An Investigation Into the Problems and Constraints experienced by Building Maintenance Managers.

A Case Study Of Kenya Airways Head Office And Base, Nairobi.

A Few of the Problems...

Aging and neglected facilities put mission, quality of life, and facility investment at risk.

What's going to happen? How in the world will I be able to...

Uncertainty about the future.

"Ad hoc" and reactionary management.

Inspection is expensive and of questionable value, per se.

Inadequate funds for proper facility M & R.

Not enough people to continue doing "business as usual".

July 2004
An Investigation Into the Problems and Constraints experienced by Building Maintenance Managers.

A Case Study Of Kenya Airways Head Office And Base, Nairobi.

By

Mativo Josphat Mativo
B03/7390/2000

A research project as partial fulfillment of the requirements for the award of Bachelor of Arts degree in Building Economics, Department of Building Economics and Management, University Of Nairobi.

July 2004
Declaration

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

Mativo J.M

Signature: 

Date: 07/09/2004

This project has been submitted with my approval as a university supervisor

Dr. Ing. Christopher M. Mbatha

Signature: 

Date: 02/09/2004
Acknowledgement

I wish to acknowledge the input of several individuals who influenced the quality of compiling and organization of the project while in progress and the documentation process of the accomplished research project.

The effort of lecturers and employees in the department of Building Economics and Management, their well meant endeavor to persistently mould me up to the final moment with such spotlight and willpower cannot be gainsaid.

Am particularly indebted by the enlightening and critical supervision and masterly advice offered by Dr. C.M Mbatha from inception to the conclusion of the research undertaking, without which the research process could have been overwhelming. His senses of humour amidst all his incisiveness were forceful.

The many enthusiastic, willing and with great positive attitude respondents to my questionnaires, the interviews administered in Kenya Airways Head Office and Base and in particular Mr. A.O Moire – Manager in Properties and Facilities Division. Their encouragement energized me to a distance I could not have otherwise considered likely.

My heartfelt gratitude extends my Wife, Sons, Dad, Mum, brothers, sisters and friends for their affection, love prayers and tireless encouragements. They upheld me consistently during my entire education process. May the almighty God bless them all.

My sincere regards to God the almighty for His Unique guidance unto me – in Him I seek the Power to lead and enforce His message - Good News Bible, St Luke 14; 28–30.

"If one of you is planning to build a tower, he sits down first and works out what it will cost, to see if he has enough money to finish the job. If he doesn’t he will not be able to finish the tower after laying the foundation; and all who see what happened will laugh at him. “This man began to build but can’t finish the job!” They will say."
Dedication

To my loving Wife - Millicent, Sons – Newton Muthoka and Titus Mativo, Dad – Mativo, Mum – Nzilani, brothers - Musyoki, Nzimbi, Nguli, Sisters – Loise, Ndulu, Niece – Regina,

To my late Sister – Ndinda, Grandfather – Kisove, whose affectionate memories are the driving mortar of my inspirations.
Table Of Contents

Title .............................................. I
Declaration .............................................. II
Acknowledgement .............................................. III
Dedication .............................................. IV
Table of contents .............................................. V
List of tables .......................................... XI
List of figures .............................................. XII
List of plates .............................................. XIII
Acronyms .............................................. XIV
Definition of terms .............................................. XV
Abstract .............................................. XXVI

Chapter One .............................................. 1

Introduction to the study .............................................. 1

1.0 Introduction .............................................. 1

1.1 Compilation of detailed property data base .............................................. 2

1.1.1 Determination of maintainers status of the asset .............................................. 3

1.1.2 Analysis of usage and performance of building spaces .............................................. 3

1.1.3 Application of life cycle costing techniques .............................................. 3

1.1.4 Formulation of works programme .............................................. 4

1.2 Background of the study .............................................. 4

1.2.1 Incorporation of Kenya Airways Ltd. .............................................. 4

1.2.2 Properties and facilities capacity .............................................. 5

1.2.3 Organization structure .............................................. 5

1.2.4 Role properties & facilities Division .............................................. 5

1.2.5 Key properties & facilities .............................................. 6

1.2.6 Aviation Hangar .............................................. 6

1.2.6.1 Space considerations / requirements .............................................. 8

1.2.6.2 Physical security .............................................. 9

1.2.7 Warehouse .............................................. 9
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2.7.1</td>
<td>Building maintenance factors to consider</td>
<td>10</td>
</tr>
<tr>
<td>1.2.7.2</td>
<td>Space configuration</td>
<td>10</td>
</tr>
<tr>
<td>1.2.8</td>
<td>Office buildings</td>
<td>11</td>
</tr>
<tr>
<td>1.2.8.1</td>
<td>Re-roofing Blocks A &amp; B</td>
<td>11</td>
</tr>
<tr>
<td>1.2.8.2</td>
<td>Movable office fittings</td>
<td>12</td>
</tr>
<tr>
<td>1.2.9</td>
<td>Infrastructural services</td>
<td>13</td>
</tr>
<tr>
<td>1.2.9.1</td>
<td>Information &amp; data network</td>
<td>13</td>
</tr>
<tr>
<td>1.2.9.2</td>
<td>Electrical services</td>
<td>13</td>
</tr>
<tr>
<td>1.2.9.3</td>
<td>Upgrading of underground cables</td>
<td>14</td>
</tr>
<tr>
<td>1.2.9.4</td>
<td>Car parks behind blocks A &amp; B</td>
<td>15</td>
</tr>
<tr>
<td>1.2.9.5</td>
<td>Fire suppression</td>
<td>15</td>
</tr>
<tr>
<td>1.2.9.6</td>
<td>Water services</td>
<td>16</td>
</tr>
<tr>
<td>1.2.9.7</td>
<td>Road &amp; Car parks</td>
<td>16</td>
</tr>
<tr>
<td>1.2.9.8</td>
<td>Foul sewer &amp; Service water drains</td>
<td>17</td>
</tr>
<tr>
<td>1.2.9.9</td>
<td>Land scaping &amp; foot paths</td>
<td>18</td>
</tr>
<tr>
<td>1.2.10</td>
<td>Building maintenance team</td>
<td>18</td>
</tr>
<tr>
<td>1.2.11</td>
<td>Building maintenance Officer</td>
<td>19</td>
</tr>
<tr>
<td>1.2.12</td>
<td>Custodial maintenance</td>
<td>19</td>
</tr>
<tr>
<td>1.2.13</td>
<td>Job requests procedure adopted</td>
<td>19</td>
</tr>
<tr>
<td>1.3</td>
<td>Problem statement</td>
<td>22</td>
</tr>
<tr>
<td>1.3.1</td>
<td>Characteristics of building maintenance</td>
<td>23</td>
</tr>
<tr>
<td>1.3.2</td>
<td>Aged building facilities</td>
<td>23</td>
</tr>
<tr>
<td>1.3.3</td>
<td>Inadequacy resources</td>
<td>23</td>
</tr>
<tr>
<td>1.3.4</td>
<td>Insufficient research &amp; development</td>
<td>23</td>
</tr>
<tr>
<td>1.3.5</td>
<td>Threat</td>
<td>24</td>
</tr>
<tr>
<td>1.3.6</td>
<td>Weakness</td>
<td>24</td>
</tr>
<tr>
<td>1.3.7</td>
<td>Sources of building maintenance/problems/constraints</td>
<td>24</td>
</tr>
<tr>
<td>1.3.8</td>
<td>Sources of maintenance problems</td>
<td>24</td>
</tr>
<tr>
<td>1.3.9.A</td>
<td>Faulty designs</td>
<td>24</td>
</tr>
<tr>
<td>1.3.9.B</td>
<td>Faulty construction</td>
<td>25</td>
</tr>
<tr>
<td>1.3.9.C</td>
<td>Defective materials</td>
<td>25</td>
</tr>
<tr>
<td>1.3.9.D</td>
<td>Decay &amp; deterioration</td>
<td>25</td>
</tr>
</tbody>
</table>

VI
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3.9.E</td>
<td>Vandalism</td>
<td>25</td>
</tr>
<tr>
<td>1.3.9.F</td>
<td>Incorrect materials methods</td>
<td>25</td>
</tr>
<tr>
<td>1.3.9.G</td>
<td>Bad property management</td>
<td>26</td>
</tr>
<tr>
<td>1.3.10</td>
<td>Constraints</td>
<td>26</td>
</tr>
<tr>
<td>1.3.10.1</td>
<td>Black box technical complexity</td>
<td>27</td>
</tr>
<tr>
<td>1.3.10.2</td>
<td>Economic constraints limits</td>
<td>27</td>
</tr>
<tr>
<td>1.3.10.3</td>
<td>Energy cost reduction</td>
<td>27</td>
</tr>
<tr>
<td>1.3.10.4</td>
<td>Lack of knowledge of I.T limits</td>
<td>28</td>
</tr>
<tr>
<td>1.3.10.5</td>
<td>Poor initial designs</td>
<td>28</td>
</tr>
<tr>
<td>1.3.11</td>
<td>why we fail</td>
<td>28</td>
</tr>
<tr>
<td>1.3.11.1</td>
<td>Scope of mobile activities</td>
<td>29</td>
</tr>
<tr>
<td>1.3.11.2</td>
<td>Expected level of performance</td>
<td>29</td>
</tr>
<tr>
<td>1.4</td>
<td>Scope of the study</td>
<td>30</td>
</tr>
<tr>
<td>1.5</td>
<td>Objectives of the study</td>
<td>31</td>
</tr>
<tr>
<td>1.6</td>
<td>Hypothesis</td>
<td>31</td>
</tr>
<tr>
<td>1.7</td>
<td>Assumptions</td>
<td>31</td>
</tr>
<tr>
<td>1.8</td>
<td>Significance of the research</td>
<td>32</td>
</tr>
<tr>
<td>1.9</td>
<td>Organization of the study</td>
<td>32</td>
</tr>
</tbody>
</table>

**Chapter two: Literature review and theoretical framework**

2.0 Maintenance problems in developing Countries ........................................ 34
2.1 Defects & damage of historical buildings ........................................... 34
  2.1.1 Defects to roof structure ......................................................... 34
  2.1.2 Defects to roof covering materials ............................................. 35
  2.1.3 Defects to chimney ....................................................................... 36
  2.1.4 Rain water disposal ....................................................................... 37
  2.1.5 Excess moisture ............................................................................ 38
  2.1.6 Masonry walls .............................................................................. 38
  2.1.7 Internal windows & doors ............................................................... 39
  2.1.8 Floors & staircases ....................................................................... 40
  2.1.9 Internal finishes – floors & staircases ......................................... 41
2.2 Mechanical & electrical services ............................................................. 41
2.2.1 Drainage .......................................................... 41
2.2.2 Improper structure .............................................. 42
2.2.3 Regular technical inspection .............................. 43
2.2.4 Economical efficiency ...................................... 44
2.3 Good building maintenance ................................. 45
2.3.1 Developing maintenance strategy ......................... 47
2.3.2 Building strong foundation .................................. 49
2.3.3 Reliability centred maintenance ......................... 50
2.3.4 Functions & performance standards ..................... 50
2.3.5 Functional failures ........................................... 50
2.3.6 Failure modes .................................................. 51
2.3.7 Failure effects .................................................. 51
2.3.8 Failure consequences ..................................... 51
2.3.9 Failure Management policy selection .................. 52
2.3.10 Schedule restoration & scheduled discard task ........ 53
2.3.11 On-condition tasks ......................................... 53
2.3.12 Failure finding ............................................... 53
2.3.13 Re-design ...................................................... 53
2.3.14 Not known scheduled maintenance .................... 53
2.3.15 RCM task selection process .............................. 54
2.3.16 Applying RCM ............................................... 54
2.3.17 Planning ....................................................... 54
2.3.18 Review groups ................................................ 55
2.3.19 Facilitators ................................................... 56
2.3.20 The outcomes of RCM analysis ......................... 56
2.3.21 Auditing ....................................................... 57
2.3.22 Implementation ............................................... 57
2.3.23 What RCM achieves ....................................... 57
2.3.24 Responsible custodianship .................................. 58

Chapter three: Research methodology

3.0 Description of study area & population ...................... 64
3.1 Sample techniques & sample size ............................... 64
Chapter four: Data collection, presentation & Analysis

4.0 Introduction ................................................. 70
4.1 Establishing of building maintenance team ................. 70
4.2 Building maintenance staff establishment data .............. 70
4.3 Observation made – facilities requiring outsourcing .......... 73
4.4 Establishing level of performance ............................. 76
4.5 Kenya Airways building maintenance staff establish­ment ......................................................... 77
4.6 Academic & professional background .......................... 79
4.6.1 Data analysis .................................................. 81
4.7 Capital budget expenditure .................................... 82
4.8 Testing the hypothesis & establishing the assumptions .......... 86

Chapter five: Summary, conclusion & recommendations

5.0 Summary ...................................................... 88
5.1 Limitations ..................................................... 89
5.2 Conclusion .................................................... 89
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3 Recommendations</td>
<td>89</td>
</tr>
<tr>
<td>5.4 Areas of further research</td>
<td>90</td>
</tr>
<tr>
<td>5.5 References</td>
<td>91</td>
</tr>
<tr>
<td>5.6 Internet websites references</td>
<td>96</td>
</tr>
<tr>
<td>Appendix I</td>
<td></td>
</tr>
<tr>
<td>Letter of transmittal</td>
<td>99</td>
</tr>
<tr>
<td>Appendix II</td>
<td></td>
</tr>
<tr>
<td>Questionnaire</td>
<td>100</td>
</tr>
<tr>
<td>Appendix III</td>
<td></td>
</tr>
<tr>
<td>Observation check list</td>
<td>107</td>
</tr>
<tr>
<td>Appendix IV</td>
<td></td>
</tr>
<tr>
<td>Interview schedule</td>
<td>109</td>
</tr>
<tr>
<td>Appendix V</td>
<td></td>
</tr>
<tr>
<td>Internet - Extracts</td>
<td>110</td>
</tr>
</tbody>
</table>
# List of tables

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Table No.</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Kenya Airways Building maintenance establishment</td>
<td>3.1</td>
<td>67</td>
</tr>
<tr>
<td>2.</td>
<td>Report of building maintenance team</td>
<td>4.0</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Building maintenance facilities requiring outsourcing</td>
<td>4.1</td>
<td>74</td>
</tr>
<tr>
<td>3.</td>
<td>Report on work requested, performed &amp; performed/requested</td>
<td>4.3</td>
<td>76</td>
</tr>
<tr>
<td>5.</td>
<td>Building maintenance staff report on academic, professional &amp; field experience Establishment</td>
<td>4.5</td>
<td>80</td>
</tr>
<tr>
<td>6.</td>
<td>Report on capital budget allocation/Expenditure</td>
<td>4.6</td>
<td>82</td>
</tr>
<tr>
<td>7.</td>
<td>Report on Kenya Airway building maintenance Capital expenditure</td>
<td>4.7</td>
<td>84</td>
</tr>
<tr>
<td>Item</td>
<td>Description</td>
<td>Figure No.</td>
<td>Page</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>1.</td>
<td>Building maintenance strategy</td>
<td>1</td>
<td>48</td>
</tr>
<tr>
<td>2.</td>
<td>A typical RCM review group</td>
<td>2</td>
<td>55</td>
</tr>
<tr>
<td>3.</td>
<td>A typical capital expenditure request form</td>
<td>3.2</td>
<td>68</td>
</tr>
<tr>
<td>4.</td>
<td>Kenya Airways building maintenance establishment</td>
<td>4.1</td>
<td>71</td>
</tr>
<tr>
<td>5.</td>
<td>Building maintenance facilities requiring Outsourcing services</td>
<td>4.2</td>
<td>75</td>
</tr>
<tr>
<td>6.</td>
<td>Report on work requested, performed &amp; Performed/ requested</td>
<td>4.3</td>
<td>77</td>
</tr>
<tr>
<td>7.</td>
<td>Kenya Airways building staff establishment</td>
<td>4.5</td>
<td>79</td>
</tr>
<tr>
<td>8.</td>
<td>Kenya Airways building maintenance staff academic, Professional &amp; field experience</td>
<td>4.6</td>
<td>81</td>
</tr>
<tr>
<td>10.</td>
<td>Report on Kenya Airways building maintenance Capital budget</td>
<td>4.8</td>
<td>84</td>
</tr>
</tbody>
</table>
## List of plates

