 118 personnel of different categories as shown in table 5.4.

The housing assistant requires certain information to perform his work. This is kept and acquired in different formats as table 5.5 clearly demonstrates. In their records the housing assistant maintains such records as:

* workforce records
* materials usage records
* work/job progress records
* users requests

The housing assistant indicated that the information received was accurate, timely and in the correct format, and that he was able to understand it. In the course of executing their

responsibilities the housing assistants had to compile certain reports at various intervals indicated in table 5.7. The report are sent to the estates manager and to the accounts department as table 5.7 shows.

Table 5.7: Summary of Reports and their Handling (Housing Assistant)

TYPE OF REPORT	INTERVAL OF PREPARATION	SENT TO
° Housing Allocation Summary	° When the need arises	° Sent to Supervisors
° Overtime Summary	° Weekly	° Sent to Accounts Department
° Establishment Summary	° Monthly	
° Inventory Summary	° When the need arises	
° Others	° When the need arises	

Source: Field Survey, 1992

The housing assistant used the information available for purposes of planning, organising, staffing, supervising and controlling.

Artisans/Technicians

These represent the transactions processing level of the estates department. At KBL, each group of artisans present was provide with a questionnaire to fill. But, only seven (7) artisans filled and returned the questionnaires duly filled. Table 5.8 shows the response to the questionnaires and the qualifications of those who responded.

Table 5.8: Response to issued Questionnaires (Artisans)

TRADE	NUMBER	QUALIFICATIONS
Plumbing	2	Grade II; Craft Certificate
Masonry	1	Grade II
Carpentry	1	Grade III
Painters	1	Grade II
Glazier	1	Craft Certificate
Electrical	1	Grade

Source: Field Survey, 1992.

The artisans performed the following duties. They were:-

(i) Carrying out repairs and inspections as directed.
(ii) Preparing progress report
(iii) Reporting to the supervisors and charge hands
(iv) Carrying out minor extensions (masons).

The duties were allocated to them by the building supervisor or their charge hands, through job cards or verbally. Verbal allocation of duties is done rarely. In order that they execute these duties, certain information as detailed in table 5.9 is provided to them from various sources.

Table 5.9: Information Needed/Source/Format (Artisans).

INFORMATION NEEDED	SOURCES
° Location of Defects	° Supervisors
° Nature of Defects	° Work Orders/ Job Cards
° Specifications of Work to be done	° Charge Hands
° Time during which the affected Premises are accessible	

Source: Field Survey, 1992.

All of the artisans surveyed except one indicated that they had access to this information. The one with a dissenting opinion said they have part of the information because the tenants who report have little technical knowledge of the defects they report. In executing these duties the artisan collect information which is related to:

(i) Materials Needed/Used

(ii) Equipment/Tools Needed

(iii) Defects and their nature

(iv) Time spent in executing the job

(v) Number of personnel used/needed.

The information is then forwarded to the supervisor for transmission to the estate manager or the accounts department or it is used for ordering materials or allocating resources as deemed necessary.

BUILDING MAINTENANCE PROCEDURES

Maintenance Request and Action

In the event of a tenants house having a defect at the Kenya Breweries Limited there are two systems, depending on the category of personnel. At KBL maintenance files are maintained according to whether one is part of management or is a unionised member of staff. This reporting system, the survey determined differed only in as far as the initiation of the maintenance process is done.

Management staff are provided with requisition books. These requisition books are filled by the tenants themselves and brought to the general office. The requisition books (see appendix F) are filled in triplicate with two copies forwarded to the housing section which is within the estates department (see general office remark). Once these requisition forms arrive at the general office they are given to clerks working there. The clerks then enter details of the requisition form to the repairs details and certification form (appendix G). The forms are then given to the supervisor who proceeds to allocate the job to an artisan. The reasoning behind the issuance of requisition books to management and not to union staff are that the former are fewer in number and that most of the union staff would not know how to fill in the forms. These requisition forms are also used to get household items such as bulbs and lamps. However, in the event of a person ordering for such stores a stores issue voucher is prepared in quintuplicate and these are distributed thus:

a) White Copy - Stores

b) Pink copy - Stores

c) Blue Copy - Housing Department

d) Green copy - Housing Department

e) Yellow Copy - Housing Department

Using a copy of the stores issue voucher the tenants can then pick up the items themselves or send a proxy on their behalf.

In the case of union staff who are not provided with requisition books for the reason that they are many and majority would not understand the forms, they report to the general office. At the general office they report their problems to the clerks who fill the details of the defects or request into Housing Office Form 'B' (see appendix H) . This form is then sent to the supervisor for allocation of jobs.

In both the management and union cases the jobs are allocated according to the trades. The supervisor has a note book which is filled in duplicate by the supervisor and it indicates to the tradesmen the duties that have been allocated to them. If the tradesman finds out during the inspection, after receiving a job order, that materials or components are required he reports to the supervisor who will either order for materials or components from the stores. If none are available from the stores he will order for their purchase, depending on priority, through the purchasing department. Financial codes are used for distinguishing between management and union transactions. The tenants both union and management must approve that work has been done before the artisan returns the work order duly completed. This approval is only indicative that the work has been completed and no reference is made as to the quality of the same.

Response Times

Although Kenya Breweries Limited, has been in existence for at least 70 years, maintenance record keeping was introduced only between 1987 and 1989. Even then it was not possible to get the records to follow up the process because the department only kept weekly progress sheets on maintenance jobs. In subsequent weekly reports it was not possible to trace jobs that took longer than a week to complete.

It was only possible to determine the average time it took for the estates department to react or respond to a maintenance request. It was established that it took an average of one (1) day for a defect to be acted upon. Apart from the fact that it was not possible to get records that stretched further back than 1992, the records at KBL seemed well kept.

Condition Survey

A total of 72 housing units were surveyed and the results documented in figure 5.2. The results indicated that wall, external and internal, accounted for 41.7 percent of the total faults observed. Floors accounted for 11.1 percent while windows and ceilings accounted for 14.8 and 12.3 percent of the faults respectively. Table 5.10 shows the various types of faults observed on each of the elements and their frequencies. This frequencies are indicators of the degree of under maintenance regarding each element and the housing units as a whole.

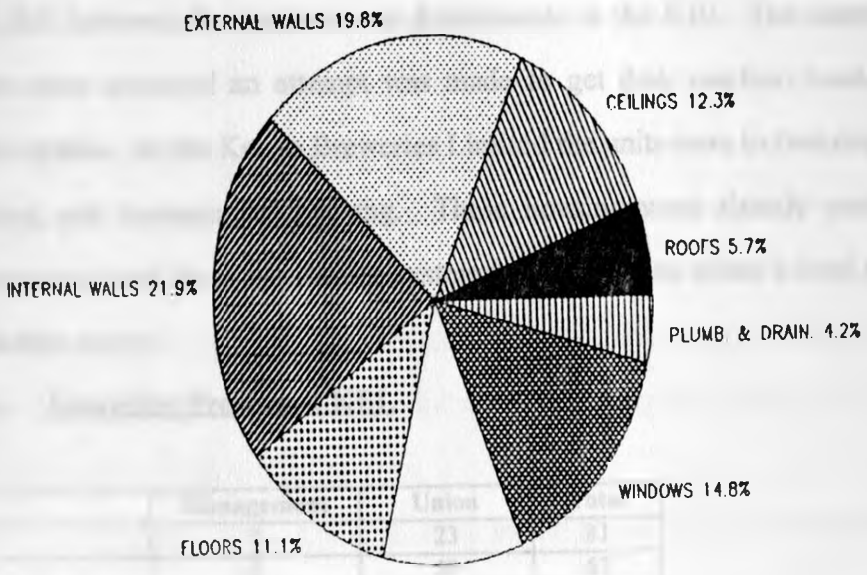
Table 5.10 Types of Faults in Each Element and their Frequencies

ELEMENT	TYPE OF FAULT	FREQUENCIES	
		Number	Percentage
Roofs	Leaking Roof, Sagging Roof, Missing Tiles	62/288	21.5
Ceilings	Stained Boards, Splitting at Joints, Boards falling off, Discoloration of ceilings	105/288	36.5
Walls (External/Internal)	Cracking, Dampness, Loss of Adhesion of Render/Plaster, Efflorescence on walls, Fading Paint work, Discoloured Paint	339/792	39.2
Floors	Cracking Floors, Faded Paint work, Missing Tiles, Lifting of Tiles	116/432	26.9
Windows/Doors	Twisted Components, Missing or Damaged Ironmongery, Corroded Frames, Cracked or Missing Panes	208/1296	16.0
Plumbing/Drainage	Missing/Malfunctioning taps, Blocked Drains, Missing/Damaged Sanitary Fittings	32/432	7.4

Source: Field Survey, 1992.