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Plate No.</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Kenya Airways Hanger – back elevation</td>
<td>1.a</td>
<td>7</td>
</tr>
<tr>
<td>2.</td>
<td>Kenya Airways Hanger – front elevation</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>3.</td>
<td>Kenya Airways Hanger Office</td>
<td>1.10</td>
<td>8</td>
</tr>
<tr>
<td>4.</td>
<td>Ware house &amp; Car park</td>
<td>1.10</td>
<td>10</td>
</tr>
<tr>
<td>5.</td>
<td>Block A Office refurbishment</td>
<td>1.12</td>
<td>12</td>
</tr>
<tr>
<td>6.</td>
<td>Block B Office Refurbishment</td>
<td>1.13</td>
<td>12</td>
</tr>
<tr>
<td>7.</td>
<td>Block B 2nd floor – Internal finishes</td>
<td>1.14</td>
<td>12</td>
</tr>
<tr>
<td>8.</td>
<td>Block B 2nd floor – plumbing fittings</td>
<td>1.15</td>
<td>12</td>
</tr>
<tr>
<td>9.</td>
<td>Block C – Electrical switch gear</td>
<td>1.13</td>
<td>13</td>
</tr>
<tr>
<td>10.</td>
<td>Block C – Electrical switch gear</td>
<td>1.14</td>
<td>14</td>
</tr>
<tr>
<td>11.</td>
<td>Stand by generator 800 KVA</td>
<td>1.15</td>
<td>14</td>
</tr>
<tr>
<td>12.</td>
<td>Back up Generator</td>
<td>1.16</td>
<td>14</td>
</tr>
<tr>
<td>13.</td>
<td>MV/ HV Electrical underground cables</td>
<td>1.17</td>
<td>14</td>
</tr>
<tr>
<td>14.</td>
<td>Electrical underground cables in trench</td>
<td>1.18</td>
<td>14</td>
</tr>
<tr>
<td>15.</td>
<td>Hardcore fill for car park</td>
<td>1.19</td>
<td>15</td>
</tr>
<tr>
<td>16.</td>
<td>Road surfacing to car park &amp; surface water drain</td>
<td>1.14</td>
<td>15</td>
</tr>
<tr>
<td>17.</td>
<td>Kenya Airways Main gate access road</td>
<td>1.21</td>
<td>17</td>
</tr>
<tr>
<td>18.</td>
<td>Rehabilitation work to internal rood</td>
<td>1.22</td>
<td>17</td>
</tr>
<tr>
<td>19.</td>
<td>Defects to roof tiles</td>
<td>1.23</td>
<td>35</td>
</tr>
<tr>
<td>20.</td>
<td>Defects to roof structure</td>
<td>1.24</td>
<td>36</td>
</tr>
<tr>
<td>21.</td>
<td>Defects to chimney bricks</td>
<td>1.25</td>
<td>36</td>
</tr>
<tr>
<td>22.</td>
<td>Defects to down pipe</td>
<td>1.26</td>
<td>37</td>
</tr>
<tr>
<td>23.</td>
<td>Defects to masonry wall</td>
<td>1.27</td>
<td>39</td>
</tr>
<tr>
<td>24.</td>
<td>Defects to windows</td>
<td>1.28</td>
<td>40</td>
</tr>
<tr>
<td>25.</td>
<td>Defects to wooden ceiling</td>
<td>1.29</td>
<td>40</td>
</tr>
<tr>
<td>26.</td>
<td>Drainage system cleaning</td>
<td>1.30</td>
<td>42</td>
</tr>
<tr>
<td>27.</td>
<td>Defects to plaster</td>
<td>1.31</td>
<td>42</td>
</tr>
<tr>
<td>28.</td>
<td>Defects to walling, roof &amp; plumbing</td>
<td>1.32</td>
<td>43</td>
</tr>
</tbody>
</table>

XIII
Acronyms

- U.O.N: University Of Nairobi
- R.O.M: Results Oriented Maintenance
- C.B.P: Current Best Practice
- C.M.M.S: Computerized Maintenance Management System
- C.B.M: Condition Based Maintenance
- C.O.B: Consequence Of Breakdown
- F.T.M: Fixed Time Maintenance
- K.P.I: Key performance Indicator
- L.C.P: Life Cycle Profit
- M.O.C: Management of Change
- L.C.C: Life Cycle Cost
- F.M.E.A: Failure Mode and Effects Analysis
- M.D.T: Mean Down Time
- M.T.B.F: Mean Time Between Failures
- S.P.M: Shock Pulse measurement
- O.P.E: Overall Production Efficiency
- R.C.P.E: Root Cause Problem Elimination
- R.C.M: Reliability Centered Maintenance
- U.S: United States
- U.K: United Kingdom
Definition Of Terms

Definition

Statistical calculation, especially of life expectancy

Work added to a maintenance schedule after the agreed upon cut-off time for the schedule.

Key Performance Indicators used for measuring results of actions that indirectly or directly impacts the financial performance of the company.

An employee in a certified training program to become a craftsperson.

An accounting term for any physical thing owned by a plant, such as buildings, equipment, desks, software, computers etc.

A number that follows a particular asset in a plant should be used for accounting purposes. Note an asset number is different from an equipment location number. An equipment location number stays in the same location, where an asset number may move location.

The current accounting value of all combined physical assets in a plant.

A study comparing the Current best Practices (CBP) with actual performance. The study assesses the effectiveness of processes in place.

Maintenance processes driven by hourly workforce without management support or intervention.

Training that is incorporated into the day-to-day work processes. The training is based on experiences and findings from the daily work and is then communicated on a regular basis.

Percentage of total hours (8760/year) or scheduled operating time a system is available for production.

Volume of all requested maintenance work, yet not completed

The approved backlog is all maintenance work that is not completed, but approved for execution.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benchmarking</td>
<td>The continuous, systematic search for, and implementation of, better practices that lead to improved performance</td>
</tr>
<tr>
<td>Bill of Materials (BOM)</td>
<td>A document of all parts for an asset.</td>
</tr>
<tr>
<td>Break down</td>
<td>When a piece of equipment ceases to function (according to predetermined parameters)</td>
</tr>
<tr>
<td>Break-In job</td>
<td>Work that changes a set schedule after an agreed upon cut-off time. Break in job are either:</td>
</tr>
<tr>
<td></td>
<td>1. Break-downs</td>
</tr>
<tr>
<td></td>
<td>2. Emotional add-on work</td>
</tr>
<tr>
<td>Capital work</td>
<td>Work done for improvements or betterments, which will increase the value of assets.</td>
</tr>
<tr>
<td>Capital Spares</td>
<td>Spare parts that are depreciated (not expensed) in accounting books.</td>
</tr>
<tr>
<td>Charge rate</td>
<td>The amount per hour a resource cost for the company. Wages plus benefits. Benefits are usually around 35% of the salary in The USA, 50-60% in Europe. Benefits include insurances, vacations, and other time off.</td>
</tr>
<tr>
<td>Component</td>
<td>A generic technical part. Many components make up equipment. Hierarchy is that parts make components, makes equipment, and makes systems.</td>
</tr>
<tr>
<td>Computerized Maintenance Management System (CMMS)</td>
<td>A computer program or interfacing programs used to manage the maintenance function in a plant.</td>
</tr>
<tr>
<td>Condition Based Maintenance (CBM)</td>
<td>Maintenance actions taken as a result of investigated condition of parts or components. The condition is measured or evaluated during programmed inspections of parts and components.</td>
</tr>
<tr>
<td>Condition Monitoring</td>
<td>All work performed in order to find failures early.</td>
</tr>
</tbody>
</table>
Consequence Of Break-Down (COB)

The "cost", not always measured in money, of a break down of equipment. COB is prioritized as follows: Environmental damage or safety hazard

1. Production loss
2. High Cost (equipment life)

Continuous Improvement

Continuous improvement of existing practices resulting in improved performance.

Corrective Maintenance

All maintenance performed to correct a break down or failure.

Crafts people

People with professional skills in mechanical, electrical or instrumentation maintenance. Many plants require skills in several of the skills mentioned.

Criticality

The criticality of a component, equipment, or system based on the consequence of Breakdown.

Current Best Practice (CBP)

The best way known to do something in IDCON's Results Oriented Maintenance (ROM) philosophy. The future might reveal a better way of doing something and thus change the CBP. A CBP is equal to an element, which is the lowest level of detail in a Key Process.

Cut-off time

Time when a schedule closes

Defect 1

Damage on final product, which forces the plant to scrap product, or sell product for lower price.

Defect 2

Can also mean a failure in a part or component.

Downtime

Time when a system is not producing product. Downtime includes scheduled and unscheduled downtime.

Downtime scheduled

When a system is down, and the downtime was documented as scheduled before cut-off time.

Downtime unscheduled

When a system is down, and the downtime was NOT documented as scheduled before cut-off time.
In the IDCON assessment, a CBP is equal to an element, which is the lowest level of detail in a Key Process. The best way known to do something. The future might reveal a better way of doing something and thus change the current best practice.

Emergency work is a synonym to break-in work.

An asset that performs a function e.g. a motor coupling pump, pumps water from pint A to point B.

Documentation for all events such as repairs, modification, and preventive maintenance performed for specific equipment.

A physical location in the plant for a piece of equipment.

A unique number assigned to an equipment location.

Time, speed, and quality performance as it relates to equipment. In IDCON’s ROM philosophy, equipment reliability is the result of maintenance work.

Estimated present value of assets.

When equipment condition reaches an unacceptable level. Example: A motor may run, but the temperature is 250 °F (unacceptable)

A classification of a failure.

The time lapsed between a failure and the break down.

Any event that may cause a failure.

Analysis tool to identify failure modes, assign priorities to each failure mode based on cost and occurrences.

An average of how often a component, equipment or system fails in a given time period.

In maintenance. Most commonly used when referring to written description of the work completed on a work order.
This tactic provides for scheduled overhauls or replacements of components often based on recommendation from the equipment vendor, general plant experience with similar components or analysis of the maintenance history of an individual piece of equipment and its components. Note: Only 10-15% of all component types have a predictable failure rate. Cost effective use of FTM is therefore limited.

The time period between repetitive inspections. The inspection frequency should be based on the failure-developing period. Note: A rule of thumb is that the inspection frequency should be: Failure Developing Period/2.

A bar chart (histogram) of scheduled tasks. Microsoft Project, and timeline are examples of software using Gantt charts.

A rated comparison of Current Best Practices and actual performance.

Measurable results you wish to accomplish at a projected point in time.

In maintenance. Failures induced by own employees. Note: Iatros means physician in Greek, and -genic, meaning induced by is derived from the International Scientific Vocabulary. Combined, of course, they become iatrogenic, meaning physician-induced. Iatrogenic disease is obviously, then, disease, which is caused by a physician.

Component failures occurring during early life of component (1-12 months).

Any activity performed to find a failure or breakdown.

*The printed list of an inspection route.

Documented instructions for condition monitoring tasks, sorted in an effective walking path through an area.

The person doing the inspection routes. Note: This could be an operator, crafts person, supervisor, engineer or a manager.

A measurement of process performance.
The key processes for IDCON's Current Best Practice (CBP) assessment format are:

1. Leadership and organization
2. Preventive Maintenance
3. Planning and Scheduling
4. Root Cause Problem Elimination
5. Technical Database
6. Materials Management
7. Skills Development maintenance
8. Safety – Maintenance
9. Engineering

Life Cycle Cost (LCC)
Total cost for acquiring, owning and disposing physical assets. Includes direct operational and maintenance costs and indirect costs for lost production when system fails.

Life Cycle Profit (LCP)
The present value of all revenue the equipment has generated less the LCC.

Log Book
Usually refers to operations log for problems found during shift.

Logic Tree
A charting method for why-why analysis.

Management of Change (MOC)
A process used to track and manage any physical or specification changes made to process related equipment in a plant.

Maintainability
The ease to maintain equipment.

Maintenance
Maintenance consists of corrective maintenance, preventive maintenance, and continuous improvement.

Maintenance Engineering
Maintenance Engineers work on design specifications of minor modifications, preventive maintenance documentation, problem identification and elimination, maintenance training, and maintenance technical database.

Maintenance Opportunity
See maintenance window

Maintenance Planning
See definition for “Planning”
Maintenance prevention

All actions performed to prevent failures. Lubrication, alignment, balancing, installation and equipment design, operating procedures, detailed cleaning, adjustments, fixed time replacements, and filtration. Note: Maintenance prevention and condition monitoring are the two components of preventive maintenance.

Maintenance Window

Defined time slots when maintenance can be performed on equipment without disturbing production.

Mean Down Time (MDT)

Average time equipment is down (for any reason).

Mean Time Between Failures (MTBF)

Total calendar operating time divided by number of failures.

Mean Time To Repair (MTTR)

Average Repair time for component.

Mean Wait Time (MWT)

All time during downtime that isn’t repair time. MDT=MWT + MTTR

Mission Statement

Summarizes how to achieve a vision.

Model Work Order

See Standard Job Plan

Non Destructive testing (NDT)

Any material testing that doesn’t destroy material. During the testing process. Note: Usually we think of Ultrasonic Thickness Testing. Also included in NDT is usually dye-penetrant testing, x-ray testing, and electrical resistance testing. Vibration, thermography, look, listen, feel, smell, winding test etc are not included since they are testing components, and equipment, not material.

See unscheduled work

Non-Scheduled work

Downtime for a component or system without affecting production. Note: If production is down it’s considered an outage, or shutdown/ Turnaround.

Off-line

Oil Analysis

Testing of oil in order to find failures early

Operate To Break-Down (OTB)

A maintenance strategy, which operates equipment until breakdown. A maintenance strategy, which sometimes can be the most cost effective. Note: OTB is used when the consequence of failure is small enough that the benefit of preventing or finding failure early is more costly. OTB will be the fact for failures that occurs randomly and have no failure-developing period.

XXI
Outage

Overall Production Efficiency (OPE)

Overall Reliability

Parts

Planned Job

A shutdown/turnaround that affects the whole plant for more than 16 hours.

The product of Quality [%] * Speed [%] * Uptime [%] for a production line.

See Production Reliability

See spare parts

A planned job includes:

- The person planning the job verifies the scope of the job.
- Lifting Equipment, tools, parts, material and personal. Equipment needed to do the jobs are identified and allocated.
- Skills needed are identified?
- A description of job steps is documented.
- Lock out tag out and other safety requirements are identified.
- Necessary technical documentation is available.
- Crafts people are part of the planning process.
- Estimated job duration by skills and the number of people needed for the job.
- Required permits available.
- The cost of each job is estimated.
- Define physical and environmental constraints.

Planning

Predictive Maintenance

Preventive Maintenance

Priority

Priority Code

The process of determining the resources, methods, and processes needed to perform maintenance work efficiently and effectively. Note: Planning is different from scheduling. Planning short definition is to decide what, how and time duration.

A synonym to condition monitoring. Note: IDCON don't use this term because it is often referred to as ONLY vibration analysis. There are many other condition monitoring tools besides vibration analysis.

All maintenance performed in order to prevent a failure, or to detect a failure early. illustration

The assigned importance of a maintenance job.

The importance of a maintenance job is defined by a priority code. A priority code represents a deadline for when the maintenance job has to be completed.
Agreed upon guidelines for assigning a priority to maintenance work.

Actions that are planned, scheduled and executed before a break-down occurs. Includes maintenance prevention activities.

Any issue that can be improved cost effectively.

A work system that is documented, executed, and measured.

Time, speed, and quality performance as it relates to manufacturing process.

The product of process and equipment reliability.

The document sent to a supplier to order parts, services, material, or machines.

A maintenance philosophy which is heavily designed by engineers supported by sound theoretical practices. Note: No known plant have been able to implement a full RCM strategy. It is often a very complicated theory for simple common sense actions. RCM has a given place in the specification phase when designing new equipment. (IDCON’s opinion).

The product of Quality [%] * Speed [%] * Uptime [%] as it relates to equipment.

The product of Quality [%] * Speed [%] * Uptime [%] as it relates to the process (operation of equipment).

The product of process reliability and equipment reliability. Measured by Quality [%] * Speed [%] * Uptime [%]

Any activity intended to bring a component, equipment, or system back to a specific condition.

Type of work that are done often in the plant. Repetitive work should have standard job plans.

Financial outcome of an action, or several actions.

Global Key Performance Indicators measuring results directly impacting the financial performance of a plant.

All repairs that have to be done again due to a poor repair the first time. Note: A combination of poor planning and scheduling. Usually due to lack of skills, material problem, missing spare parts, or not enough time assigned to do a precision job before starting equipment again.
Maintenance Philosophy developed by IDCON, INC.

A systematic way to collect select, analyze, and solve failures

A systematic way to collect select, analyze, solve and eliminate a problem. (An IDCON CBP Key Process)

The result of all actions executed to prevent personal injuries.

A key performance indicator for the storeroom measuring the % of times the correct quantity of the correct part is received when requested. Note: If the service factor falls below 95% maintenance people begin to lose confidence in the store room's ability to supply the correct material & parts when needed. Usually result in growth of "unofficial personal stores" at frontline level.

A job put on the schedule before the cut-off time. Specific people, start time and end time is documented.

The process of determining what jobs gets worked on, when, and by whom based on the priority and resource/equipment availability. Note: that this process should take place before the job is executed. See definition for "break-in job". Scheduling short definition is when and who.

A KPI measuring: The sum of Add-on jobs and jobs, on the schedule, not completed OVER the jobs on the schedule before cut-off time.

A condition Monitoring Tool measuring the shock pulse in rotating equipment. Note: Shock pulse is the pressure wave generated through materials when two materials hit each other. A vibration will wave will be generated by the Shock pulse

Scheduled or unscheduled downtime for a system or plant area.

An event that triggers a failure.

All machine parts, materials and supplies that may be required to repair an asset

A documented plan for a type of job that can be used repetitively. See planning for definition of "plan"

A process with lower hierarchy than a key process in IDCON's CBP material.

XXIV
System (1)

A combination of equipment that are dependent of each other to complete a production task.

Can refer to a computer software, a work system or production system.

Terotechnology

Maintenance management and technology. A term often used by universities in the UK.

Total Productive Maintenance (TPM)

A maintenance philosophy. TPM is usually profiled for the strong operator involvement in equipment care.

Trades person

See craftsperson

Tribology

The science and technology of interacting surfaces in relative motion, including the study of lubrication, friction and wear.

Tribological wear

Wear that occurs as a result of relative motion at the surface.

Turnaround

See shutdown. Term usually used in steel, aluminium, and mining industry.

Unplanned Maintenance work

A maintenance job where necessary planned activities are incomplete before job is scheduled. Planning should always be done before scheduling.

Unscheduled Maintenance Work

Work added to the schedule after the cut-off time.

Uptime

Opposite to Downtime. Time when a component, equipment or system is producing product. Note: The component, equipment or system may produce defect product or at a slower speed than usual.

Vibration Analysis

A condition Monitoring tool measuring the vibration in equipment.

Vision Statement

Summarizes what an organization (or individual) want to achieve in the future. A vision must be supported by a mission statement and a goal.

Why-why analysis

A problem solving method which forces the problem solver to break down and analyze different possible causes as to why a problem occurred.

Work Order

An approved work request.

Work Request

A request to do maintenance work.
Abstract

The research investigated into problems and constraints experienced by building maintenance managers at Kenya Airways Head Office and Base, Nairobi. This was induced by continuous low performance level both in quality and quantity of service delivery in all spectrum of building maintenance services.

Kenya Airways Office and Base has a population working staff of three thousand and five hundred and the mode of buildings and infrastructural facilities it possesses varies widely. The properties under focus of maintenance team are Buildings – Office blocks, Warehouses for storing cargo goods for the freights, Hangers – for servicing of small scale to giants planes; infrastructural facilities namely Water storage tanks both low and high level and its entire reticulation, Electrical services facilities backed by Generators, Telephone services, Airconditioners fire suppression facilities; movables office facilities and equipments such as chairs, tables, bulk fillers; Fittings such carpets, blinds, curtains; recurrent day today services such as cleaning and ground support. Just to mention a view.

The contrasting nature of above mentioned facilities and services reinforced with the degree of urgency at which the performance is expected by the users poses major challenges to the entire building maintenance team whose level of performance is supposed to be world class. Note that the Airline Business world is global and sluggish inferior services cannot be compromised as this portrays inverted images to the international community. It is really a sensitive world requiring dynamic performers to sustain its goals and objectives globally.

Data analysis collected from the field indicates that Kenya Airway allocates a budget at least Kshs. 850 Million annually for capital expenditure and about Kshs.1.44 Million P.a for its recurrent and expenditure. Owing to problems and constraints experienced on the implementation process, its appalling to realize that, hardly 60% of this provision is utilized for proposed targets and this poses risks of indirect wastes.

The research found out that the building maintenance staff is understaffed, has inadequate academic, technical and computer skills to meet the users expectations timely and therefore, there is need for the entire staff to be upgraded in order to cope with the current demand.
The research also noted that there are some key facilities such as generators, Electrical switch gear, Air-conditioners, Hand driers, Bore water pumps, lifts & photocopiers which require outsourcing owing to its related advantages over similar facilities.

The study concluded that the approval and procurement procedures particularly on capital projects needs to be restructured to meet the growing demand of the technical orientation principles. The bureaucratic principles need to be integrated with law of contracts, which is the driving motor of the entire implementation process of the capital & recurrent projects. Generally there is need to adhere to law of contract to achieve a balance between the client and the service providers.
Chapter One: 1.0 INTRODUCTION TO THE STUDY

Building maintenance refers to works undertaken in order to keep, or restore a facility to an acceptable standard of performance. Maintenance comprises three components namely: servicing, Rectification or repair and replacement.

Servicing is attributed with day-to-day routine checks that maintain check lines and order. Rectification or repair is the act of making good faults identified in components or the facility resulting from either usage of inferior materials or adoption of wrong specifications. Replacement is restoring work out parts resulting from wear and tear.

Good building maintenance practice has to conform to maintenance policy objectives which focuses on what is relevant and critical to the enterprise as a whole and it provides this by integrating the relevant content of the functional disciplines within the context of 'organizational purpose' (McCarthy, Minichilelo, and Curvan, 1974:14)

A maintenance policy should therefore ensure that organizational goals are met at the least resource cost with respect to organization. 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, the owner/occupier is protected against breaches of legal and statutory obligations and apart from these, the owner/ occupier should be closely involved in the asset management process.

Miles & 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 dwelling and their surroundings and, their longevity depends greatly on the residents and users. Thus, in addition to the factors previously stated, maintenance policy should be clear on the roles(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 organization's maintenance policy:
Aims of the parent organization—especially the effects of such aims on built assets;

The standards required— influenced by the aims of the organization and the types of built assets in place;

Legal liability – compliance with statutory obligations,

Method of works execution (maintenance) with particular attention to their effect on primary organizational goals, and

Financing of maintenance – decisions based on predetermined criteria

The aim here is to have a systematic manner in the management of assets because of 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:

- Compilation of a detailed property data base
- Determination of the maintenance status of the asset
- Analysis of the usage and performance of building spaces
- Application of life cycle costing techniques on all resource implications.
- Formulating of a works programme

1.1 **Compilation of a detailed property database.**

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 the information are various ranging from designers, contract documents, building maintenance manuals, and inspection reports (condition surveys (e.g. valuation reports).

Like the construction industry itself, the implementation process of building maintenance is intricate and this calls for need to be approached with a more rational, precise and conscious preliminary planning geared to prompt service delivery to the users or clients. As such most
building professionals prefer to be involved in new construction works, rather than maintenance and repair works. Building owners have generally neglected importance of good building maintenance in the past decade. A detailed database would greatly assist in one area where maintenance management is deficient i.e. planning. Spillover benefits of planed maintenance would be better usage of organizational resources and also providing user/occupiers better environments.

1.1 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 owners; evidence of substantial waste in present efforts at maintenance as a result of a serious knowledge gap of the asset being managed, and the need for pursuit of 'value for money' (Then 1992). Condition surveys are great help in meeting these challenges.

1.1.2 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 the funds of putting up new assets are increasingly scarce. Such an analysis ensures that all optimally utilized spaces and those bringing the highest returns or the those that influence the esteem in which the organization is held receive their due attention. Also, alternative space usage's can be considered in the light of market trends.

1.1.3 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 faces 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 are 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.

1.1.4 Formulation of a Works Programme

The work programme sets out the resources required and the timing of the various tasks that have been identified which obviously depend on the scale and prioritization of the work involved. Work 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-donating 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.

1.2 Background of the study

Kenya Airways as the corporate business slogan goes is "The Pride Of Africa" when it comes to the international and regional flights. Its Head office and Base is located at Eastland's - Embakasi division approximately 18 Kilometres from Nairobi central business districts. It is neighboring the strategic Jomo Kenyatta International Airport. Engaged in a very sensitive global business venture, it has managed to create magnetic impact where the multinationals have succumbed to pressure owing to steep competition.

1.2.1 Incorporation of Kenya Airways

Formed in 1977 after the collapse of the East African community which was by then known as East African Airways then embracing three countries namely Tanzania, Uganda and host Kenya, today, it has a working staff capacity of three thousand and five hundred. It commands medium to giant scale of international and regional flights. Its major Business rival are Emirates, South African Airways, British airways and Ethiopian Airways. Just to mention a view.
1.2.2 Properties and Facilities capacity

It has unique network of capital resources, which are well intertwined for its effective corporate business transactions so far, considered within the world-class level. Among the key facilities which contribute immensely to its latest success are Industrial buildings – Hanger, Warehouses for loading and offloading its spare parts for planes and the consumable goods for its freights, Sales offices at Jomo Kenyatta International airport, Hub Offices, Infrastructural services – Electrical, Information technology (I.T), water services, roads and car parks, Mechanical services, and movables facilities such as furniture, carpets and other related office facilities.

The extent of nature of the capital resources listed above and many more, all interlinked together for the effective services delivery today poses a major challenge to the Kenya Airways building maintenance team. Note that every facility requires totally different implementation approach whenever a defect or a fault arises.

1.2.3 Organization Structure

Kenya Airways has eight departments, which are posed with responsibility of articulating different significant roles but all interrelated in one way or the other for one common goal. These departments are Commercial - Africa, commercial – Head Office and cargo departments, Commercial – Europe and rest of the world, Finance, Flight operations, Ground operations, Human resources, Information systems and Technical.

1.2.4 Role of Properties and facilities Division

The responsibility of rendering capital and recurrent services on various assets at its Head Office and base and other sales offices at Barclays Plaza, Yaya Centre, Mombasa and Kisumu, is the Properties division in Technical department. Their mission statement reads; “To provide, maintain and upgrade to a very high level of standard serviceability offices, workshops, stores, hanger, utilities, compound, roads, footpaths, office equipment, reception and PABX services; ensure prompt mail collection and deliveries at all times and diligently undertake and deliver projects to specification, within budget and in time"
They also plan for future expansion and needs of Kenya Airways e.g. New Hangar and Office accommodation on the network.

**TECHNICAL**

**ORGANISATION CHART**

---

Properties and facilities division is posed with the responsibilities of undertaking all building maintenance and recurrent projects at Kenya Airways.

**1.2.5 Key properties and properties and facilities**

There are variety of building and infrastructure facilities, which differ significantly on their roles and magnitude, but all are intertwined together for the effective service delivery of the entire airline. Some of the key facilities, which contribute, immensely to the systems are as follows:

**1.2.6 Aviation Hangar**

Aircraft hangars are commonly referred to as "glorified garages" for airplanes. They can vary from simple "shade" structures that protect all or parts of the aircraft from the elements to complicated environmentally controlled maintenance facilities in which robots apply radar-absorbing coatings. However, since planes are designed to fly, it is essential to minimize their maintenance time in the hangar and maximize their availability to fly.
In the commercial aircraft sector the designer needs to rely on Facility and Planning Criteria that are issued by the aircraft manufacturers for their aircraft or a third party compilation of data. For example, the Boeing aircraft characteristics can be found on the company's web site. The designer must follow local building codes and integrate the characteristics of all possible aircraft that can populate the hangar to develop the space requirements for the intended use of the hangar. There are five types of spaces in hangar facilities

1. Hangar Area
2. Shops Area
3. Warehouse Area
4. Office/Administration and Specialty Areas
5. Building Utilities Area

Careful analysis of the following will allow designer to determine the space needs for general spaces listed above common to aircraft hangars.

- Identification of the type of aircraft that will populate the hangar.
- Identification of the aircraft mix that will populate the hangar.
- Identification of the aircraft maintenance functions that will be performed in the facility.
- Estimation of the type and amount of shop area required performing the maintenance functions.
- Estimation of the type and amount of warehouse space required supporting the maintenance effort.
• Estimation of the floor space required for Office and Administration Area.
• Identification of special purpose areas such as locker rooms, toilets, personnel berthing area, dining areas and public lobbies to name a few.
• Estimation of the floor space required for the Building Utilities Area.

Plate: 1.10  80 Meter clear span Aircraft Maintenance Facility at Kenya Airways Head Office and Base.