As previously indicated (chapter 4) it was assumed that each fault occurred in one house and to that extent indicated the degree of under maintenance regarding each element and the housing units as a whole. Table 5.10 shows that walls, both external and internal, suffered the highest degree of under maintenance followed by ceilings which suffered 36.5 percent under maintenance. On average 24.6 percent of the residential units were under maintained.

Fig. 5.2: Condition Survey (KBL)



Source: Field Survey, 1992

User-Reaction

A user reaction survey was undertaken aimed at establishing the nature of the information link between the maintenance departments at the KBL. The users/occupants of the premises were surveyed an attempt was made to get their reaction towards the whole maintenance system. At the Kenya Breweries Limited the units were in two major categories: union housing and management housing. These housing were already numbered by the Estates Department and these numbering system was utilised to select a total of 72 units for the user-reaction survey.

Table 5.11: Sampling Process at KBL

Village	Management	Union	Total
Allsopps	8	23	31
Tusker	8	59	67
Company Owned/Leased	3	-	3
Makadara	-	1	1
Ziwani	-	4	4
Shauri Moyo	-	4	4
			110

Source: Field Survey, 1992.

These units were numbered and randomly selected using a table of random numbers to select those to be surveyed. It was possible to get returns from 72 of those asked to fill in the questionnaires. This was a return of 65.5 percent.

Table 5.12: Length of Occupying House.

Length/Period of Occupying House (Months)	FREQUENCY	
	Number	Percentage
1 - 96	40	55.6
97 - 192	21	29.1
193 - 288	7	9.7
289 and over	4	5.6

Source: Field Survey, 1992.

Table 5.12 shows the periods of occupancy of the premises surveyed. It indicates the 55.6 per cent occupied the premises for varying periods between one and ninety-six months. While 84.7 per cent were occupants of the premises for periods ranging from one (1) to sixteen (16) years.

When KBL Housing occupants were asked how they present their maintenance request 14.3 per cent said that they presented their requests orally while 85.7 per cent did it by filling out standard forms. As indicated in Table 5.13 when asked about the maintenance procedure 47.8 percent of the interviewees said that they informed the housing department, while 21.7 percent indicated that they filled a maintenance requisition booklet. The remainder gave answers closely related to the first two.

Table 5.13: Response of KBL Tenants when asked about the maintenance procedure

RESPONSE	FREQUENCY	
	No	%
Inform the housing department	33	47.8
Fill a form at the estates office on-site	1	1.4
Report to housing department giving details of the defect	3	4.3
Report to housing department who sent repairmen	7	10.1
Report to housing department giving problem and house No.	10	14.5
Fill in Requisition Booklet and give to Housing Department	15	21.7

Source: Field Survey, 1992.

On the issue of how long it took for the estates department to respond to their request, 39.4 percent of the respondents said that it depended upon the defect as indicated in table 5.14.

Table 5.14: Response to the question "How long did it take before your maintenance request was acted upon?"

Response of the Tenant	FREQUENCY	
	Number	Percentage
It depends on the defect	28	39.4
Response is Quick	11	15.5
Response is Slow	11	15.5
It takes a long time	14	19.7

Source: Field Survey, 1992.

The user reaction results seem to indicate that a substantial proportion, 35.2 percent of those surveyed said that the response was either slow or it took a long time as shown by the results in table 5.14. They also show that a significant proportion of 39.4 percent said that the response depended on the nature of the defect.

Table 5.15 : Maintenance Responsibility of Tenant (KBL)

Responsibility of the Tenant	FREQUENCY	
	Number	Percentage
Carrying out minor repairs	33	52.4
Cleaning of Premises	43	68.3
Internal Painting	-	-
Approving work carried out on the House	5	8.1

Source: Field Survey, 1992.

In terms of the tenants maintenance obligations, 52.4 per cent said that this included carrying out minor repairs, 68.3 per cent said it included cleaning premises, none said that internal painting was part of their responsibilities while only 8.1 per cent said that approving of maintenance work carried out on their premises was their responsibility.

When asked how they became aware of their obligations, 8.1 percent said that did so through education by the maintenance staff, 19.4 percent through the tenancy agreement, 3.2 percent through the lease agreement while 74.6 percent said they did so on their own. Majority, 95.8 percent of them did not keep any records on the maintenance of their abodes. When asked whether any information is provided to them on entering a new house, 81.4 percent replied in the affirmative. Of these 54.5 percent said that they were told of their maintenance responsibilities, 48.2 percent said they were aware of the maintenance condition of the building they were entering.

Only 52.2 percent indicated that they approved the maintenance work that they request to be done in their houses. This was inconsistent with their reply when asked whether approving of maintenance work was one of their obligations. In the latter instance only 8.1 percent replied in the affirmative.

SUMMARY

At the KBL the record keeping system was not as comprehensive as at the NCC. The personnel at all levels indicated that they had certain information requirements which were not readily available to them. For instance they required condition surveys but this was not available because the residential units were not regularly inspected. Only 23.6 percent of the respondents indicated that their dwelling units were surveyed. Thus, there was no accurate technical basis upon which maintenance activities were carried out. Although unplanned maintenance does not necessarily mean poorly maintained buildings, it is more expensive. At the KBL the defect reporting mechanism was a little bit less bureaucratic. But still the tenants were not satisfied with it as shown by the results of the user-reaction survey which showed that 35.2 percent of the respondents said that maintenance requests were not expeditiously addressed.

It was evident that there was lack of systematic maintenance management. This was seen by the lack of comprehensive and detailed property data bases, the lack of condition surveys, and the evident lack of a detailed works programme as far as the study was able to determine. It would have been difficult at the KBL to utilise life cycle costing techniques because this required accurate data bases if they are to be useful at all. The maintenance budget was determined by financial ratios determined elsewhere and not on the technical requirements of the assets. Although the Estates Manager indicated that they undertake certain cyclical maintenance activities such as painting of the units but this was not adequate as shown by the results from the condition survey which indicated that the residential units were under maintained.

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CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

SUMMARY OF FINDINGS

This study was prompted by concern for the declining standards of maintenance of built assets. This is evidenced by the fact that most public institutions in Kenya carry out crisis as opposed to the more effective planned maintenance regime **(UNCHS, 1991)**. This was inspite of evidence to the effect that crisis or response-based maintenance costs twice as much as planned maintenance **(UNCHS, 1990:30).** Also funding for maintenance is usually the first item of an organisations funds to be slashed in the event of budgetary cuts. Further evidence of deficient maintenance of built assets especially residential buildings was seen during a housing condition survey that indicated a decline in maintenance standards **(Syagga and Aligula, 1993)**. It set out to investigate the manner in which maintenance information was managed at the Nairobi City Commission and the Kenya Breweries Limited. The aim was to put up a case for the need for improved maintenance information management through the techniques identified as crucial for effective and efficient maintenance information management. This was because several studies had put forward poor management, inadequate funds, staff, and transport amongst others as reasons for the declining maintenance standards **(Aloo, 1985; Syagga, 1985; Miles and Syagga, 1987; and Mbucua, 1988)**. However, this study contends that these were effects of the inadequate management of maintenance information. The crux of the matter was that information that could be used to allocate or hire resources was either not there or if it was, it was not in a management usable form. This is to say that the information did not assist the maintenance personnel in making correct and informed decisions.

The study hypothesised that the present deficient maintenance management of built assets was caused in a significant part by the inadequate management of maintenance information. The results from the user reaction survey showed that there was a breakdown in

communication between the tenants and those responsible for the maintenance of the built these assets. For instance at the NCC and the KBL 78.4 percent and 65.2 percent respectively of the respondents indicated that their houses were either not inspected at all or it was not done regularly. When seen in the light of the condition surveys: it is estimated that under maintenance is running at 20.6 percent and 24.6 percent respectively for the NCC and the KBL it is seen, that this breakdown in the link between the users and the maintenance operatives is a contributing factor to the poor maintenance state in which the built assets are in. This is data that the maintenance personnel at both departments did not have. They just responded to complaints by the tenants. There efforts were thus, not effective and efficient as these results indicate.