Source: Own field survey

1.2.6.1 Space Considerations/ Requirements

Step 1: Determine the types and number of aircraft, which populate the hangar.
During this initial stage, input is needed from the hangar's future owner about his aircraft fleet.
Information such as the following:
- Type of aircraft in the fleet
- Number of each type of aircraft in the fleet
- Mix of aircraft that will populate the hangar
- Allowance for future aircraft that may populate the hangar

Step 2: Determine the Maintenance Function of the Hangar Facility.
The role of building maintenance team at the Hangar is to facilitate recurrent cleaning service within the various areas of the hangar and to undertake building repair works as they arise.
1.2.6.2 Physical Security:

The aviation industry is a high profile industry and is a target for terrorist attacks. Future building designs will incorporate higher levels of security and force protection/anti-terrorism standards. In order to facilitate high degree of security, there is manual and electronic devices mounted at the main gate, which inhibits any, would be trespassers inside the compound. Maximum security is enforced round the clock without compromise.

1.2.7 Warehouse

Warehouses are facilities that provide a proper environment for the purpose of storing goods and materials that require protection from the elements. Warehouses are designed to accommodate the loads of the materials to be stored, the associated handling equipment, and the needs of the operating personnel. The design of the warehouse is planned to best accommodate business service requirements and the products to be stored/handled.

Kenya Airways has different types of warehouses, which include:

- **Heated and unheated general warehouses**—provide space for bulk, rack, and bin storage, aisle space, receiving and shipping space, packing and crating space, and office and toilet space;
- **Refrigerated warehouses**—preserve the quality of perishable goods and general supply materials that require refrigeration. Includes freeze and chill space, processing facilities, and mechanical areas; and
- **Controlled humidity (CH) warehouses**—similar to general warehouses except that they are constructed with vapor barriers and contain humidity control equipment to maintain humidity at desired levels.

Special-designed warehouses meeting strict requirements can also provide liquid storage (fuel and monopropellants), flammable and combustible storage, radioactive material storage, hazardous chemical storage, and ammunition storage.
Features already now common in warehouse designs are higher bays, sophisticated materials-handling equipment, broadband connectivity access, and more distribution networks. A wide range of storage alternatives, picking alternatives, material handling equipment and software exist to meet the physical and operational requirements of the warehouse. Warehouse spaces must also be flexible to accommodate future operations and storage needs as well as mission changes.

1.2.7.1 Building maintenance factors to consider

Being utilitarian facilities, warehouse designers should focus on making the warehouse spaces functional and efficient, while providing a safe and comfortable environment for the workers to increase productivity and control, reduce production costs and improve customer service. To this end, warehouses should:

1.2.7.2 Space Configurations

As building maintenance manager, some of key factors one need to put into account

- Be designed based on current and future needs.
- Warehouse spaces should be flexible to accommodate warehousing and mission changes.
- Maximize utilization of space while providing adequate circulation paths for personnel and material handling equipment such as forklift trucks.
- Use higher bays to take advantage of height allowances in the space.
- Optimize layout and configuration for the warehouse operation, including efficient circulation and material handling and storage processes.
1.2.8 Office Building

There are a number of office blocks which are punctuated with the latest infrastructural facilities such as IT communication network—See the figure below. The internal finishes are of high quality and properly harmonized with corporate branding. Respective divisional Office pools are clearly demarcated with imaginary signage’s detailing their respective functions for ease of identity of their roles.

1.2.8.1 Re-roofing blocks A & B

In order to cope with the growing demand of the staff requirements, Kenya Airways of late has undertaken various building refurbishment. This has focused on expansion of office space, upgrading of the existing infrastructural facilities such as electrical services, information technology, water services, roads and car parks, fire suppression and warehouse storage buildings.
Note: The IT infrastructural services mounted to roof structure

Plate: 1.12 Newly refurbished Office block A had flat roof converted to pitched one & additional IT facilities upgraded at roof level.
Source: Own field survey

Plate: 1.13 Newly refurbished Office block B, had flat roof converted to pitched one & additional floor added
Source: Own field survey

1.2.8.2 Movable Office fittings

Nearly all the offices are well furnished with imported furniture whose design criteria facilitate integration of infrastructural services such as electrical, data and telephone lines. Windows bear curtains/blinds and many all the directors’ office floors are finished with carpets. Office blocks are well integrated with sanitary appliance, coffee bars and conference room to ensure there is adequate human comfort thereby cultivating the morale of the working team.

Plate: 1.14
Nearly finished Office block finished in Ceramic floor tiles & Furniture packed in boxes ready for assembling in Block B 2nd floor
Source: Own field survey

Plate 1.15
Block B 2nd floor newly finished toilets, Floor & wall well finished in ceramic tiles
Source: Own field survey
1.2.9 Infrastructural services

Kenya Airways has the most dynamic infrastructural services, which facilitates it day-today business operations at various levels. These services are Electrical services, Water services, IT. Network, telephone services, Fax services, roads, car parks, drainages both foul and service drains and various modes of fire suppression. All these services have lately been upgraded to match with the growing demand.

1.2.9.1 Information and data network

Kenya Airways is ranked among the leading corporate institutions, which of late have invested heavily on the information technology network. This has been greatly induced by a number of factors such as global stiff competition in its business venture, its privatization process, its objective policy of being the world class airline the year 2006, the nature of most of its business transactions call for the latest mode of communication. Promptness in service delivery is really crucial when it comes to delivery of global services, which takes the lion’s share of its core business. All the working staff are effectively interlinked either by intranet or internet services, a working tool facility, which has proved to bear most cost cutting measures within the systems.

1.2.9.2 Electrical services

In order to facilitate for a smooth and continuous task operations within the various users, Kenya Airways has invested heavily on electrical services. There has been a major overall upgrade of all the electrical cables, Generators, main switchgear, lighting fittings and other related items.

Plate: 1.13 Front elevation of electrical switchgear facilitates automatic switch on standby generator at Kenya Airways – block C
Source: Own field survey

Plate: 1.14 Back elevation of the electrical switchgear Source: Own field survey
Source: Own field survey
Generators

In view of the recurrent power outages it was deemed necessary to add an additional generator, top right, as standby of the existing top left. A lot of losses were being experienced due to power outages. See the diagram below.

![Diagram of standby generator](Image)

1.2.9.3 Upgrading of underground cables

The entire aged electrical cables underwent in buildings and the high voltage underground ones were all upgraded after serving for at least over 50 years. Before they were installed, there were rampant reported cases of power faults, which induced the approval of the upgrade exercise. The plates below indicate the site implementation process, which took place 2000-2003. This exercise improved the image of the Airline tremendously.

![Aged high voltage cables](Image)

![New high voltage cables](Image)
This project involved the complete replacement of the existing 50-year-old electrical High voltage and low voltage switchgear, conduits, wiring and fittings. This was necessitated by the need to overt a possible catastrophic electrical fire accident.

1.2.9.4 Car Parks Behind Blocks A & B

Plate: 1.19 hardcore fill to newly excavated car park
Note the earth moving mechanical plant on site.
Source: Own field survey

Plate: 1.20 Car park surfacing & Surface water drain work in progress
Source: Own field survey

The project involved provision of suitable car parking facility for Kenya Airways staff. Please note the difference between this project and a similar one the internal roads. In this instance, it was possible to give the contractor the whole site, as the Army gave alternative parking, thereby enabling works to continue unhindered. An additional car park space was also added in order to cope with the increased demand.

1.2.9.5 Fire suppression

Following a high capital investment input at its head office and base aggravated by the extent of highly inflammable materials handled, Kenya Airways has invested heavily on fire fighting facilities namely water hydrants, Sprinklers, Foam & water mixed, portables – Carbon, Enemgen – Clean expensive (clean agent), hosieries and oscillating monitors. These facilities
are clearly mounted at various strategic places which vulnerable fire risks such as sores-warehouses, at the hangar, Office blocks, I.T data center. Just to mention a few. Note that, these are the areas, which are the backbone of the airline, and negligence would not be condoned as this would turn out to be a major disaster should there be outbreak of fire.

1.2.9.6 Water Services

Nearly over 70% of the structural operations at the head office require reliable and substantial amount of water for day today execution process. To facilitate effective flow of clean water, the airline relies on local authority main line well supplemented by bore water. Reservoirs of varying magnitudes are mounted in every key building blocks and the pressure is boosted through a mechanical booster strategically mounted at the main source distribution line. The water level at the major water reservoir tanks is monitored through calibration devices, which is monitored accordingly on daily routine by the plumber. Should there be any anomaly, its promptly diagnosed and resolved before the water within the storage tanks is depleted. Missing water at Kenya Airways head office is like the organ heart doing without the blood!

1.2.9.7 Roads and car parks

There is a good network of access within the entire compound of the Kenya Airways. All the roads and the car parks have been upgraded lately using sound building materials and well finished in precast concrete paving. The car parks are big and secure enough and cater for all staff and visitors vehicles.
1.2.9.8 **Foul Sewer /Service Water Drains**

Kenya Airways is seated on gentle topographical terrain and this implies that, the nature at which surface water is drained is crucial. There is a sound network of surface water drains within its internal compound and its peripheral limits. The drains structure takes either open or piped mode of layout. During the rain seasons, users don't experience any threats at all emanating from surface water run off.
The existing foul sewer drains system is aged and its depth is rather shallow posing a major threat to the entire building maintenance team. Owing to plasticity properties of clay soil, which punctuates the physical geological features of this built up environment, cases of blockages are rampant. Foul sewer unlike other infrastructural facilities earlier mentioned above, was not arrested during the upgrade. A proposal appealing for its upgrade needs to be compiled and tabled to the board for the approval soonest possible, before it poses menace to users. As the saying goes “Stitch in time, saves nine”.

1.2.9.9 Landscaping / Footpaths

There is a unique input of landscaping well-executed and maintained recurrently at Kenya Airways. Pedestrian paths are neatly linked to respective building blocks ideally meant to offset eradication of naturally/ artificially preserved natural vegetation such grass, shrubs and trees. Exotic vegetation features have neatly been branded to catch the attention of human psych, create harmony within the ecosystem whereas portraying the corporate dynamism in its venture to exhale as the saying goes – “Kenya Airways, The Pride of Africa”. Long lives the corporate spirit.

1.2.10 Building maintenance team

Building maintenance team at Kenya Airways is entrusted with the responsibility of undertaking routine building maintenance works and enforcing of capital projects at its head office and local office stations namely Yaya Centre, Barclays plaza, Kisumu, Mombasa, Lamu and Malindi. They also undertake implementation process of creating outstation offices where its business venture is needed. Capital projects take form of remodeling, refurbishing or additions to the existing structures or completely new proposals requested for the system to meet a crucial demand e.g. the current erection of the proposed new Hangar at the Head office and base.

Building maintenance division at Kenya Airways is under the umbrella of technical department. The Manager properties and facilities leads the team and his immediate staff is the property administrator who is charged with the responsibility of monitoring all projects implementation and controlling the budgets, general building upkeep of all properties, enforcing all payments rates for facilities upkeep such as electrical bills,
water bills, garbage collection, cleaning services and general coordination of the entire building maintenance team. He is answerable to the Properties and facilities manager.

1.2.11 Building Maintenance Officer

He is in charge of all building maintenance works and corroborates with all the technicians - the electricians, carpenters, masons, plumbers and metal fabricators for the implementation process.

1.2.12 Custodial Maintenance

This refers to routine daily cleaning, landscaping – (ground support) and the general upkeep of other related facilities such maintaining movable office facilities such as curtains, carpets, blinds, furniture and providing the necessary attention to signage at various building blocks offices.

The maintenance team as their mission statement states, is expected to provide, maintain and upgrade to a very high level of standard and serviceability offices, workshops, stores, hangar, utilities, compound, roads, footpaths, office equipment, reception and PABX services; ensure prompt mail collection and deliveries at all times and diligently undertake and deliver projects to specification, within budget and in time.

They also plan for future expansion and needs of Kenya Airways e.g. the current ongoing Hangar project and office accommodation on the network is part of projects of their injection.

1.2.13 Job requests procedure adopted

The respective job requests are channeled from various users through service request forms. The forms have details of the name of the user and his division, his requirement, location where service is expected, his cost center if necessary, provisions for his/ her manager to sign. Similar provision is also provided for the maintenance team to fill on cost implications, proposed execution period, the staff delegated the work and approval of the job request by the manager and facilities as well. Note that if the cost implication is above the manager’s authority then, the other documentation process if enforced and forwarded to the Technical director for an
approval. If the input of demand for the job request is exceeding the capacity of building maintenance team, it's normally outsourced. A typical job request form is as illustrated below.

KENYA AIRWAYS
PIECE RATE PAYMENT AGREEMENT

WORKER’S NAME: ____________________________

JOB NO. ____________________________

WORKING PERIOD: FROM: ____________________________to: ____________________________

WORK DESCRIPTION

[Blank space for work description]

I ____________________________ ID/NO. ____________________________

Agreed to do the above stated work as per description and within the agreed period of ____________________________ days and at the agreed amount of Kenya Shillings (Amount in words)

Worker’s Sign: ____________________________ Date: ____________________________

Client’s Sign: ____________________________ Date: ____________________________

MODE OF PAYMENT: Two/One installments as follows:

<table>
<thead>
<tr>
<th>AMOUNT</th>
<th>DATE</th>
<th>SIGNATURES OF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payer</td>
<td>Receiver</td>
<td></td>
</tr>
</tbody>
</table>

1st Installment Kshs. ____________________________ ____________________________ 

Last Installment Kshs. ____________________________ ____________________________ 

AUTHORISED BY CONTROLLING MANAGER

SIGNATURE: ____________________________ DATE: ____________________________

Fig: 1.13 Service request form used for outsourcing building maintenance services whose cost doesn’t exceed Kshs. 50,000. (medium level projects) Maintenance Manager can approve this without the input of the director.

Source: Own field study

Projects whose cost implications is fifty thousand and above, the building maintenance team normally raises Purchase demand (Indent? capital expenditure request, and executive summary
justifying the demand of the proposed project. Note all the proposed projects undertaken ought to reflect in the approved annual capital budget.

As stipulated in the attached capital expenditure form below, the procedure calls for collective approval responsibility whereby, the originating officer has to raise the request, present to his manager for checking, the manager forwards to his director, who submits to the Technical Director approval, the fiancé director has to confirm the validity of the budget. If the budget is okay and the expenditure is exceeding Kenya shillings five million, the Managing Director who is the chief executive Officer has to approve. If the expenditure exceeds Kenya shillings ten million, then it would require the approval of the board of directors and chairman of directors. This helps to facilitate thorough and collective implementation process on the capital expenditure, which if not properly controlled, would ruin the airline image.

All the projects proposed are supposed to be reflected in proposed and approve capital budget which must be scrutinized by finance department prior to final approval by the originating director together with his counterpart in finance. See a typical approved sheet for capital budget in the figure below.

![figure](image)

**Figure:** 1.14 Capital budget approved sheet, 2003/2004

**Source:** Own field study
1.3 Problem statement

Most building professionals prefer to be involved in new construction works, rather than maintenance and repair works. Building owners have generally neglected importance of good building maintenance in the past decade. Kenya Airways is therefore not an island and the case is aggravated by the "unique" nature in terms of both the capacity and the variable nature of the entire building facilities and services to be handled. In actual fact, as earlier mentioned in the introduction, the challenge of keeping all the properties and facilities in conformity with the users' expectations is immensely bear upon by the maintenance team.

Building maintenance technology is a topic that a building surveyor must be familiar with and it entails an endless learning process, which goes hand in hand with working experience. When you start tackling a building defect, at the first instance, you have to identify the causes of it; followed by detailed diagnosis and collection of useful information before deciding on an appropriate method of repair.

Building operators lack good information on major building systems. Information tools currently in use in these buildings severely limit a building managers' ability to assess their own O&M practices in a comprehensive manner. As mentioned, the questionnaire had sections asking about continuous information systems such as EMCSs, as well as one-time and short-term diagnostics such as vibration analysis and thermography. The most significant conclusion from the surveys and literature search is that building managers have little information on the energy performance of their major building systems, such as the cooling plant, lighting, and ventilation. They therefore have very limited capabilities to:

- detect and diagnose problems or
- evaluate the economic benefit of modifying O&M practices or changing existing equipment with more efficient equipment.

The general problem of lack of information on major building systems comprises a series of specific problems. For example, the most sophisticated building managers face problems in keeping sensors properly calibrated. Thus, the information directly available from the EMCS is questionable. Temperature, humidity, and flow sensors are all reported as problematic, with the most concern over humidity and flow sensors. The following five constraints are also found to be significant in evaluating opportunities for a continuous diagnostic system.
1.3.1 Characteristics of Building maintenance

Building maintenance works sector has no barrier of entry because of piece-meal nature of work, lack of universal standard the nature of work is of small value compared to new construction projects. This contributes a lot to the type and size of contractors who undertake maintenance projects. Many are small scale, who lack efficient working staff, have inadequate cash to run the project and lack specialized staff who can provide world class end results expected by the many of Kenya Airways user today.

1.3.2 Aged building facilities

Aging and neglected facilities put mission, quality of life, and facility investment at risk. The building maintenance team is therefore faced with major challenge of keeping thorough periodic inspection on identifying anticipated defects and giving the necessary remedy promptly. However, under normal circumstances, there are inevitable lapses of here and there, get maintenance team unaware and this call for proper diagnosis before more problems are extended thereby casing vicious circle phenomenon. Note that, inspection is expensive and of questionable value, perse.

1.3.3 Inadequacy resources

In most cases, there are cases where you find the building maintenance team doesn't match with arising demand both in quantity and quality. Cases of inadequate cash flow, inadequate staff skills, inadequate working tools and equipment and many other related facilities require for effective implementation process constrain building maintenance team time and again.

1.3.4 Insufficient research and development

Undertaking of research and development has been in one way or the other inhibited by small scale of works and small size of firms involved. Lack of research and development contributes negatively on maintainability, Planned maintenance budgeting and control, maintenance project organization, compatibility in use of sound materials, life cycle costing, durability of materials and quality of management.


1.3.5 Threat

Absence of control enables incompetent and dishonest contractors to flourish in the market. Lack of specialization affects overall efficiency of the sector. Note that, eventually quality and status of the parties involved cannot be upgraded.

1.3.6 Weakness

Most of building maintenance works is labour intensive and this characterized by general inefficiency in terms of resource utilization. The quality of work is not consistent compared to new work. It is not cost effective to perform close supervision. Use of inferior materials and malpractices are common for hidden work. In most cases, execution is undertaken without proper documentation on quality, completion time and the over all cost implications.

1.3.7 Sources of building maintenance problems/Constraints.

Like the construction industry itself, problems of building maintenance are intricate emanating right from the preliminary level up to lifecycle level. Some of the major and frequent ones are faulty designs, faulty contraction, defective materials, decay and deterioration, vandalism, incorrect maintenance methods and bad property management. The key contributors of are contractors, Architects, Project managers, Developers, Building service Engineers, Clerk of works and manufacturers.

Other associated problems arising after commissioning of the project are unauthorized building works, lack of sound maintenance, poor management and misuse buildings, multiple ownership, disincentives to owners to maintain, inadequate law related to properties rights and obligation to the parties involved, lack of public awareness and low return from the properties.

1.3.8 Sources Of Maintenance Problems

Building maintenance like the construction industry has intricate problems namely:

1.3.9A Faulty Designs

Sometimes owing to haste phase at which building construction projects are implemented, there is no adequate scrutiny done by both the consultants and the client to ensure that building
designs done for a new project are compatible to client's requirements and this results to multiple subsequent problems in form of defects leading to additional cost to the client.

1.3.9.B Faulty construction

Poor workmanship during the construction period and even at maintenance process may lead to continuous problems. Proper diagnosis is necessary at the preliminary level in order to avoid this.

1.3.9.C Defective Materials

There is high level of inconsistency of material of similar nature in the market against adherence of sound specifications adopted by building maintenance team and this aggravates the quality of performance leading vicious circle of similar related problems.

1.3.9.D Decay and deterioration.

Various material adopted in the construction industry have limited lifespan to which they can structurally withstand acceptable level of performance. However this is sometimes influenced by a number of various factors such as exposure to the atmosphere, neighboring environment, climatic conditions and degree of workmanship during execution.

1.3.9.E Vandalism

In a big institution like Kenya Airways, there are all kinds of people of various tribes, culture and social beliefs of which vary drastically. In one way or the other, their beliefs and ideological lifestyles differ and this may lead to 100% harmonization process when undertaking building maintenance projects e.g. whereas rehabilitating Kenya airways toilets, a building maintenance manager meet the following experiences: Breakage of new doors, users standing on newly installed water closet – w.c thereby causing breakages rather than seating on the seat cover, stealing of plumbing appliances e.g. soap dispenser, hand driers Breakage and stealing of ironmongeries and mirrors.

1.3.9.F Incorrect maintenance methods

In most cases when defects arises, owing to the nature of alarm raised by the users, maintenance team hurriedly attend to them without sound diagnosis and this turns out to be
Bad property management

This arises from the poor implementation process, which fails to conform to the managerial aspects of sound planning, organization, controlling, staffing and leading. Failure to articulate these aspects amounts to weak and substandard performance level thereby adversely affecting other departments in the entire system. This is overwhelmingly costly in long term.

Many companies spend over 50 percent of their installation real property maintenance funds on maintenance and repair (M&R) of buildings. It is difficult to allocate these funds optimally without structured, objective condition rating and functionality rating procedures, component remaining service life determinations, and easily developed short- and long-range work plans based on a sound investment strategy and prioritization criteria.

Also, key components may not be inspected adequately and deficiencies are often overlooked. The total result is that work cannot be planned, programmed, and budgeted efficiently. The large number of buildings on installations increases the difficulty of budgeting effectively and allocating funds to areas that most urgently need attention.

In addition, it is difficult to establish effective preventive maintenance programs, or to even set work priorities. Without objectivity in work planning, cost-effective M&R programs cannot be sustained. Mission-support capabilities, quality of life, and past investment in facilities are jeopardized.

Constraints

The number of constraints experienced by building maintenance managers will vary from one institution to another. Kenya Airways therefore being an enterprise engaged in global trade is therefore not an highland as far as building maintenance constraints are concerned. They range from internal level of the organization hierarchy to external ones and each requiring a totally different approach to undue. One needs to be quite conversant with the bureaucratic procedures, law of property / contract and other related rules and regulations in order not to execute tasks beyond his authority.
1.3.10.1 Black Box Technical Complexity Confuses Operations

A building engineer wants to understand how their control and diagnostic systems operate. For a variety of reasons, current advanced control systems often fail in this regard. Many control systems use proprietary, black box control algorithms. It therefore is difficult for operators to assess the impact of changes in control strategies. There is a significant challenge to the buildings industry to integrate operators and sophisticated systems in order to provide optimal results. Clear feedback to an operator on how the technology function is essential but frequently nonexistent in current systems.

1.3.10.2 Economic Constraints Limit Innovation

Building managers operate in a tight economic environment. Investments in building systems must have defensible estimates of energy and cost savings. These investments must ultimately lower tenant costs and have a quick payback. New or retrofitted systems that do not produce expected savings could seriously jeopardize one's career. Diagnostic systems must provide defensible cost-benefit information in a usable form if investments in improved O&M or retrofits are to be approved.

1.3.10.3 Energy Cost Reduction is not a Top Priority

Building managers compare the annual energy use and costs of individual buildings with others for which they have data. These data may be from their own portfolio, from trade association statistics, or from utility data. Most building managers do not seek aggressive reductions in annual energy use and associated energy costs provided that their building is not dramatically far from other benchmark data. Rather, building managers and engineers spend significant time responding to complaints and seeking to maintain high standards of comfort and indoor air quality. Similarly, preventative maintenance is of great interest. A diagnostic system that assists in these areas as part of the effort to reduce energy costs is desirable.
Lack of Knowledge of Information Technology Limits Innovation

Building managers are interested in strategies to improve the energy performance of their buildings, but lack the training in new information tools needed to conceptualize and evaluate the next level of building efficiency technologies. The computer facilities available to them are limited.

Poor Initial Designs Cause Ongoing Problems

The most common problem reported by the managers was that critical equipment was often poorly (either under or over) sized. The second most common problem reported was that some aspect of the equipment layout was faulty. These managers see these problems as continual issues in achieving optimal operations. They currently have no formal mechanism to document these problems, economically justify retrofits or provide feedback to designers, which might help ensure that the problems are not repeated in the future.

Why We Fail

The statistics are cruel; 95% of weight loss effort based on dieting alone fail within 3-5 years. While I can't produce statistics for maintenance management, common sense tells me that they would be fairly similar. Among the most common causes cited for failure are:

- Reliance on only one measure.
- Making temporary changes but failing to address the long-term behavior that produced the present condition.
- Overcomplicating the plan to change.
- Failure to recognize or correct a resource balance or attitude of which the current state is the outcome.
- Over reliance on technology or a silver bullet.
- Trying to do it on your own.

Even after scrutinizing this list closely, it would be hard to find an item that did not apply to both maintenance improvement and weight loss success. While there are hundreds of ways to go about improvement, there are several important junctions and turns you should not miss on the road to sound maintenance and weight loss practices. Let's look at them in turn.
Why many maintenance improvement initiatives fail to deliver expected results?

It is not uncommon that many reliability and maintenance improvement initiatives fail to deliver expected results. Why is it so? Some of the most common causes I have observed include:

- Lack of top management understanding, directive and long-term support.
- Initiatives are shortsighted and too cost focused instead of long term and reliability focused.
- Politics and disjointed organizational goals and objectives.
- Mobility of management.
- Confusing the organization with new names on well-known concepts.
- Failing to understand that the reliability and maintenance improvement initiative is a process without an end, not a program with an end.
- It is a process driven by disciplined thoughts and actions by people.
- Technology is secondary to behavior and will be very successfully applied when an organization is ready.

1.3.12 Scope of maintenance activities

This falls under various categories depending on the case at hand:

- Servicing - This in most cases applies to those assets undergoes wear and tear and is done to prevent breakdown.
- Repairs - this applies to defects arising calling for corrective action e.g. aged paint requiring repainting to wall/ ceiling surfaces.
- Replacement - building elements reach their economic life and therefore are subject to replacement in order to function at their acceptable level of performance.
- Improvement - this refers to upgrading process on facilities in order to achieve the expected and acceptable standards.

1.3.13 Expected level of performance

Evidence emanating from the Kenya Airways users from various departments indicates that, the building maintenance team is not meeting their performance expectations. There is Lagging pace on delivery of services requested by the users. The quality of work performed many times is not world class, documentation process is below expectations and
communication between the users and the maintenance team seems to be below average. Under normal circumstances, once the user request for services, there are service request forms, which are filled accordingly, and terms and condition of execution is clearly spelt out. Today, over 70% of the users are claiming, these terms are not adhered to, no vivid details are given as to why and they fill let down in one ways or the other. They are demanding affirmative action today, not tomorrow. As the saying goes, “stitch on time, saves nine”.

1.4 Scope of the study

The study examines the problems and constraints experienced by Building maintenance manager at Kenya Airways. By virtue of its major venture on global Airfreight business intertwined with variety of other crucial building and infrastructural facilities, this poses a real challenge to the building maintenance team.

A cross-section on various obstacles met on the execution process by the maintenance team is examined. Kenya Airways head Office bears a potential and competitive working environment, which is integrated with completely contrasting working tools depending on the respective department. Whereas authority is decentralized in one way or the other, there still exist some handles facing the maintenance team which calls for attention in order to achieve acceptable level of performance expected by the system if it has to compete effectively with other world class Airlines.

The incident displays loads of technical and logistical problem in the issue of building maintenance, which are outside the scope of this research, the focus herein is on awareness of along the bureaucratic ladder along the users and the building maintenance team. The choice of Kenya Airways can serve as a benchmark to other related institution locally and globally. There is need to eradicate the gaps and weaknesses on service delivery approach failure to which leads to monumental wastages particularly in the developing countries.
1.5 Objectives of the study

1. To establish the quantity and the quality of maintenance staff work demanded.
2. To establish budget allocation for building maintenance works per annum.
3. To relate the cost of quantity demanded in 1. above with budget.
4. To establish the actual number of cases reported/demanded and their cost.
5. To calculate the deficits in terms of budget allocated, quantity budgeted, quantity actually reported and actual amount spent.
6. To establish the number of staff and the required respective skills for the actual demand.
7. To establish the actual number and skills of staff in employment.
8. To establish the adequacy/inadequacy of staff and skills.
9. To measure the actual performance with respect to expected performance.

1.6 Hypothesis

This study hypothesises as below:

- There is a direct relationship between sound implementation process enforced by the building maintenance manager against his maintenance team and quality/quantity of service delivered to users.
- Training of the staff influences the awareness on the proper and sound maintenance services delivered.
- There is direct relation between the level of decentralization of authority among the hierarchy of power and the performance level of the maintenance team.
- The building maintenance organization structure is not sound enough to deliver effectively.

1.7 Assumptions

The study makes assumptions as follows:

- The current performance level by building maintenance team at Kenya -airways team is below the expected level of performance.
- The building maintenance team is faced with problems and constraints along its bureaucratic process thereby inhibiting its entire execution of service delivery.
- There is possibility of insufficient financial cash flow to effectively facilitate to required level of standards, the arising building maintenance demands.
The building team organization structure is not sound enough (both in quality and quantity) to match on promptly on the demands from the users.

1.8 Significance of the Research

The current outcry from the users from various departments at Kenya-airways and other related institution will benefit from the suggestions reached which will contribute overwhelmingly positive results if properly adopted and articulated accordingly.

The research will highlight on sound and relevant structures/procedures of addressing the unique nature of demands arising on maintenance services thereby targeting customer satisfaction.

Through proper, sound and rational approach on maintenance demands reinforced with articulation of managerial roles namely control, organization, staffing, planning and leadership Kenya–airways stands to benefit a lot from eradication of unnecessary wastages incurred through improper implementation process.

1.9 Organization of the study.

The research work contains five Chapters each dealing with a specific aspect of undertaking. Chapter one includes the general introduction and background of the study, the problem statement, objectives, hypothesis, significance and scope of the research study and limitations encountered.