The objectives of the study were fourfold. First, the study aimed at determining the maintenance management functions at each organisational level and the activities performed under each level. Secondly, the study was to determine the information needed to perform the activities at these levels in the study areas. The study areas were divided into four operational levels, namely: the strategic planning level; the management control level; the operations control level and the transactions processing levels. These was determined and the results are detailed in Tables 4.2 and 5.1 for the NCC and the KBL respectively. The results showed that at the strategic planning level the personnel performed almost the same activities as well as having similar information requirements. These information that they indicated they required, for example condition surveys or the maintenance backlog, was not available to them. It was information that was useful in ensuring systematic built asset management. A difference came at the management control level where at the KBL it did not exist. However, this was in the process of being created. A noticeable difference was seen at the transactions processing level where at the NCC the operatives at this level had some controlling function. This was in the sense that they indicated that they carried out inspections, prepared job progress reports and reported to the supervisors. However, the field survey in achieving the third objective showed that at the NCC these operatives at the transactions processing level

did an extremely poor job at preparing reports and ensuring that work orders were properly filled out. The aim of the third objective was to determine the manner in which the maintenance information is collected, stored, analysed, retrieved, and applied in the study area. It was determined that information required for maintenance purposes was collected mainly through use of standard prepared forms and procedures that were specified by upper management. However, as previously stated this procedures were not always followed and the result was that a lot of the maintenance information required was missing. A condition assessment survey of the built assets in the study area was made and it determined the level of under maintenance in the case study areas. The number of units used point to the fact that a deeper more thorough survey would show a higher level of under maintenance. When this was coupled together with the results of the user-reaction survey it was evident that the manner in which information was handled in both organisations was not efficient and effective and contributed to the high incidence of poorly maintained elements and therefore built assets.

The data was analysed using the literature review that established the requirements for an effective maintenance management information system. The phenomena that was being observed was that of maintenance information management. Chapter two and three secured the conditions under which a systematic approach to the management of built assets and more significantly in the management of maintenance information would be effective and efficient. These conditions involved the definition of a methodology that enabled maintenance personnel clarify the data that they need for asset management, identification of techniques for handling data with emphasis on those relevant to maintenance, and the characteristics of good data. Data definition methodology included a clear and comprehensive maintenance strategy addressing and clarifying issues of maintenance policy, maintenance procedures, and economic aspects of maintenance decisions was deemed essential. This study also made a A distinction was made between data and information. It saw information as data that influenced the decision making patterns of those who receive it. Also cited were those

characteristics of information that have differentiated it from the traditional resources of land, labour, and capital. These included the fact that information can be shared but cannot be consumed. It is expansive and is increasingly viewed as a commodity **(Goetz, 1990)**. It is such attributes that have lent this age the label of the `information age'. The development of information systems and the various types thereof are identified as well as the roles they play in the management of information. Data characteristics such as relevance timeliness, and correctness of format were essential if useful information were to be derived from the data collected. Information systems are important in the sense that they assist in collecting, processing, presenting, communicating, and retrieving data so as to assist those responsible for the use of resources in problem solving and decision making **(UNCHS, 1990:32)**. The study identified various techniques of managing information as well as the tasks entailed in managing information in respect of built assets **(Then, 1992)**. Considering the fact that maintenance management involved the handling of data from diverse sources and for a multiplicity of uses concepts such as classification and coding were essential for the effective collection, analyses, retrieval, and application of information. In this era of increased usage of computers coding especially was key to the successful integration of computers were into the maintenance management information systems. These areas of a maintenance management information system formed the basis upon which the case studies were analysed. The analysis detailed the organisation of the maintenance management functions in the study areas, the activities performed within the functions and the information required to effectively carry out these functions. It analysed the information flows with respect to actual maintenance work and went through the records of past maintenance jobs. These conditions that have been related did not to a great extent occur in the case study areas. In this regard they did not promote good proper information management practices in the study areas. The results of a maintenance condition survey of the assets in these case studies were also outlined.

This poor performance of the MMIS in the case study areas was mainly because it failed to address certain issues crucial to effective maintenance information management. The

framework within which the maintenance personnel were to collect data was not adequate in terms of ensuring that information required at all the management levels was available. Information management means getting the right information, in the correct form, to the right person, at the right time to make a decision. As was evident from the field survey some of the tenants reported defects that were in need of urgent attention late and some times inaccurately. This meant unnecessary resources were utilised to attend to them and it only emphasises the need for more regular inspection of the built assets.

In the following section the conclusions from these findings are set out with respect to the areas obligatory for effective and efficient maintenance information management.

CONCLUSIONS

Data Definition Methodology

Maintenance personnel need a clear and comprehensive maintenance strategy that must address and clarify issues of maintenance policy, maintenance economics, and maintenance procedures. When this is done then they have a good idea about what kind of data to collect, how to collect it, and how to utilise it to achieve their stated goals. It was found out that although the maintenance personnel in both organisation stated that they needed policy guidance, it was not totally available. Only financial policy was stringently followed. A comprehensive maintenance policy focuses the actions of the participants in the maintenance process and therefore leads to more effective and efficient maintenance.

Maintenance Policy

Maintenance policy addresses itself to the roles of participants in the maintenance process, funding for maintenance activities, maintenance standards, statutory obligations, and the objectives and benefits of maintenance to the organisation. In both organisations the maintenance policies as discerned from the interviews did not deal fully with these issues. The maintenance personnel at the strategic planning level were unable to articulate what their

organisations objectives were in carrying out maintenance work. At the NCC they indicated that maintenance was carried out to deal with wear and tear. The maintenance standards that the organisations relied upon were those set out in the statutes and other delegated legislation. These were vague because no objective basis that could be used to determine whether they had been met was available. There was no visible effort at collecting information that would assist in preparing such standards. Funding at the KBL for maintenance activities was based on allocations from the finance department based on ratios determined by the finance department. At the NCC funding was from rentals and from the general fund of the commission. The rentals were inadequate considering that those that the tenants were paying were way below the market values in all of the commission housing estates. It was found out during the survey that these budgets were not based, especially at the NCC, on information indicating the technical requirements of the built assets but on the amount utilised in the pervious financial year. There was no evidence of a comprehensive data bases in both organisations. At the NCC the information on the built assets was scattered between the departments of the City Engineer, Social Services and Housing, and the Town Clerk. No condition surveys were undertaken. In both organisations the only time a procedure close to such was when an inspection was undertaken in a premises when a new tenant was moving in.

Thus, the study concluded the maintenance policies at both the KBL and the NCC were not comprehensive. This, therefore, did not give the maintenance personnel a framework that defined the information that they ought to collect and why they ought to do so. For instance the artisans and the supervisors did not see why they had to spend time properly filling in the BWOs after completion of a job. It did not allow for proper matching of tasks and information. The policies did not address adequately the issues of the roles of participants in the maintenance process, maintenance standards and also the funding for maintenance. This was in the sense that it did not allow the proper collection, processing, storage, and application of information for these areas to be properly executed.

Maintenance Economics

Appraisal techniques such as life cycle costing, costs-in-use, and cost-benefit analysis were not applied in both organisations. First of all the appraisal techniques mentioned were of recent use and most of the maintenance personnel had grown on the job and were reluctant to accept such innovative techniques. Thus, there was no way those charged with maintenance were able to objectively justify their choices in the use of maintenance resources. Another factor that prevented use of these techniques was the evident lack of accurate and usable raw data.

The study concluded that the conservative nature of the maintenance personnel and the lack of raw data contributed to the visible lack of utilisation of appraisal techniques in maintenance management decision making. Even if the maintenance personnel wanted to use this techniques evidence from the field indicated that data was inaccurate, poorly collected and therefore not useful for this techniques. There was no visible effort by the superior officers especially at the NCC to ensure that the forms such as the Building Works Orders were properly kept. These is vividly seen from table 4.11 which show that the record keeping was poor at NCC. At KBL it was not possible to verify this because they kept their record for short periods of tie and then either destroyed them or they were not accessible to the researcher. But, even then the manner in which the data was collected did not allow any room for use of such innovative techniques as Life Cycle Costing.

Maintenance Procedures

At both organisations maintenance was classified according to the size and nature of the works to be executed, expenditure budgets, and/or the maintenance process. They were utilised in combination. So that for instance if the works exceeded a certain cost limit then authority had to be sought from upper management to incur such expenditure.

An important factor that was missing was the lack of adequate information that would enable both organisations to carry out condition-based and planned maintenance as they said

they did. This was because at both the NCC and the KBL over 70 percent of the tenants interviewed indicated that their premises were never inspected. Thus, it was impossible for these maintenance procedures to be effective because of the lack of accurate data to implement them.

At the NCC the maintenance request procedure was cumbersome. It took in some districts a minimum of four (4) weeks for a maintenance request to be acted upon. In the case of the KBL it took only one (1) day for the maintenance personnel to respond to a maintenance request. These however did not mean that the KBL procedures were more effective, because the results of the condition survey indicate that the residential units were equally under maintained at KBL as at NCC.