Chapter two entails the literature review and theoretical framework. Literature review focuses on problems and constraints experienced by building maintenance team both in Kenya Airways and globally as a whole. Theoretical framework refers to various maintenance services undertaken, various causes of defects arising day today maintenance processes, and varying proposals suggested by other participants in maintenance world on both positive and negative implementation process. It has given broad theories on managerial procedures globally practiced meant to compare against ones adopted at the case of study.
Chapter three encompasses research methodology, which underlines the description of the study area and population, the sampling technique and sample size, data collection instruments and the data collection procedures.

Chapter four entails data collection, presentation, discussion, analysis and findings therein. While Chapter five sums up the findings through the conclusion and recommendations and further areas of study,
2.0 Maintenance problems in developing countries

In developing countries, building maintenance technology is currently vastly underrated and ignored by owners, managers, and professionals. The building and construction authority of Singapore (BCA) has identified that the complaints about building defects have gone up in recent years with common problems such as leaky roof and walls, floor defect, and improper outlet pipe. This paper presents a brief description on building defect in use for commercial building as well as residential buildings in Singapore. The main objective is to highlight the important problems and suggest a greater participation of professionals in building maintenance. It also provides some site investigations photographs of various defects, which is expected to be useful for builders, architects, and others who deal with building materials.

2.1 Defects and Damage on Historical Buildings

Missing tile, clogged gutter, not renewed painting of window, frames, etc. are very simple defects which, when are not treated in time and properly, can cause a serious damage to the historical structure. Not only a clogged gutter itself, but also surrounded plaster, masonry, and doors below can be affected by leaked rainwater. When the maintenance i.e. debugging of these simple defects is neglected, after a certain period of time, large-scale restoration is needed. Such restorations, although are carried out on very high quality, always mean loss of original substance of the historical building.

2.1.1 Roof structure

In roof timbers, the principal defects in original timber may be large dead knots leading to partial failure of the member, longitudinal fissures due to shrinkage and radial cracks, only visible at the ends, which together with the fissures may weaken a member and vane due to faulty conversion or decay sapwood: Fungus and insect attack is very serious problem especially for joints, as well as chemically aggressive excrements of beards and animals living in under roof spaces. These excrements cause slow chemical changes in the wood and weaken the members. Roof structure (trust) is very vulnerable to any water penetration. There are some places, where water is usually penetrated in. Around the chimneys, roof windows, gable wall, etc. Wooden members in these places can be very easily affected by rot or fungi, because of
Humidity and temperature, very usual in those spaces. Specially dangerous is insect attack. Usually it is caused by incorrect preparation of wooden material, which is built-in without bark removal. In the space between wood and bark are very often located grubs of longhorn beetle and Anobidae sp.

### 2.1.2 Roof cover

Plays most important role in protection of the building, since it is its function. Roofing material is continuously exposed to the climatic conditions. Most damage occurred in spring when snow is melting and in autumn, when heavy rains are combined with strong winds bringing fallen leaves and other debris. In addition biological roofing materials (wood, thatch, etc) can be attacked by insects, moss, fungi, etc. usually on southern site of the roof, where is favorable temperature for pests. For analyzing of weak points of roof cover is very important to know quality and lifespan of roofing material. In generally there are places, which are tend to be damaged.

Plate: 1.23

Not only the quality of roofing material is important, but regular maintenance as well. Also simple Defects will cause serious damage - House No. 39 on The Town Hall Square – Bardejov

Most vulnerable places are where vertical construction penetrates roof cover. Only a little defect on the details around chimneys, gable walls, electricity poles, dormers, etc, if not treated properly, can cause large damage to whole building. The load by strong wind is higher on ridges and on the borders of the roof, then on other parts of the roof and wind can blow away tiles from those parts. Hail, in fact, usually caused only a very little damage, when braking few tiles, or roof window. On another hand damage will occurs when broken tile is not replaced immediately.
When places where vertical construction penetrates roof cover are not maintained regularly, serious damage can occur. - House No.38 on The Town Hall Square – Bardejov

2.1.3 Chimneys

Beside gutters, the most vulnerable points for rain penetration in most buildings are chimneys, which until now, were not build with water-proof trays, thus allowing water to penetrate down the stack. If there is not sufficient lap cover between roofing materials, the details can allow capillary attraction or penetration trough porous materials. Rain penetration will cause rotting of roof timbers at abutments, as these are rarely properly flashed and damp-proofed in historical buildings. The top of the chimney is very vulnerable and when the stability of this part is not ensured by regular maintenance, by proper technical solution, or by other means, falling bricks can damage roof cover and plaster can help to block the rainwater disposal system.

Bricks falling from the top of chimney are dangerous for roof cover. - House No. 38 on The Town Hall Square – Bardejov

Another danger caused by improperly maintained chimney is fire. Inspection of fireproof of the chimneys is regulated by special regulations, is obligatory and is provided on regular Bases by specially trained sweeps.
2.1.4 Rainwater disposal

Properly working rainwater disposal system is essential for safeguarding of historical building. Smaller defects on gutters and down pipes can cause serious problems, they must be maintained regularly. Dysfunction of disposal system is evident during heavy rains. Wall staining, rust marks and internal moist patches usually point to defects. Rising of moisture can cause attack by fungi and deterioration of wooden parts of the structure, falling off plaster and painting layers, defects on ceilings etc. Rainwater disposal system can be damaged or blocked at the beginning of spring by melting snow mixed with remains of trees from autumn. Wet, heavy snow can easily move not properly fixed gutter, what leads to problems with water flow. Autumn remains are not visible from the ground and at the beginning are dangerous only during heavy rains. Later, when the system is not cleaned remains of leaves, branches, etc. become a basis for growing moss, and leads to rust of metal parts connected to those places and to total block of the system in certain point. If rainwater is not removed from the roof immediately, can easily penetrate through other damaged point, or simply flow down the facade. Problems can be caused by improper design of the details, not correct realization, or even by using low quality materials.

Plate: 1.26

More than 20 years missing down pipe is continuously damaging walls, foundations and ground soil. House on The Trinity Square – Banská Štiavnica

Water penetrating from broken rainwater drains, which do not dispose water at least 3-4 meters from foundations, usually cause moisture penetration into basement and crypts. Serious damage to historical structure can occur when foundations and ground below are affected by water. Bearing capacity of wet ground is usually lower than bearing capacity of dry ground,
because of dissolving and flowing out some elements of the soil by water. In addition, the depth of foundation if certain kind of historical buildings / (folk architecture) is lower than depth of frozen soil in winter (in Slovakia it is about 80-100 cm). In this case the expansion of wet masonry and ground, can cause structural defects of outer wall of the building.

Driving rain will often penetrate doors and windows and cause rot to sills and the base of frames, especially if painting has been neglected.

2.1.5 Excess moisture

Moisture penetrating by capillary from the ground into masonry transports dissolved salts. By evaporating of water salts crystallize and destroys plaster and painting layers, later also masonry can be affected. These problems usually occurred in basement, not exceptionally on first floor as well and were caused by elimination of natural evaporation of water from the ground trough the floor. Damp-proofed floor layers in interior, and asphalt or concrete sidewalks touched to the facade do not allow natural water evaporation. Stopped ventilation in basement (by closing ventilation windows), or in the space below wooden floor cause rising of humidity, which creates ideal conditions for fungi and mould. Very often is the rising of the moisture in outer walls caused by leaking of drainage close to the foundation.

2.1.6 Masonry walls

Cracks in masonry walls are usually indicating movement of whole structure. The tendency for movement should be deducted from the tapering and angle of any cracks, many signify nothing more then thermal movement and-the slow wearing out of the structure. But cracks may be very significant and can indicate a likely failure. It is important to record and study every significant crack, if it's only in plaster layer, or goes trough the stone or brick wall. If any of cracks are considered as serious, arrangement of gauge or micrometer reading across three points can provide regular recording. After analyzing this data proper measures should be undertaken.
Cracks on the wall occurred during construction works on neighboring house. Although they are not moving any more, they must be maintained, not to cause more damage. - Jewish synagogue on Klastorska Street – Bardejov

In the cases, when the foundations are on soil less than 1 meter deep, some deformation of the wall can be caused by soil shrinkage cracks. Adjacent trees and shrubs or wall creeping plants may cause settlement by extracting water from the clay in summer.

Moisture in walls is as serious as in foundation masonry.

2.1.7 Interior - Windows and doors

Rot is often found at the bottom of frames and in wooden sills and then may spread into the wall lining or frame. A sagging arch or lintel indicates trouble – either structural settlement or local defects such as dry rot in concealed timbers. Defective putties at paintwork are common faults, which can lead to more serious trouble.

Condensation from windows can also be a serious cause of trouble. Windows and doors are always exposed to the climatic condition so the regular renewal of painting can not be abandoned.
Water condensation on the window glass sheet causes damage to painting, plaster, and to window frames as well. - Greek-catholic church of Virgin Mary in Chmelova

2.1.8 Floors and staircases

Floors and staircases may be the elements most likely to collapse and care should be taken if there is any doubt. Collapse or damage is generally due to fungus and insects attack in the ends of beams. Beams can be weaken by walls moving out, thus loosening their end bearing, or by the floor's strutting and wedging wearing loose.

Plate: 1.29

Mould on the wooden ceiling indicates high humidity above the ceiling. Building on Town Hall Square 3A, Bardejov

Damage is often caused by single-minded electricians and plumbers cutting joists at their weakness points to insert cable and pipes. The wearing of all floors in historical buildings is a problem too.

Staircases of historical buildings are either of wood or in masonry. The joints at the newel posts and the stiffness of these members are important as well as the strength and stability of balustrades and firmness of handrails.
2.1.9 Internal finishes - Floors and staircases

Most of the defects likely to be found, unless accounted for by structural actions, are due to poor workmanship; shrinkage cracks, plaster detached from lath (dangerous in ceilings) and the preparation of plaster coats are examples. The cause of all such defects should be analyzed. Mosaics and wall paintings of all types need special consideration, since they are vulnerable to condensation and penetrating water capillary action. Care must be taken to note canvas linings and wallpapers, which may have historic and artistic value. Ornate plaster ceilings are very heavy, so special attention must be paid to the fixing of their armatures. Cornices also present similar problems, particularly if their framing is of wood and liable to decay.

2.2 Mechanical and electrical services

Mechanical and electrical services are dangerous when installed or used improperly, or when lifetime of the materials used is over. Usually only licensed companies or craftsmen can realize these parts. According our legislation, these services, especially electricity must be examine and controlled regularly by the authority. On another hand defects are very dangerous, if they occurred they could cause fire. Internal water supply system is very often a source of damage not only in historical buildings. Leakage of water destroys not only paintwork or layers of plaster, but sometimes can cause cracks in the walls or volutes by overloading of the structure (when, for example, continuously penetrating masonry of the volutes).

2.2.1 Drainage

The danger points for broken drains are point of entry to sewage system and at point of entry to a building, if settlement has occurred, and under a lightly constructed drive over which heavy loads may passed. Damaged ventilation of the top of the drain can cause condensation of aggressive steams from the sewage. Leaking septic or savage tank is dangerous because waste water usually contains more aggressive dissolved salts than rain water. Problems mentioned above can by caused by wrong management, neglecting of maintenance, improper design of the details, not correct realization, or even by using low quality materials.
Very simple activity – cleaning certain points on drainage system can avoid many problems. - House in Town reserve Litomerice

2.2.2 Improper maintenance

Majority of the defects mentioned above can be avoided, when the building is maintained on regular basis. Unfortunately in Slovakia we do not have legal tools to motivate the owners to do this. In addition there is no specialized organization to inspect the building and to formulate the advises for efficient maintenance regularly, since the main task of the Institute of Monuments is research, documentation and methodology of the listed monuments which are going to be restored, or are under restoration. Of course, many of the owners are taking care of their property. But very often happens, that the maintenance is provided in improper way. In usual situation, when the owner has a limited budget for maintenance, it is essential to repair most dangerous and serious defects of the building. For example repairing of chimney, which is falling apart, deteriorated roof cover, or cleaning drainage system is usually more important, then repairing of plaster of the main facade.

Plate: 1.31

Repairing of the plaster of main facade was finished without repairing of deteriorated top of the chimney. House No. 38, Town Hall square, Bardejov before and after repairing of main façade.

When the defects are not treated in right way, without any serious analyze, using wrong materials, techniques, etc. the danger can even increase. Although it is known, that the
Cement plaster has very high resistance against diffusion of vapour, it is still used as a solution against excess of moisture into masonry. Same problem is using concrete damp proof in the basement. Sometimes it is enough to use simple logic.

Although there were some maintenance activity done, they are not sufficient since they were related to consequence not to cause of the damage. - Garden house of the castle at Liblice

2.2.3 Regular technical inspection

The methodology of all conservation depends upon making an inspection and report at regular intervals on all items of cultural property, recording visible defects factually, in order to diagnose the causes of decay and propose an effective cure that involves only the minimum intervention.

What is required is a coordinated strategy involving the owner and users of the building, the maintenance stuff and the daily cleaners, all of whom can, by constant vigilance, provide an early-warning system.

Inspectors besides preparing reports can provide „first aid“ repairs - Team of Monumentenwacht Netherlands inspects Palffy's manor house in Svaty Jur. Inspections are the basis of future action, so it is important that they should be thorough and accurate. The purpose of the initial report is to record and evaluate the significance and condition of the historic building. Most importantly, the report can be used as a basis of the maintenance plan, so it is an essential part of the strategy of preventive maintenance, which is the highest form of conservation.

A full report may be worked up by stages, as follows:

* Initial report based upon visual inspection, listing all defects, and describing and
studying the building.

- A maintenance plan. Approximate itemized estimates or immediate urgent and necessary repairs and other desirable works.
- Historical research and analysis supported by photographic records.
- Recording of the initial state of the building; soil mechanics, humidity studies and opening up suspect parts.
- Further studies. Structural analysis.
- Final estimates and proposal with specifications and full report for submission for governmental grant covering all above factors, as they modify each other.

2.2.4 **Economical efficiency**

In generally prevention is better than cure. And cheaper. Although in Slovakia there was no economical calculation done, it seems to be obvious, that to maintain the building on regular bases is cheaper, than to restore it in longer period of time. In addition, the budget for preservation of cultural monuments in Slovakia is decreasing constantly. By inclusion of the policy of maintenance into national policy for preservation of cultural monuments and into legislation, the decreased budget can be used more efficiently. This topic can be a subject of research since it can be a very strong argument for state authority to enhance maintenance and to introduce national maintenance policy. Of course reducing of costs for keeping the property in good condition is right motivation for the owner as well.

Many defects and damage on historical buildings are caused by neglecting, or by improper maintenance. Since the owner of that buildings are usually not specialists in the field of monument's preservation, there is need for defining a preventive maintenance policy as well as for an independent, highly skilled specialist, who can provide the owner with the information on technical state, threats, causes of damage and with advises for efficient maintenance. Technical inspections and preventive maintenance of historical buildings must be provided on regular bases.
Good maintenance

What exactly is the purpose of the maintenance function? In a world of growing expectations, increasingly onerous regulatory constraints, shifting technological paradigms and endless reorganizations – all of which must be dealt with urgently – it is easy to get lost. In this environment, just as most major corporations develop formal mission statements to help them maintain a steady course through an ocean of distractions, it is worth developing a formal mission statement to help maintenance do likewise.