Apart from this unnecessary bureaucracy is the problem of recording of the details of the defects. The clerks and the estate officers who take down these details are laymen in as far as the building industry and maintenance issues are concerned. When a tenant came and related that their roof is leaking without any indication as to the cause of the same then it meant that the allocation of resources took longer and it may not have been as effective as it ought to be. Thus, the recording of the details of the defects is not accurate in as far as it does not indicate what the causes are and also those who take down these details are not qualified to do so. Coupled with this was the absence of any prioritisation criteria that would enable proper allocation of resources. At the NCC the clerks record the works requisition orders as they come or as they are instructed by their seniors to. At the KBL the clerks record the requisitions which are sent to the building supervisor or the housing assistant who then allocates the jobs. No objective basis is availed to both these categories of personnel in order that they are able to sieve through the numerous reports that they receive. This leaves room for the occurrence of favouritism in responding to the defects.

Thus, the more fundamental explanation lies in the fact that the procedures that they had in place did not allow them to systematically and therefor effectively and efficiently manage the information available. This inevitably led to the poor state of maintenance.

The study concluded that the maintenance procedures were inadequate and in the case of the NCC they were too bureaucratic. This was in as far as no information on the maintenance criteria was provided to enable proper sorting out of maintenance jobs in order of priority. Also those maintenance personnel who recorded the defects were not suited for those duties and the information provided on the building works orders in both organisations was inadequate.

Techniques for Data Handling

Data that is collected must be organised in a manner that enables the organisation to meet its maintenance objectives. However, it was previously noted that the organisations studied had no clear maintenance objectives. *The data collected was aimed basically at accounting for the resources assigned to them.*

Although some data was collected, the only form of processing done was the preparation of summaries and observed trends. No analysis was done to come up with causes of any observations made. *Basic information on such crucial matters as the maintenance backlog was unavailable.* The reason being that no information on the maintenance needs and the work already carried out on the built assets was compiled.

At the NCC some form of classification according to the type of assets i.e. health facility, markets, or residential buildings was evident. But this was only useful in as far as ensuring that funds allocated to each were properly utilised. That is to say that the classification was mainly for accounting purposes. Also such classification was not scrupulously maintained. Inspite of the large number of building work orders dealt with, no attempt was made to code this information in order to ease the task of data handling. There was on the building work orders at the NCC some serial numbers that indicated some pertinent data such as the department of origin, page number in the register of work requisition orders, the number of entry and the data of entry. However, this information was only recorded here and no attempt was made to utilise it.

At the KBL no proper records were kept and it was not possible to determine what form of classification was carried out. although, the company had computerised its stores, the benefits of this were not translated to the other aspects such as record keeping for actual maintenance work carried out.

The study concluded that at the NCC the framework for proper classification of data and eventual introduction of computers as a data handling tool were present. But, there was laxity in ensuring that data was classified in an orderly and clear manner. At the KBL there is need to ensure that data relating to maintenance is properly managed so as to be useful to the maintenance planners.

The Maintenance Data

The data/information collected was not accurate, timely or in the correct format. This is inspite of the fact that the maintenance personnel said it was. The reason for this conclusion was that, the information only stated the observed fault such as "Repair leaking tap". It did not indicate the cause of the fault. At the end of the job, no information regarding the time spent on the job, the cost of the materials used or any other relevant information was tendered.

The information in the organisations maintenance records was not accessible in a greater majority of the cases. At the KBL the stated reason was that these were not kept for a long time or that the manager could not release them. At the NCC it was simply a reason of improper record keeping, where the work orders were available most entries were not made although the job was certified done. The data on maintenance jobs was a lot in both organisations such that manual handling of this data was not possible if proper use was to be made of the same. The information that was observed in the maintenance records was not compatible for use in such critical applications as life cycle costing.

The study concluded that the data in both organisations was relevant for very few uses and was not practical for the efficient and effective maintenance management of built

assets. ***It was not readily available for use by those concerned with making maintenance management decisions.***

It was concluded that the role of the existing maintenance management information systems in the study areas was found to be ineffectual because the framework within which the maintenance personnel were to collect the data did not meet those basic conditions necessary to ensure maintenance management received the data and information it needed to manage the built assets under its care. Further evidence of this was in the lack of systematic steps in the management of built assets. The organisations it was determined, for the most part, carried out only crisis maintenance and even then it was not effective. The MMIS in this cases was unable to provide all the management levels with the information that they indicated that they required as seen from Table 4.2 and 5.1.

Also the MMIS in the study areas did not utilise the tenants well. There was scope for user-participation in the maintenance of their residential units. At the NCC where the tenants to a greater extent were involved in the maintenance of their dwellings that at the KBL the evidence showed that the degree of under maintenance was less, 20.6 percent at NCC as compared to 24.6 percent at KBL.

RECOMMENDATIONS

In the light of the observations and conclusions drawn, several recommendations have been made to assist in improving information management with regard to maintenance and implicitly the maintenance standards of built assets. In view of the conclusions made the study recommends the following:

1. A review of maintenance policy taking into account the roles of various participants in the maintenance management process, the funding for maintenance, and objectives that maintenance is meant to achieve for the organisation. This will assist in ensuring that data/information needed by the maintenance personnel at all levels is properly collected, processed and stored.

2. Education of maintenance personnel on the usefulness and benefits of cost appraisal techniques such as life-cycle costing. At the same time efforts must be undertaken to ensure that data collected by the maintenance personnel is compatible to these techniques. This is to avoid situations such as observed in the field where the maintenance operatives see no reasons why the BWOs must be accurately completed.

3. A reappraisal of maintenance request procedures be undertaken to reduce bureaucracy while ensuring accountability. At the same time the paper work involved ought to be reduced so that all the data to be collected is got from a few sources that are accurate and reliable. The procedures for maintenance should also include stated prioritisation criteria based on proper information.

4. The maintenance clerks should not just be anybody but they should be people with a knowledge of construction techniques, and materials so as to allow faster and better initiation of maintenance action. Then it can be easier to institute measures that will lead to better utilisation of maintenance resources.

5. The classification systems should be reappraised with a view of ensuring that information regarding each built asset can be easily retrieved for processing or analysis. Such classification should allow use of new, innovative techniques and technology.

6. Because of the large number of built assets which results in numerous data on each, there is a need for computers to be introduced to handle all the aspects of data management as well as being an important tool in the planning of maintenance programmes as well as budgets.

7. Before use of computers is effected in maintenance activities the organisations should first of all organise their information. They should do so by ensuring that their maintenance departments are aware of the objectives they should achieve.

8. The maintenance personnel should be educated on the importance of accurate recording of maintenance information. The upper management of maintenance departments must also insist that artisans complete their work orders clearly and accurately.

9. Collection of data on the maintenance status of built assets should be made a priority as it will ensure that planning for their maintenance is based on their real needs. This especially so given that no information on maintenance backlog was available and that the incidence of under maintenance was significant.

10. The management in both organisations should set in motion changes that will lead to better matching of the tasks that the maintenance personnel have to undertake, the procedures and the information requirements.

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APPENDICES

APPENDIX A - QUESTIONNAIRES

ESTATE MANAGERS - STRATEGIC PLANNING LEVEL

ESTATE MANAGERS - STRATEGIC PLANNING LEVEL

1. What is the nature of ownership of the properties mentioned below?

	Property	Ownership(s)
1.	Maisonettes	_____
2.	Flats	_____
3.	Bungalows	_____
4.	Offices	_____
5.	Hospitals/clinics	_____
6.	Schools	_____
7.	Production	_____
8.	Depots/godowns/Warehouses	_____
9.	Social/Recreational Halls	_____
10.	Research buildings/Laboratories	_____
11.	Commercial	_____

Ownership codes

1. Wholly owned 2. Leased 3. Rented

2. What other work, apart from maintaining the properties in your jurisdiction, does your office perform?

1. Buying and selling properties(expansion)
2. Alteration and upgrading of existing properties
3. Preparation of design briefs for new buildings
4. Designing new buildings
5. Leasing arrangements
6. Insurance arrangements
7. Security for properties against intruders
8. Others

3. If others to Q4, specify _____

4. Does your organisation have a maintenance policy?

1. Yes 2. No

5. If yes, what is your policy?

1. Maintenance to a standard consistent with type of building, age and funds available.
2. Maintenance standards to comply with legislation and funds available from profit
3. Maintenance to be undertaken using maintenance free materials and fittings to maintain public image
4. Minimum maintenance consistent with profits and funds available
5. Maintenance of prestige buildings to highest standard possible
6. Other

6. If other, specify in the space given _____

7. What factors does your organisation take into account in formulating maintenance policy?

1. Organisational objectives and the demands they place on the buildings and services
2. Standards required
3. Legal liabilities of the organisation with respect to maintenance
4. Methods of executing maintenance work
5. Costs and methods of financing maintenance work
6. Outline plan of maintenance work
7. Analysis of the condition of the buildings, their nature, use and estimated life cycle
8. Method of implementing the program
9. Benefits to be gained-financial, technical and human
10. Calculation of approximate costs

8 Does your organisation have a maintenance strategy?

1. Yes 2. No

9. If yes, what is your maintenance strategy?

1. Planned preventive maintenance strategy
2. Condition based maintenance strategy
3. Crisis/ad-hoc maintenance strategy
4. Other

10. If others, please specify _____

11. Are the following given any roles in the maintenance process in your organisation?

a.	User's/occupiers	1. Yes	2. No
b.	Designers of buildings	1. Yes	2. No

12. Where is funding for maintenance obtained from? _____

13. What kind of standards does your organisation maintain? _____

14. What legislation influences your maintenance work?

1. Registered Land Act, Cap 300
2. Public Health Act, Cap 242
3. Local Government Act, Cap 265
4. The Factories Act, Cap 514
5. Rent Restriction's Act, Cap 296
6. Landlords and Tenants Act, Cap 301
7. Government Lands Act, Cap 280
8. The Building Code
9. Occupiers Liability Act, Cap 34
10. Sectional Properties Act No. 21 of 1987
11. Housing Act, Cap 117
12. Others

15. If others, please list _____

16. What are the objectives of your organisation regarding maintenance? _____

17. What type of maintenance is carried out in your organisation? _____

18. What criteria do you use when carrying out maintenance activity?

1. Physical characteristics of the building
2. Organisational considerations
3. Policy considerations
4. Economic criteria
5. Financial considerations
6. Environmental considerations

19. What issues does your maintenance strategy address itself to? (please list them)

_____ _____

20. What cadre of staff do you require in your organisation, for maintenance purposes?

Cadre Code:

1. Maintenance/Estate Manager
2. Maintenance/Estate Officer
3. Supervisors
4. Artisans/Technicians
5. Clerical staff
6. Drivers
7. Labourers
8. Architects
9. Engineers
10. Quantity Surveyors
11. Clerk of works

Cadre	1. In-house 2. Others		Purpose

21. Are all the positions in the cadres listed above available in the required numbers in the organisation?

1. Yes 2. No

22. If no, specify which cadre(s) is (are) deficient. (Use cadre code as in Q 20 above) _____

FUNCTIONS AND ACTIVITIES PERFORMED UNDER EACH FUNCTION AND THE INFORMATION NEEDED

23. What are your responsibilities as an estate/maintenance manager?

1. Preparing briefs for new building projects for the organisation
2. Assisting in the preparation of maintenance manuals for properties
3. Negotiating leases for existing and/or new properties
4. Monitoring the payment of rents
5. Upkeep of the valuation roll and raising objections in case of excess rates than envisaged
6. Protecting the company property and ensuring that the organisation is adequately compensated in cases of compulsory acquisition
7. Acquiring land for the organisations development
8. Assisting in the allocation of staff housing
9. Repair and general upkeep of the building
10. Ensuring compliance with statutory requirements
11. Updating organisational records for the landed property
12. Providing investment and taxation advice on buildings
13. Preparing maintenance plans and budgets
14. Aiding in the development of organisational maintenance policy
15. Liaising with and co-ordinating the input of specialist maintenance bodies/firms/organisations
16. Others

24. If others, please specify _____

25. Which of the following management functions do your responsibilities entail?

1. Planning
2. Organising
3. Staffing
4. Directing
5. Controlling

26. What activities are undertaken under each of the following management functions:

i). Planning

1. Preparing inspection and condition survey plans
2. Preparing maintenance plans (short and long term)
3. Preparing specifications and standards
4. Preparing property/asset registers
5. Liaising with the design team
6. Preparing budgets
7. Institution of planning and controlling systems
8. Deciding on the work execution modes
9. Others

iii). Organising.

1. Allocating of maintenance responsibility
2. Setting up administrative routines
3. Delegating of authority
4. Setting up a supervisory system
5. Setting up a job execution system
6. Establishing an appropriate information system and communication channels ensuring co-ordination and effective feedback for control purposes
7. Providing suitable office accommodation and facilities
8. Others

v). Staffing.

1. Selection of personnel
2. Determination of qualification levels
3. Assisting in the development of schemes of service for maintenance personnel
4. Motivation of personnel
5. Recruitment and training of personnel

vii). Directing.
1. Supervision
2. Others

ix). Controlling.
1. Measuring work or job progress
2. Maintaining feedback systems
3. Updating maintenance programmes and plans
4. Evaluating progress reports of jobs at hand
5. Quality control
6. Budgetary control
7. Determining performance measures
8. Others

27. What is the information that you require for purposes of:

i). Planning.
1. Organisations maintenance policy and strategies
2. Property/Asset registers
3. User request analysis
4. Inventory records
5. Staff records
6. Nature, location and spread of workload
7. Condition assessment surveys
8. Inspection reports
9. Property usage patterns
10. Space usage patterns
11. Maintenance responsibilities
12. Uses and potential uses of assets
13. Organisational objectives
14. Statutory obligations

ii). Organising.
1. User patterns
2. Space usage patterns
3. Volume of workload and it's nature and location
4. Staff availability and their qualification
5. Availability of financial and other resources
6. Maintenance responsibilities
7. Work execution methods
8. Supervision patterns
9. Technical requirements of work
10. Timing of work
11. Building owner's or user's policies for different types of buildings

v). Staffing.
1. Maintenance standards required
2. Nature and volume of workload
3. Organisations maintenance policy and strategies
4. Modes of work execution
5. Financial resources availability
6. Technology available to organisation
7. Qualification levels for required staff cadres available in the market
8. Others

vii). Directing.
1. Location, nature and volume of workload
2. User patterns
3. Space usage patterns
4. Drawings
5. Specifications and standards required
6. Manufacturer's maintenance manuals
7. Buildings/Property maintenance manuals
8. Organisation's traditions
9. Current organisation's policy
10. Others

ix). Controlling.

1. Maintenance Programmers(Short and long term)
2. Maintenance Budgets
3. Performance measures e.g. output, man-hours per job etc.
4. Maintenance manuals
5. Maintenance profiles i.e. patterns of maintenance costs over the life of a building, and other cost summary data e.g. unit cost
6. User reports
7. Standards and specifications
8. Monthly statements of expenditure (or periodic)
9. Variance analysis i.e. analysis to determine the cause of differences between budgets and expenditures
10. Maintenance analysis
11. Elemental cost analysis
12. Response time analysis
13. Maintenance audits
14. Others

x). If others, please specify _____

28. What kind of information do you use to determine the maintenance demand facing you?

1. Condition assessment surveys
2. Inspection reports
3. Strategic asset plans or long term maintenance plans

29. What is the information you need in order to formulate your maintenance budget(s)?

1. Property Data Base
2. User request analysis
3. User requests
4. Condition assessment surveys
5. Inspection reports
6. Maintenance schedules
7. Life cycle cost plans
8. Elemental cost analysis
9. Maintenance funds allocated
10. Productivity of resources
11. Standard Costs
12. Standards

30. Do you maintain a property data base or assets register?

1. Yes 2. No

31. If yes, which of the following information does it provide?

1. Property name
2. Property location and age
3. Property design team
4. Property contractor/subcontractors
5. Property handing over report/s
6. Space usage patterns
7. Maintenance log/history
8. Usage patterns
9. Site value
10. Function/use of property
11. Elemental areas
12. Services available within property
13. Constructional details
14. Occupation costs
15. Replacement cost of property
16. Value(Market or otherwise) of property
17. Life of building
18. Constraints e.g. listed building
19. External works
20. Maintenance work done on the property

32. What criteria do you use in prioritising your maintenance activities?

1. Complexity of work
2. Volume of work
3. Cost of work
4. Availability of personnel
5. Effect of work on organisational activities
6. Risk to occupants and/or contents of the property, and to the asset itself i.e. safety and health considerations

33. What information do you need to monitor and evaluate:

i). Job Progress.

1. Job cards (work orders)
2. User reports
3. Work progress reports

ii). Staff Performance.

1. Job cards (work orders)
2. User reports
3. Response time analysis
4. Analysis of completed time sheets
5. Analysis of completed work orders
6. Work studies
7. Performance measures i.e. measures to assist in evaluating planning and working methods e.g. supervision factors, service efficiency factors, productivity measurements etc.

iii). Backlog Status.

1. User requests
2. User reports and analysis
3. Maintenance programmes
4. Work orders
5. Work order analysis
6. Performance measures e.g. service efficiency factors

iv). Inventory Status.