Perhaps a good place to start would be to look at the meaning of the word 'maintain'. The Oxford dictionary defines maintain as cause to continue. Cause what, you may ask, to continue to do what? The first 'what' is easy. Maintenance exists because we have physical assets, which need maintaining. So the mission statement must reflect the fact that maintenance is first and foremost about physical assets.

But what is it that they must continue to do? The answer lies in the fact that every physical asset put into service because someone wants it to do something. In other words, it is expected to fulfill a specific function or functions. So it follows that when we maintain an asset, the state we wish to preserve must be one in which it continues to do whatever its users want it to do. This shift in emphasis – from preserving what each asset is to preserving what it does – should be acknowledged in the mission statement.

The mission statement must also recognize the 'customers' of the maintenance service. Maintainers serve three distinct sets of customers – the owners of the assets, the users of the assets (usually the operators), and society as a whole. Owners are satisfied if their assets generate a satisfactory return on the investment made to acquire them. Users are satisfied if each asset continues to do whatever they want it to do to a standard of performance, which they consider to be satisfactory. Society as a whole is satisfied if assets do not fail in ways, which threaten public safety or the environment.

If things didn't fail they wouldn't need maintenance. So the technology of maintenance is all about finding and applying suitable ways of managing failure. Failure management techniques include predictive and preventive maintenance, failure finding, run to failure and one-time changes to the design of the asset or the way it is operated.
Each category includes a host of options, some more effective than others. Maintainers not only need to learn what these options are, but they also have to decide which are worthwhile in their own organizations. If they make the right choices, it is possible to improve asset performance and at the same time contain and even reduce the cost of maintenance. If they make the wrong choices, new problems are created while existing problems get worse. So the mission statement should stress the need to make the most cost-effective choices from the full array of options.

When considering failure management options, note that failures only attract attention because they have consequences. Failures can affect output, safety, environmental integrity, output, product quality, customer service, protection and operating costs in addition to repair costs. The severity and frequency with which a failure incurs these consequences dictates whether any failure management technique is worth applying. So the mission statement should acknowledge the key role of consequence avoidance in maintenance.

It should also acknowledge that most of us work in a highly resource constrained environment. The most efficient maintainers are those who apply the resources that they do need – people, spares and tools – as cost-effectively as possible, but not so cheaply that they damage the long-term functionality of their assets. In other words, the cost of ownership of the assets must be minimized throughout their useful lives, not just to the end of the next accounting period.

Finally, the mission statement must recognize that maintenance depends on people – not only maintainers, but also operators, designers and vendors. So it should acknowledge the need for everyone involved with the assets to share a common and correct understanding of what needs to be done, and to be able and willing to do whatever is needed right first time every time. All this suggests the following as a possible maintenance mission statement:

* To preserve the functions of our physical assets throughout their technologically useful lives
* to the satisfaction of their owners, of their users and of society as a whole
* by selecting and applying the most cost-effective techniques for managing failures and their consequences
* with the active support of all the people involved.
Developing A Maintenance Strategy

It is one thing to decide on a mission. It is quite another to develop and implement a strategy that enables the maintenance enterprise to accomplish that mission.

Given all the day-to-day pressures faced by maintenance managers, the first question is where do we start? Buy a new maintenance management system (MMS)? Reorganize? Invest in loads of condition monitoring equipment? Knock the whole place down and rebuild it?

The answer lies at the beginning of the mission statement, which states that our mission is to preserve the functions of our assets. It is only when these functions have been defined that it becomes clear exactly what maintenance is trying to achieve, and also precisely what is meant by “failed”. This makes it possible to move on to the next step, which is to identify the reasonably likely causes and effects of each failed state.

Once failure causes (or failure modes) and effects have been identified, we are then in a position to assess how and how much each failure matters. This in turn enables us to determine which of the full array of failure management options should be used to manage each failure mode.

At this point, we have decided what must be done to preserve the functions of our assets. This process could be called “work identification”.

When the tasks that need to be done - the maintenance requirements of each asset - have been clearly identified, the next step is to decide sensibly what resources are needed to do each task. "Resources" consist of people and things, so the following questions must now be answered:

- Who is to do each task: a skilled maintainer? the operator? a contractor? the training department (if training is required)? Engineers (if the asset must be redesigned)?
- What spares and tools are needed to do each task, (including condition monitoring equipment).

It is only when resource requirements are clearly understood that we can decide exactly what systems are needed to manage the resources in such a way that the tasks get done correctly, and hence that the functions of the assets are preserved.
This process can be likened to building a house. The foundations are the maintenance requirements of each asset, the walls are the resources needed to fulfill the requirements (skills and spares/tools) and the roof represents the systems needed to manage the resources (MMS).

Looking at maintenance requirements in the context of the functions of each asset (by seeking to preserve what the asset does rather than what it is), completely transforms the way in which the requirements are perceived. In other words, such a review changes the size, shape and location of the foundations upon which the maintenance enterprise is built. Clearly, when the foundations change, everything built on those foundations must also change.

The good news is that if the review of requirements - the work identification process - is carried out correctly, the foundations not only end up somewhere else, but they are usually much smaller than if requirements are determined by old fashioned seat-of-the-pants methods. Smaller foundations mean that the entire structure (resources and systems) built on those foundations will also be smaller.

Even better news is that the initial focus on functions makes the whole enterprise far, far more effective.

To summarize, the development and execution of maintenance strategy consists of three steps:

- formulate a maintenance strategy for each asset (work identification)
- acquire the resources needed to execute the strategy effectively (people, spares and tools)
- execute the strategy (acquire, deploy and operate the systems needed to manage the resources efficiently). In other words, as shown in Figure 1, build your foundations first, then your walls, then your roof.

Figure 1: Building a maintenance strategy
Building Strong Foundations

As every builder knows, the integrity of any structure depends first and foremost on the integrity of its foundations. So if we seek a maintenance enterprise that is robust enough to satisfy all the expectations of its customers, then:

- its foundations must always be the right size and shape, and in the right place
- the foundations must be sufficiently solid to bear all the loads placed upon them.

Building solid foundations means that the building project must be planned properly, the ground must be prepared correctly, the foundations must be properly designed, the right materials used and the foundations must be built by people with appropriate knowledge and skills.

Planning the project means that clear objectives must be established, resources allocated and a plan prepared. Preparing the ground means that everyone in the organization served by the maintenance enterprise must clearly understand what maintenance can and cannot achieve, and what they must do to help to achieve it. Designing the foundations and selecting the right materials means systematically defining the functions and required performance standards of each asset, deciding what failure modes are reasonably likely to cause it to fail, assessing the effects and consequences of each failure, and selecting a failure management policy that deals appropriately with the consequences.

Using appropriate people means that the exercise must be performed by groups of people who have a thorough understanding of each asset in its operating context, working under the guidance of someone who profoundly understands the process being used to assess the maintenance requirements and who has a long-term vested interest in the success of the project.

In the absence of any comparable asset management strategy formulation processes, the only really effective way to do all this at once for modern, complex industrial processes is to arrange for groups of appropriately trained operators, maintainers, supervisors and specialists who live with the asset on a day-to-day basis to apply Reliability-centred Maintenance (RCM) under the guidance of a suitably qualified facilitator.
Reliability Centred Maintenance is defined as 'a process used to determine what must be done to ensure that any physical asset continues to do whatever its users want it to do in its present operating context'. It entails asking seven questions about the asset under review, as follows:

- **what are the functions and associated performance standards of the asset in its present operating context?**
- **in what ways does it fail to fulfill its functions?**
- **what causes each functional failure?**
- **what happens when each failure occurs?**
- **in what way does each failure matter?**
- **what can be done to predict or prevent each failure?**
- **what if a suitable proactive task cannot be found?**

These questions are reviewed in the following paragraphs.

### Functions and Performance Standards

Part 2 of this paper mentioned that it is only when the functions of an asset have been defined that it becomes clear exactly what maintenance is trying to achieve, and also precisely what is meant by "failed".

For this reason, the first step in the RCM process is to define the functions of each asset in its operating context, together with the associated desired standards of performance. The users of the assets are usually in by far the best position to know exactly what contribution each asset makes to the physical and financial well being of the organization as a whole, so it is essential that they are involved in the RCM process from the outset.

### Functional Failures

The objectives of maintenance are defined by the functions and associated performance expectations of the asset. But how does maintenance achieve these objectives?

The only occurrence that is likely to stop any asset performing to the standard required by its users is some kind of failure. However, before we can apply a suitable blend of failure management tools, we need to identify what failures can occur. The RCM process does this at two levels:
firstly, by identifying what circumstances amount to a failed state
then by asking what events can cause the asset to get into a failed state.

In the world of RCM, failed states are known as **functional failures** because they occur when an asset is unable to fulfill a function to a standard of performance which is acceptable to the user. In addition to the total inability to function, this definition encompasses partial failures, where the asset still functions but at an unacceptable level of performance (including situations where the asset cannot sustain acceptable levels of quality or accuracy).

### 2.3.6 Failure Modes

Once each functional failure has been identified, the next step is to try to identify all the events, which are reasonably likely to cause each failed state. These events are known as **failure modes**. ‘Reasonably likely’ failure modes include those that have occurred on the same or similar equipment operating in the same context, failures that are currently being prevented by existing maintenance tasks, and failures that have not happened yet but that are considered to be real possibilities in the context in question.

Most traditional lists of failure modes incorporate failures caused by deterioration or normal wear and tear. However, the list should include failures caused by human errors (on the part of operators and maintainers) and design flaws, so that all reasonably likely causes of equipment failure can be identified and dealt with appropriately. It is also important to identify the cause of each failure in enough detail for it to be possible to identify a suitable failure management policy.

### 2.3.7 Failure Effects

The fourth step in the RCM process entails listing **failure effects**, which describe what happens when each failure mode occurs. These descriptions should include all the information needed to support the evaluation of the failure consequences, such as:

- what evidence (if any) that the failure has occurred
- in what ways (if any) it poses a threat to safety or the environment
- in what ways (if any) it affects production or operations
- what physical damage (if any) is caused by the failure
- what must be done to repair the failure.
2.3.8 Failure Consequences

A detailed analysis of an average industrial undertaking is likely to yield between three and ten thousand possible failure modes. As mentioned in Part 1 of this paper, each of these failures affects the organization in some way, but in each case, the consequences are different. The RCM process classifies failure consequences into four groups, as follows:

- **Hidden failure consequences**: Hidden failures have no direct impact, but they expose the organization to multiple failures with serious consequences.

- **Safety and environmental consequences**: A failure has safety consequences if it could hurt or kill someone. It has environmental consequences if it could breach a corporate, regional, national or international environmental standard.

- **Operational consequences**: A failure has operational consequences if it affects production (output, product quality, customer service or operating costs in addition to the direct cost of repair).

- **Non-operational consequences**: Evident failures that fall into this category affect neither safety nor operations, so they involve only the direct cost of repair.

The RCM process uses these categories as the basis of a strategic framework for maintenance decision-making. By forcing a structured review of the consequences of each failure mode in terms of the above categories, it focuses attention on the maintenance activities which have most effect on the performance of the organization, and diverts energy away from those that have little or no effect (or which may even be actively counterproductive). It also encourages users to think more broadly about different ways of managing failure, rather than to concentrate only on failure prevention.

2.3.9 Failure Management Policy Selection

Failure management policies fall into two categories:

- **proactive tasks**: these are tasks undertaken before a failure occurs, in order to prevent the item from getting into a failed state. As discussed below, RCM further subdivides these tasks into *scheduled restoration, scheduled discard* and *on-condition maintenance*.

- **default actions**: these deal with the failed state, and are chosen when it is not possible to identify an effective proactive task. Default actions include *failure-finding, redesign* and *run-to-failure*. 
Scheduled restoration and scheduled discard tasks

Scheduled restoration entails remanufacturing a component or overhauling an assembly at or before a specified age limit, regardless of its condition at the time. Similarly, scheduled discard entails discarding an item at or before a specified life limit, regardless of its condition at the time. Collectively, these two types of tasks are now generally known as preventive maintenance.

On-condition tasks

On-condition techniques rely on the fact that most failures give some warning of the fact that they are about to occur. These warnings are known as potential failures, and are defined as identifiable physical conditions that indicate that a functional failure is about to occur or is in the process of occurring.

On-condition tasks are used to detect potential failures so that action can be taken to reduce or eliminate the consequences that could occur if they were to degenerate into functional failures. This category of tasks includes all types of predictive maintenance, condition-based maintenance and condition monitoring.

Failure-finding

Failure-finding entails checking hidden functions to find out whether they have failed (as opposed to on-condition task, which entail checking if something is failing).

Redesign

Redesign entails making any one-time change to the built-in capability of a system. This includes changes to hardware, one-time changes to procedures and if necessary, training.

Non-scheduled maintenance

This default entails making no effort to anticipate or prevent failure modes to which it is applied, and so those failures are simply allowed to occur, then repaired. This default is also called run-to-failure.
The RCM Task Selection Process

The RCM process applies a highly structured consequence evaluation and policy selection algorithm to each failure mode. It incorporates precise and easily understood criteria for deciding which (if any) of the proactive tasks is technically feasible in any context, and if so for deciding how often and by whom the tasks should be done. It also incorporates criteria for deciding whether any task is worth doing, a decision that is governed by how well the candidate task deals with the consequences of the failure. Finally, if a proactive task cannot be found that is both technically feasible and worth doing, the algorithm leads users to the most suitable default action for dealing with the failure.

This approach means that proactive tasks are only specified for failures that really need them, which in turn leads to substantial reductions in routine workloads. In fact, if RCM is correctly applied to existing maintenance programs, it reduces the amount of routine work (in other words, tasks to be done on a cyclic basis) issued in each period, usually by 40% to 70%. On the other hand, if RCM is used to develop a new maintenance program, the resulting scheduled workload is much lower than if the program is developed by traditional methods. Less routine work also means that the remaining tasks are more likely to be done properly. This together with the elimination of counterproductive tasks leads to more effective maintenance.

2.3.11 Applying RCM

Correctly applied, RCM contributes to remarkable improvements in maintenance effectiveness, and often does so surprisingly quickly. However, as with any fundamental change management project, RCM only succeeds if proper attention is paid to thorough planning, how and by whom the analysis is performed, auditing and implementation. These issues are discussed in the following paragraphs

2.3.11.1 Planning

The successful application of RCM depends first and perhaps foremost on meticulous planning and preparation. The key elements of the planning process are as follows:

- Define the scope and boundaries of each project
Define and wherever possible quantify the objectives of each project (now state and desired end state)

Estimate the amount of time (number of meetings) needed to review the equipment in each area

Identify project manager and facilitator(s)
Identify participants (by title and by name)
Plan training for participants and facilitators
Plan date, time and location of each meeting
Plan management audits of RCM recommendations
Plan to implement the recommendations (maintenance tasks, design changes, changes to operating procedures)

2.3.11.2 **Review groups**

We have seen that the RCM process embodies seven basic questions. In practice, maintenance people simply cannot answer all these questions on their own. This is because many (if not most) of the answers can only be supplied by production or operations people. This applies especially to questions concerning functions, desired performance, failure effects and failure consequences.