1. Condition assessment surveys
2. Inspection reports
3. Maintenance audits (Technical)

34. Do you maintain any past maintenance records in your organisation?

1. Yes 2. No

35. If yes, what kind of information do the maintenance records provide?

1. Budgetary control information-to produce annual or other periodic sums which need to be set aside to provide for maintenance and operating services
2. Management control information-to permit day to day control over maintenance expenditure
3. Design cost control information- to provide full information concerning causes of failure, types of failure, design faults and similar particulars
4. Maintenance profiles

36. If no, why are no maintenance records kept? _____

SOURCES, COLLECTION, STORAGE, ANALYSIS/PROCESSING, RETRIEVAL, DISSEMINATION AND APPLICATION OF INFORMATION:

37. Is there an established procedure for collection, storing, analysing/processing, retrieving, disseminating and applying information for maintenance in your organisation?

1. Yes 2. No

38. If yes, please briefly describe the:

i). Collecting system _____

ii). Storing system _____

iii). Analysis/Processing system _____

iv). Retrieval system _____

v). Dissemination/Application system _____

39 Is the system adequate, in terms of enabling you to get sufficient information, quantitatively and qualitatively, for discharging your responsibilities?

1. Yes 2. No

40. If no, please briefly list the inadequacies present in the system.

_____

41. What are the sources of data/information for maintenance in your organisation, assisting you in discharging your responsibilities?

1. User's/Owner's reports
2. Maintenance records
3. Analysis of maintenance records
4. Statutes
5. Codes of regulation
6. Manufacturers (of components and materials)
7. Statements from upper management
8. Maintenance manuals
9. Property/asset registers or data bases
10. Inspection reports
11. Contract documents
12. Job cards/Work orders
13. Government departments(central and local)
14. Research institutions
15. Insurance companies
16. Catalogues
17. Drawings

42. How is this information collected?

1. Manually
2. Electronically by (computers)
3. Verbally by phone or interview

43. Is there classification of the information that is:

	Classification	Classification Mode
1. Collected		
2. Stored		
3. Analysed/Processed		
4. Retrieved		
5. Disseminated and Applied		

Classification Code

1. Yes 2. No

Classification Mode code.

1. Universal Decimal Classification (UDC) 5. Indexing
2. Construction Industry SfB (CI/SfB) 6. Others
3. Co-ordinated Building Communications (CBC)
4. Faceted classification

44. Do you code your information?

1. Yes 2. No

45. If yes, for what purpose is the information coded?

1. Facilitate storage, retrieval and processing of data and information
2. Facilitate machine and computer processing

46. What is the nature of the coding?

1. Numerical
2. Alphabetical
3. Alpha-numerical
4. Mnemonics (i.e. use of abbreviations e.g. BKWK for BRICKWORK)

47. In what format is the information:

	Format
1. Collected	
2. Stored	
3. Analysed/Processed	
4. Retrieved	
5. Disseminated and Applied	

Format Code

1. Reports
2. Unit costs
3. Indices
4. Codes of practice
5. Standards
6. Regulations
7. Catalogues
8. Specifications
9. Drawings
10. Trends
11. Procedures

48. What criteria is used in selecting the formats used above?

1. Availability
2. Ease of use
3. Cost
4. Applicability to tasks
5. Compatibility with existing procedures
6. Popularity with staff

49. Is this information updated?

1. Yes 2. No

50. If yes, when is it updated?

1. Periodically 2. Occurrence related

51. Who does the updating?

1. Maintenance Manager
2. Supervisors
3. Artisans/Technicians
4. Maintenance Officers
5. Upper management

52. What kind of technology is used in the tasks of

Tasks	**Technology**
1. Collecting Information	_____
2. Storing Information	_____
3. Analysing/Processing Information	_____
4. Retrieving Information	_____
5. Dissemination/Application of information	_____

Technology.

1. Manual 2. Computer 3. Combination of manual and computer technology

COMMENTS: PLEASE GIVE YOUR OPINION ON THE FOLLOWING:-

53. Is the maintenance information system used in your office satisfactory?

1. Yes 2. No

54. If no, what are the major constraints facing the system?

_____

55. What actions may be taken to overcome these constraints:

i). Without expanding the budget? _____
ii). With budgetary implications? _____

56. Do you have any collaborative effort with design team personnel?

1. Yes 2. No

57. If yes, please explain on the nature of this collaborative effort?

_____

58. If no, why not? _____

MIDDLE MANAGERS

(MANAGEMENT CONTROL LEVEL)

FUNCTIONS, ACTIVITIES PERFORMED UNDER EACH FUNCTION, AND THE INFORMATION NEEDED

1. What are the responsibilities of your office?

   1. Monitoring maintenance activities
   2. Reporting to the maintenance manager
   3. Prioritising maintenance work
   4. Allocation of the tasks to supervisors/foremen
   5. Initiating condition assessment surveys
   6. Initiating inspections of properties
   7. Analysis of work orders and work allocation sheets
   8. Maintaining appropriate stock inventory levels
   9. Procurement of materials, equipment and tools required
   10. Others

2. If others, please specify _____

3. Which of the management functions does your responsibility entail?

   1. Planning
   2. Organising
   3. Staffing
   4. Directing
   5. Controlling

4. What activities are undertaken under each of the following management functions?

   i) Planning:

   1. Preparing short-term budgets
   2. Preparing detailed inspection plans
   3. Preparing detailed condition survey plans
   4. Liaising with finance department
   5. Others

   iii). Organising:

   1. Selection of organisations/firms to execute maintenance work
   2. Giving specific tasks/jobs to the supervisors
   3. Others

   v). Staffing:

   1. Recommending to maintenance manager staffing requirements
   2. Others

   vii). Directing:

   1. Supervision
   2. Others

   ix). Controlling:

   1. Analysis of work orders
   2. Measuring work or job progress
   3. Calculating or evaluating performance measures
   4. Financial control
   5. Quality control
   6. Preparing specifications
   7. Others

5. What is the information you require for the following functions

FUNCTION	INFORMATION NEEDED
Planning	_____
Organising	_____
Staffing	_____
Directing	_____
Controlling	_____

Information codes:

1. Budgets
2. User requirement analysis
3. Inspection reports
4. Space usage patterns
5. Maintenance Procedures
6. Nature, location and spread of available workload (Maintenance)
7. Maintenance responsibilities
8. Statutory Obligations
9. Staff availability
10. Maintenance profiles
11. Materials prices/costs
12. Labour costs
13. Property maintenance manuals
14. Financial resources
15. Work execution methods/
16. Specifications and standards
17. Elemental cost analysis

6. Is this information available at a central location?

i). Within the organisation 1. Yes 2. No
ii). Outside the organisation 1. Yes 2. No

7. Who do you report to? _____

8. Who reports to you? _____

SOURCES, COLLECTION, STORAGE, ANALYSIS/PROCESSING, RETRIEVAL, DISSEMINATION AND APPLICATION OF INFORMATION:

9. What are the sources of the information you need for executing your responsibilities?

1. Users/occupiers of premises
2. Maintenance records
3. Statutes
4. Codes of regulations
5. Maintenance manuals
6. Property/asset registers or data bases
7. Inspection reports
8. Contract documents
9. Government departments(Both central and local)
10. Catalogues
11. Drawings
12. Manufacturers (of components and materials)
13. Statements from upper management
14. Specialist maintenance organisations
15. Research Institutions
16. Merchants
17. Others

10. If others, please specify _____

11. How is this information collected?

1. Manually
2. Verbally
3. Electronically

12. Is there classification of this information?

1. Yes 2. No

SUPERVISORS/FOREMEN

(OPERATIONAL CONTROL LEVEL)

FUNCTIONS, ACTIVITIES PERFORMED UNDER EACH FUNCTION AND THE INFORMATION NEEDED:

1. What are your responsibilities as a supervisor/foreman?

   1. Supervision of artisans/technicians/tradesmen
   2. Allocation of jobs to artisans/technicians/tradesmen
   3. Keeping records of work undertaken
   4. Ensuring that work done complies with contract particulars and relevant statutory requirements
   5. Ensuring safety of work being undertaken
   6. Ensuring satisfactory work standards (materials and workmanship)
   7. Ordering of materials
   8. Preparing of job cards or work orders
   9. Receiving user requests
   10. Supervising/carrying out inspections or condition survey
   11. Reporting to the middle managers, maintenance officers
   12. Other

2. If other, please specify _____

3. What group(s) of tradesmen or personnel do you superintend upon?

   1. Plumbers and Fitters
   2. Carpenters
   3. Masons
   4. Electricians
   5. Painters
   6. Glaziers
   7. Cleaners
   8. Others

4. If others, please specify _____

5. How many tradesmen/personnel do you superintend upon? _____

6. What kind of information do you need in order to perform your responsibilities?

   1. Maintenance tasks to be done
   2. Location of the tasks
   3. Materials and equipment needed
   4. Personnel required
   5. Drawings and constructional details of work to be done
   6. Specifications
   7. Plans or schedules for executing the tasks
   8. Others

7. If others, please specify _____

8. Who do you report to? _____

9. Who reports to you? _____

SOURCES, COLLECTION, STORAGE, ANALYSIS, PROCESSING, RETRIEVAL, DISSEMINATION AND APPLICATION:

10. Do you maintain any records in your office?

    1. Yes 2. No

11. If yes, what kind of records do you maintain?

    1. Workforce records
    2. Materials usage records
    3. Work/job progress records
    4. Work details records
    5. Drawings
    6. Specifications
    7. User's requests

12. If others, please specify _____

13. In what format is the information that you require in executing your responsibilities found?

1. Reports
2. Unit costs
3. Indices
4. Codes of practice
5. Standards
6. Specifications
7. Regulations
8. Procedures
9. Catalogues
10. Drawings
11. Verbal

14. What are the sources of this information?

1. Users/Occupiers
2. Artisans/Technicians
3. Fellow Supervisors
4. Upper management
5. Statutes
6. Regulation books
7. Procedures
8. Others

15. If others, please specify _____

16. Is the information that you collect, store, analyse, process, disseminate and apply:

i).	Accurate?	1. Yes	2. No
ii).	Timely?	1. Yes	2. No
iii).	In the correct format?	1. Yes	2. No
iv).	Understood by you?	1. Yes	2. No
v).	Communicated by the right channel?	1. Yes	2. No
vi).	Have the right level of detail?	1. Yes	2. No
vii).	Complete for enough for its purpose?	1. Yes	2. No

17. Please. comment briefly on your response to the following attributes of the information:

i). ***Accuracy*** _____
ii). ***Timeliness*** _____
iii). ***Correctness of format*** _____

18. Do you compile any reports or summaries?

1. Yes 2. No

19. Please, state the kind or type of the report or summary and the frequency of its compilation?

KIND/TYPE OF REPORT/SUMMARY	FREQUENCY OF COMPILATION

Frequency Code:

1. Weekly
2. Monthly
3. Quarterly
6. Annually
4. Bi-annual
7. When need arises(special circumstances)
5. Bi-weekly

Report/Summary Code:

1. Progress Reports
2. Materials inventory
3. Equipment/Tools inventory
5. Special reports
4. Others (specify)

20. What happens to these reports?

1. They are kept in the office for future reference
2. Sent to superiors immediately
3. Sent to accounts department
4. Sent to stores

21. **If others, please specify** _____

22. **What do you use the information available to you for?**

1. **Planning**
2. **Organising**
3. **Staffing**
4. **Directing/Supervising**
5. **Controlling**

COMMENTS:

23. **What kind of problems do you face in executing your responsibilities?**

_____

_____

ARTISANS TECHNICIANS

(TRANSACTIONS PROCESSING LEVEL)

FUNCTIONS AND ACTIVITIES PERFORMED UNDER EACH FUNCTION AND THE INFORMATION NEEDED:

1. What trade(s) are you trained in and what is the level of training you have attained?

Trade(s) Level of Training

_____ _____

Trade codes:

1. Plumbing
2. Fitting
3. Masonry
4. Electrical
5. Carpentry
6. Painting
7. Glazier

Level of training codes:

1. Trade Test Grade I
2. Trade Test Grade II
3. Trade Test Grade II
4. Craft Certificate
5. Higher National Diploma
6. Ordinary National Diploma

2. What duties do you perform?

1. Carrying out repairs
2. Carrying out inspections
3. Preparing job progress reports
4. Reporting to the foreman/supervisor
5. Others

3. If others, please specify _____

4. Who allocates you these duties?

1. Supervisors/Foremen
2. Maintenance Officers
3. Maintenance Manager
4. One particular foreman
5. Others

5. How is this work allocated?

1. Through job order cards
2. Verbally
3. Other

6. If other, please specify _____

7. What kind of information do you need to perform your duties?

1. Location of defects
2. Nature of defects
3. Specification of work to be done to repair the defect
4. Time during which affected premises is accessible
5. Others

8. If other, please specify _____

9. Is this information available to you?

1. Yes 2. No 3. Partly

10. If partly, please list the deficiencies of this information

_____

_____

11. Do you have a permanent work station?

1. Yes 2. No

SOURCES, COLLECTION, STORAGE, ANALYSIS/PROCESSING, RETRIEVAL, DISSEMINATION AND APPLICATION OF INFORMATION:

12. What are the sources of the information you need for your duties?

1. Supervisors/Foremen
2. Users
3. Job cards/Work orders
4. Specifications
5. Others

13. If others, specify _____

14. Do you collect any information while executing your duties?

1. Yes 2. No

15. If yes, what kind of information do you collect?

1. Materials needed or used i.e. quantity and quality
2. Equipment/Tools needed
3. Defects and their nature
4. Time spent in executing job or duty
5. Number of tradesmen/labourers used/needed

16. Where do you take this information?

1. To supervisors
2. To maintenance officers
3. To maintenance managers

17. How do you collect this information?

1. Manually using standard forms
2. Electronically using computers
3. Verbally

COMMENTS:

18. What kind of problems do you face in executing your work?

_____

USERS/OCCUPIERS

1. How long have you:

   i). Occupied this residence _____
   ii). Used this office _____

2. Is there a procedure for requesting for maintenance or repair services?

   1. Yes 2. No

3. If yes, please briefly elaborate on the procedure

   _____

4. How do you present your request(s)?

   1. Orally/Verbally
   2. Filling Standard forms

5. How long does it take before your request is acted upon?

   1. It depends on the defect
   2. Response is quick
   3. Response is slow
   4. It takes a long time

6. How regularly are your premises inspected by the maintenance department?

   1. Regularly (every _____ years/Months)
   2. Irregularly
   3. Never
   4. On request

7. Are you aware of your maintenance responsibilities with respect to your premises?

   1. Yes 2. No

8. If yes, what are these responsibilities?

   1. Carrying out minor repairs e.g. replacement of light bulbs, water taps
   2. Cleaning of the premises
   3. Internal painting of the premises
   4. Approving work carried out by the maintenance department
   5. Others

9. If others, please specify _____

10. How did you become aware of these responsibilities?

    1. Education by maintenance staff
    2. Through tenancy agreement
    3. Through lease agreement
    4. On my own

11. Do you maintain any records of such do-it-yourself work?

    1. Yes 2. No

12. If yes, what kind of information is contained in these records?

    1. Cost of the work
    2. Materials used for the work
    3. Number of artisans/labourers used in the work
    4. Time taken in executing the work

13. What do you do with this information?

1. Take to maintenance department
2. Claim refund from finance or accounts department
3. Keep it ourselves

14. Is any information provided to you, upon entry of the premises?

1. Yes 2. No

15. If yes, what kind of information is it?

1. Maintenance status of the premises at the time you assume occupancy
2. Your maintenance responsibilities
3. Others

16. If others, please specify _____

17. Do you vet or approve work performed by the maintenance department on your premises?

1. Yes 2. No

HOUSING CONDITION SURVEY

1. **ROOF**

Leaking	1
Sagging	2
Missing Tiles	3
Cracked Asphalt	4
Other (Specify)	5

2. **CEILING**

Stained	1
Splitting at Joints	2
Falling Boards	3
Discoloration	4
Other (Specify)	5

3. **WALLS**

		EXTERNAL	INTERNAL
Cracking	1		
Dampness	2		
Loss of Adhesion of Plaster	3		
Efflorescence	4		
Faded Paint work	5		
Discoloured Paint work	6		
Other (Specify)	7		

4. **FLOORS**

Cracking	1
Loss of Adhesion of Screed	2
Faded Paint work	3
Missing PVC Tiles	4
Missing Parquet Tiles	5
Lifting of PVC Tiles	6
Other (Specify)	7

5. **OPENINGS**

		WINDOWS	DOORS
Jam when opening	1		
Twisted component	2		
Damaged Ironmongery	3		
Corroded Frames	4		
Missing Panes	5		
Cracked Panes	6		
Missing Ironmongery	7		
Other (Specify)	8		

6. **PLUMBING**

Missing Taps	1
Missing Traps	2
Malfunctioning Traps	3
Malfunctioning Taps	4
Blocked Drainage	5
Missing/Damaged Sanitary Fittings	6
Other (Specify)	7

7. **COMMENTS**

APPENDIX B - MAINTENANCE RESPONSE SHEET

Req. No.	Loc. of Prop.	Defect	Art. Hrs.	Lab. Days	BWU Serial No.	S.I.V Details			Comple. Date
						Issued	Recieved	*D.O.A.	
66286/12/7/90 SOE 12/7/90	Mariakani	Re waste [illegible]			SSH P2/25/29/7/90				
63129/19.12.89 SOE 15/2/90	Mariakani	- C&G [illegible]							
63163/6/2/90 SOE 22/2/90	Mariakani	- Repair roof,			SSH P1/9/27/2/90				
63172/15/2/90 27/2/90	Mariakani	- Replace [illegible] and disservicewable			SSH/P1/10/2/3/90				
68724/24/8/90 21/2/90	Mariakani	- Waste water [illegible]	1HR 51 [illegible]	[illegible]	SSH P2/27/8/90 Issued 21/2/90	[illegible]			20/2/90
68773/26/10/90 1/11/90	Mariakani	-Rep. water pipe [illegible]			SSH P2/45/6/11/90	NO BWO			
68768/17/10/90 23/10/90	Mariakani	- Rep [illegible]			SSH P24/166/1/11/90				
68701/9/8/90 21/8/90	Mariakani	- [illegible] - Replace one [illegible]				SWO 11689 21/8/90	22/10/90	——	
68730/29/8/90 31/8/90	Maruabani	- Re-cement Kit [illegible] - Defrost [illegible] - Re-cement floor [illegible]	No. BWO available						
66290/17/7/90 18/7/90	Mariakani	C&R waste pipe leaks in kitchen	9[illegible] (1)	1	SSH P2/26/20/7/90 Issued ——				20/7/90 9/8/90
66275/27/6/90 4/7/90	Mariakani	- Rep. [illegible] pipe	37 (3)	1	SSH P20/101/11/7/90 Issued 11/7/90				13/7/90 [illegible]
66233/11/5/90 N/A	Mariakani	-C&R Kit. Sink waste pipe C&R waste pipe [illegible]	12) 18	1	SSH/P1/22/24/5/90 Issued 24/5/90				17/5/90 9/8/90
66219/24/4/90 N/A	Mariakani	-CER leaking [illegible]	8 (1)	1	SSH/P1/19/15/5/90 Issued 15/5/90				20/7/90 29/8/90
63705/9/4/90 9/4/90	Mariakani	- C&R. water [illegible] which is [illegible]	4 (2)	1/2	SSH P1/9/4/90 Issued 9/4/90				29/5/90 N/A
66204/4/4/90 10/4/90	Mariakani	Replace worn out [illegible]	18 (2)	1	SSH/P1/18/24/4/90 Issued 24/4/90	25/4/90	7/5/90		17/5/90 9/8/90
66202/3/4/90 5/4/90	Mariakani	- Replace worn out and unserviceable [illegible]	4 (1)	1/2	SSH/P1/14/6/4/90 Issued 6/4/90				4/5/90 29/8/90

*Issued by storekeeper * D.O.A - Date of Approval of S.I.V.
*Received by foreman

APPENDIX C - BUILDING WORKS REQUISITION ORDER

CE/BWR1 PHD/97/12/14/4/72

CITY COUNCIL OF NAIROBI (1)

WORKS REQUISITION

NAIROBI CITY COUNCIL
KANGEMI HEALTH CENTRE

Serial No. 47994

To		From		Date
B. W. Section	✓	Name	SR. Karanja	8/4/97
Elect. Section		Section	DLO H PHA	Fin. Code Number 11926-0
Highways Section		The following defects require attention:		
Parks Section				

Location of Property	Defect
Kariobangi NAIROBI CITY COUNCIL KANGEMI HEALTH CENTRE	Please attend to roof in the health centre which is leaking H. Thank you. SR Karanja NAIROBI CITY COUNCIL LABOUR OFFICE

Please put "X" where applicable

Signed _____

KENYA BREWERIES LIMITED
ESTATES DEPARTMENT
MAINTENANCE RECORD
WEEK ENDING ..5..4..92.... MANAGEMENT 6

DATE	REQUISITION NO.	HOUSE OR LOCATION	OCCUPANT	DETAILS OF REQUISITION	DATE COMMENCED	DATE COMPLETED	REMARKS
1.4.92	19569	Training Centre	Purchasing	Supply one second hand refrigera			
				tor for storing milk for the workers			
" " "	09905	MEL. 7	Randiak	Replace broken window louvres in	2.4.92		Material ordere
				Sitting room, bedroom			
				loose door handles	2.4.92	2.4.92	work done
				loose floor tiles	"	"	" "
" " "	09904	MEL. 7	Randiak	Leaking hand wash basin tap	"	"	" "
				open blockage in bathroom &	"	"	" "
				kitchen sinks			
				Security light socket shorting	"	"	" "
" " "	19570	Training Centre	Purchasing	Urgently please replace broken			
				translucent glasses on 2			
				doors — front & rear	2.4.92		Glass Ordered
" " "	19568	Training Centre	Purchasing	Removing of single top plug and			—
				replacing same with twin top			
				plug to facilitate double use	2.4.92		Socket Ordered
				of the plug and one time			
4.4.92	11736	MEL - 4	Githu	Repair bathroom shower pipe	4.4.92		Shower Socket to be
				Replace toilet louvre	4.4.92	4.4.92	Blades fitted
				Replace window louvre in S/quarters	4.4.92		Louvre frame to
				Repair kitchen door locks (reminder)	4.4.92	4.4.92	Work done.
4.4.92	09969	MEL-10	Mwita	Repair 3 beds			
				Replace 6 window louvres (reminder)	4.4.92		Louvre blades
3.4.92	11605	2	Mwangi	One plate is	[illegible] out of order		
				it is giving	sparks & from	4.4.92	Hotplate ordered
				Repair fault	water tap in the kitchen	"	Ball glass ordered
				& bathroom			
				Repair locks	two of the metal doors	4.4.92	Work done.
				Move security	light outside main		
				room and	paint		

APPENDIX E - ANALYSIS SHEET

DISTRICT: _____ **SHEET NO.:** _____

NO.	A	B	C	D	E	F	G	H	J	K	L

KEY

A - Works Requisition Order Serial Number
B - Date of Works Requisition Order
C - Date of Signing by Superintendent of Estates
D - Delay
E - Date of Registration of WRO
F - Date of Issue of Building Works Order
G - Delay
H - Date of Completion of Work
J - Delay
K - Date of Signing by Estates Officer

APPENDIX F - REQUISITION BOOK

KENYA BREWERIES LIMITED

EMERGENCY/PETTY MAINTENANCE - REQUISITION No. 09981

TO BE COMPLETED IN TRIPLICATE AND TWO COPIES HANDED TO HOUSING DEPARTMENT FOR ACTION.

Company House/Flat No. _____

Occupant _____

Location _____

Telephone No. _____ Department _____ Date _____

Please check and repair the following:—

_____

_____

_____

_____

_____

_____

_____

_____

_____

Occupants Signature

ACTION TAKEN:

Date Received	Date Started	Date Completed	Remarks

APPENDIX G - REPAIRS DETAILS AND CERTIFICATION FORM

KENYA BREWERIES LIMITED

REPAIRS DETAILS AND CERTIFICATION (MANAGEMENT)

HOUSE/FLAT/LOCATION.....PLOT NO.....ROAD.....OCCUPANT.....

ARTISAN(S) ASST.(S).....COY NO.....

DATE	JOB NO. DETAILS	MATERIAL NEEDED NAME & QUALITY	DATE COMMENCED	DATE FINISHED	MATERIAL ACTUAL USED	MATERIAL REMAINING	REMARKS

CERTIFICATE: I hereby certify that the above repair(s) requisitioned by me has/have been satisfactorily completed.

SIGNATURE.....DATE.....

APPENDIX H - HOUSING OFFICE 'FORM B'

KENYA BREWERIES LIMITED

HOUSING OFFICE FORM 'B' (LUMPY)

OCCUPANT.....COY NO.....HOUSE .....

VILLAGE.....DEPARTMENT.....DATE.....

NATURE OF REPAIR(s) NEEDED

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

CAUSE OF BREAKAGE:

1. _____

2. _____

OCCUPANTS SIGNATURE.....DATE.....

ARTISAN(s) ASST(s) 1. _____ GRADE.....

2. _____ GRADE.....

3. _____ GRADE.....

HOUSING ASSISTANT

_____

_____

SIGNATURE..... DATE.....

APPENDIX I - BUILDING WORKS ORDER (NCC)

CE/ BWO 1

CITY COUNCIL OF NAIROBI

BUILDING WORKS ORDER

(21HD/97/12/14/4/92) – Serial No.

Workman's Name	Financial Code No.	Issued	Completed
Julius - Kenya	119200	14.4.92	

Req. No.	Locaton of Property	Repairs Required	Materials used	Time	
				Art. hrs.	Lab. Days
47990	Kangemi	Repair roof	4 No. Asbestos	27	3
8/4	Health	Centre	sheet 6' long.		
132	Centre				

Signed _____