For this reason, a review of the maintenance requirements of any asset should be done by small teams which include *at least* one person from the maintenance function and one from the operations function. The seniority of the group members is less important than the fact that they should have a thorough knowledge of the asset under review. Each group member should also have been trained in RCM. The make-up of a typical RCM review group is shown in Figure 2.

![Figure 2: A typical RCM review group](image)

---

55
The use of these groups not only enables management to gain access to the knowledge and expertise of each member of the group on a systematic basis, but the members themselves learn a great deal about how the asset works.

2.3.11.3 Facilitators

RCM review groups work under the guidance of highly trained specialists in RCM, known as facilitators. The facilitators are the most important people in the RCM review process. Their role is to ensure that:

- the RCM analysis is carried out at the right level, that system boundaries are clearly defined, that no important items are overlooked and that the results of the analysis are properly recorded
- RCM is correctly understood and applied by the group
- the group reaches consensus in a brisk and orderly fashion, while retaining their enthusiasm and commitment
- the analysis progresses as planned and finishes on time.

Facilitators also work with RCM project managers or sponsors to ensure that each analysis is properly planned and receives appropriate managerial and logistic support.

2.3.11.4 The outcomes of an RCM analysis

If it is applied in the manner suggested above, an RCM analysis results in three tangible outcomes, as follows:

- schedules to be done by the maintenance department
- revised operating procedures for the asset operators
- a list of areas where one-off changes must be made to the design of the asset or the way in which it is operated to deal with situations where the asset cannot deliver the desired performance in its current configuration.

A less tangible but very valuable outcome is that participants in the process tend to start functioning much better as multidisciplinary teams after their analyses are completed.
2.3.11.5 Auditing

After the review has been completed for each asset, senior managers with overall responsibility for the equipment must satisfy themselves that the review is sensible and defensible. This entails deciding whether they agree with the definition of functions and performance standards, the identification of failure modes and the description of failure effects, the assessment of failure consequences and the selection of tasks.

2.3.11.6 Implementation

Once the RCM review has been audited and approved, the final step is to implement the tasks, procedures and one-time changes. The revised tasks and procedures must be drawn up in a way which ensures that they will be clearly understood and performed safely by the people to whom they are allocated. The maintenance tasks are then fed into suitable high- and low-frequency maintenance planning and control systems, while revised operating procedures are incorporated into standard operating procedure manuals. Modifications are usually dealt with by the engineering function.

2.3.12 What Reliability Conditioned Maintenance achieves

The most important single contribution of the RCM process to industry is that if it is correctly applied, it provides a far more solid foundation for the maintenance enterprise than anything, which has been available hitherto. Key areas in which it contributes directly to maintenance effectiveness and efficiency are as follows:

* Greater safety and environmental integrity

RCM considers the safety and environmental implications of every failure mode before considering its effect on operations. This brings safety and the environment into the mainstream of maintenance decision-making

* Improved operating performance (output, product quality, customer service)

By concentrating on what physical assets do (their functions) rather than what they are, RCM enables users to identify much more clearly and precisely what must be done to achieve real and substantial long-term improvements in plant availability and reliability
Greater maintenance cost-effectiveness

RCM continually focuses attention on the maintenance activities, which have most effect on the performance of the plant. This helps to ensure that everything spent on maintenance is spent where it will do the most good.

Longer useful life of expensive items, due to a careful focus on the use of on-condition maintenance.

A comprehensive database

An RCM review ends with a comprehensive and fully documented record of the maintenance requirements of all the significant assets used by the organization. This makes it possible to adapt to changing circumstances without having to reconsider all maintenance policies from scratch. It also enables equipment users to demonstrate that their maintenance programs are built on rational foundations (the audit trail required by more and more regulators).

Greater motivation of individuals, especially people who are involved in the review process. This leads to greatly improved general understanding of the equipment in its operating context, together with wider ‘ownership’ of maintenance problems and their solutions. It also means that solutions are more likely to endure.

Better teamwork: RCM provides a common, easily understood technical language for everyone who has anything to do with maintenance. This gives maintenance and operations people a better understanding of what maintenance can (and cannot) achieve and what must be done to achieve it.

All of these issues are part of the mainstream of maintenance management, and many are already the target of improvement programs. A major feature of RCM is that it provides an effective step-by-step framework for tackling all of them at once, and for involving everyone who has anything to do with the equipment in the process.

In terms of our structural analogy, it is worth noting that many maintenance enterprises spend immense amounts of time, energy and money on maintenance management systems (roofs) and on tools such as condition monitoring (part of the walls), but spend little or nothing on clarifying perceptions about what must really be done to cause the assets to continue to do what their users want them to do (the foundations).

The result is elegant roofs and walls built over foundations that are the wrong shape, the wrong
size, in the wrong place and not nearly strong enough to support the loads imposed upon them. The end result is a maintenance enterprise that is not nearly as effective as it should be.

This is not to suggest that we don't need an MMS or condition monitoring. Of course we do, in the same way that (nearly) every building needs a roof and walls. However, the roofs and walls must fit their foundations, and the foundation must be able to support the rest of the structure.

In essence, the only way to develop a truly viable, long-term maintenance strategy is to invest appropriate amounts of time and energy in every element of the process. In particular, avoid the temptation to concentrate too soon or too heavily on maintenance techniques and systems without first ensuring that everyone shares a clear, common and correct understanding of what must be done to ensure that every asset continues to do what its users want it to do.

2.3.13 Responsible Custodianship

The first part of this paper proposed a maintenance mission statement. In doing so, it stressed that maintainers serve three distinct sets of customers: the owners of the assets, the users of the assets - usually the operators - and society as a whole. Owners are satisfied if their assets generate a satisfactory return on investment. Users are satisfied if each asset continues to do what they want it to do to standards of performance which they - the users - consider to be satisfactory. (In this context, satisfactory performance includes the notion that the risk of death or injury caused by equipment failure should be reduced to tolerable levels.) Finally, society is satisfied if the assets do not fail in ways which threaten the environment.

Because they are maintaining assets on behalf of all these people, it could be said that maintainers are the custodians of the assets.

In this context, parallels can be drawn between the custodianship of physical assets and the custodianship of financial assets.

In 1494, a Florentine named Pacioli invented double-entry bookkeeping, the process at the heart of financial custodianship. To this day, throughout all branches of organized human endeavour, armies of bookkeepers and accountants use Pacioli's ideas to look after financial assets on behalf of the people who actually own, earn and spend the money. In their world, responsible custodianship means ensuring that all financial transactions are accounted for and
the books balanced to the nearest penny at the end of every accounting period. The procedures and documentation needed to make this process work have become part of the way we are all obliged to do business, even though they are highly resource intensive and very expensive. Businesses the world over have learned that anything less precise quickly leads to financial chaos.

In the world of maintenance, our 'currency' is the failure mode. To exercise standards of custodianship similar to those of our financial brethren, we must ensure that every failure mode is properly 'accounted for'. This obliges us to exercise due diligence in trying to identify every failure mode that is reasonably likely to affect the functions of our assets, to understand the consequences of each failure mode, to select the most cost-effective failure management policies, to deploy the most appropriate human and physical resources to execute the chosen policies and to ensure that each task is planned and executed in the right way, at the right time and by the right people.

In the context of this analogy, compare what happens when things go wrong in the worlds of financial and physical asset management. The worst consequences of the irresponsible custodianship of financial assets are that a business may go bankrupt and its custodians end up in prison. However, the worst consequence of the incorrect or irresponsible custodianship of physical assets is that people die, sometimes in very large numbers.

In fact, the extent to which the physical and financial health of most organizations now depends on the continued physical and functional integrity of their assets means that the pressure upon maintainers to exercise this custodianship in the most responsible fashion possible is becoming extraordinarily intense. Not only is this pressure arising from the expectations of the 'customers' of the maintenance service, but also it is attracting the attention of regulators. Government bodies like OSHA, the FDA, the FAA and the EPA in the USA and the HSE in the UK, in addition to regional and municipal regulatory bodies, are not only demanding much greater precision and clarity in our asset management policies, but they are also asking us to be able to prove that what we are doing is sensible and defensible. The sanctions they apply if we are thought to have got it wrong are also becoming steadily more ferocious. For example, the British government has recently introduced a new class of crime called 'corporate manslaughter', to be applied to the senior executives of organizations where fatalities can be shown to be the result of irresponsible custodianship.
In this environment, maintainers need to raise their standards of custodianship to far higher levels than have ever been acceptable in the past. And yet, at this point in time, industry in general still spends much more energy on the high precision management of its financial assets than of its physical assets, despite the fact that the consequences of incorrect custodianship are often far worse in the case of the latter than in the case of the former.

This is partly because the processes used to manage financial assets have been under development since Pacioli's era. By comparison, the concept of planned maintenance has been in existence for less than 50 years, while Reliability-centred Maintenance was first codified in the Nowlan & Heap report barely 20 years ago. Terms like PdM (or CBM) and CMMS have only come into widespread use in the last 10 years. In short, industry is only just beginning to appreciate what must be done to exercise truly responsible custodianship of physical assets. We are decades away from establishing physical asset management processes that are as widely accepted and rigorously enforced as those in the world of financial management.

Under these circumstances, it is not surprising that a great deal of experimentation is still going on in the world of physical asset management. Some of this experimentation is leading to developments, which are of great value. In particular, think of the explosive growth in condition monitoring techniques, continuous advances in the CMMS field, rapidly growing understanding of the processes that cause systems to fail (including the part played by human error), and the formal incorporation of quantified risk into maintenance strategy formulation.

One area where we still have a great deal to learn is in the field of RCM. It has been extensively applied with great success by the aviation industry in particular, in addition to which the author and his associates have been involved in the application of RCM to physical assets on more than 1000 sites encompassing nearly every major field of organized human endeavour. As a result, the process is well established. However, despite the tremendous successes enjoyed by those who apply RCM correctly, industry in general is only just starting to come to grips with it.

One feature of this learning process is the number of attempts that are being made to 'streamline' the maintenance strategy formulation process. Most of these attempts are being made by well-intentioned people concentrating more on the cost of the strategy formulation process than on what it achieves. However, it is apparent to those who know RCM best that we all still need to learn much more about the intricate relationships between functions, failure
mechanisms, failure consequences and failure management policies than we currently know. What is more, as mentioned earlier, the consequences of formulating inappropriate strategies are horrendous. It is a situation that demands more rigor, not less, so too much emphasis on shortcuts right now is both dangerous and irresponsible.

In fact, nearly all of the 'streamlined' maintenance strategy formulation processes encountered by the author to date contain logical or procedural flaws that increase risk to an extent that overwhelms any small advantage they may offer in reduced application costs. Chief among these processes are (1) those that attempt to combine the three incompatible methodologies needed to set intervals for different types of periodic maintenance tasks into one all-embracing formula, (2) those that place too much emphasis on assessing the 'criticality' of assets or systems before a detailed FMEA has been performed, and (3) those that reverse or simply skip key steps in the RCM process.

Ironically, it also transpires that many of these 'streamlined' techniques actually take longer and cost more to apply than the rigorous application of RCM, so even this small advantage is lost.

So if we wish to be truly responsible custodians of our physical assets, we need to recognize that shortcuts simply have no place in the maintenance strategy formulation process in general, and in the application of RCM in particular.)

A further point about responsible custodianship concerns auditing. In most organizations, financial managers have to submit their custodianship to exhaustive, expensive – and mandatory – external scrutiny at least once a year. At present, the notion of regular external audits of physical asset management activities is still in its infancy. However, the concept of an 'audit trail' is featuring in more and more industrial safety legislation. Our regulators are asking us not only to do the right things, but also to be able to demonstrate in writing why we are doing them. The day is approaching when this will evolve into an audit process every bit as formalized and highly regulated as that to which our financial colleagues are subjected.

The depth, intrusiveness and cost of this audit process will be governed by how much our regulators accept the validity of the methods we use to exercise custodianship of our physical assets, and the rigour and precision with which they consider us to be applying them. In short, if the world of physical asset management wishes to maintain a reasonable degree of control over its own destiny, it must match if not exceed the standards of custodianship that are the norm in
the world of financial asset management. Right now, how many of us can honestly say that it does?
Chapter three: Research Methodology

3.0 Description of study area and population

Kenya Airways as the corporate business slogan goes is “The Pride Of Africa” as far as international and regional flights are concerned. It has unique network of capital resources, which are well intertwined for its effective corporate business transactions so far, considered within the world-class level. Among the key facilities which contribute immensely to its latest success are Industrial buildings – Hanger, Warehouses for loading and offloading its spare parts for aeroplanes and the consumable goods for its flights, Sales offices at Jomo Kenyatta international airport, Hub Offices, Infrastructural services – Electrical, Information technology (I.T), water services, roads and car parks, Mechanical services, and movables facilities such as furniture, carpets and other related office facilities.

3.1 Sample technique and sample size

The available population was defined according to departmental lines as distributed over building blocks. A sample was selected representing the salient characteristics of accessible population, aiming at least 15 percent (15%) of the accessible population. Sampling technique was through the use of departmental registers or lists to identify the number of offices per floor or building block catering for a given department as the sampling frame. Simple random sampling was then applied to derive a probability sampling. Random numbers were allocated to offices and the even numbered sampled offices, which formed the accessible population hence scaling down the sample by half. Data was collected from the six departments using the allocated equal number of questionnaires for each department, which were the units of analysis. Thereafter, the results of all the departments were generalized to the entire building blocks, that is Kenya Airways Head Office and Base in Nairobi.

3.2 Data Collection Procedure

The research was dedicated to tactical internet browsing /reading and review of materials available in secondary data services. The latest and past editions have captured the importance of building maintenance. Primary data was collected using questionnaire, while endeavoring to
remain unbiased the sample realized through the sampling procedure employed was used to
distribute the questionnaires, to the offices in the given department. In order to get effective
response from the users, the researcher personally administered the questionnaires to the
various offices identified while taking time to let the respondents fill them. Getting the feedback
was then done before proceeding to the next office in the sample. However, in some inevitable
circumstances where highly willing respondents run short of time, it would be collected at a later
convenient time. There have also been very rare cases of lack of respondent owing to hostility
or unwillingliness from users. The major objective of all this was to remain as close as possible
within the approximation of the random sample.

The researcher’s interview targeted the building maintenance staff and managements or other
person’s relevant staff. The objective of the exercise underlined on the queries regarding the
role of the building maintenance staff and their relevant awareness on rational implementation
process on arising demands from the users. It also touched on the type and the extend of
training they have undergone in the past.

3.3 Information technology data

Kenya Airways has invested heavily of late on information technology and this has contributed
immensely on extracting data on capital and recurrent expenditure incurred for at least last two
years. With the modern I.T network, it has been easy to down load details on building
maintenance requests from the users, cases attended/ not attended.

The internet/intranet facilities provided details on the Kenya Airways organization structure,
communication tools such emails, telephone and fax, various forms and to some extend other
relevant materials which have been very crucial for compiling this research particularly on
literature review. The network systems proved to be very crucial as far booking appointments for
interviews and submitting and collecting of questionnaire papers to the targeted group. A single
pressing on a cursor of a computer would link me with the targeted and articulate group for
provision of the deserved information details. Contacts of all the staff, their job designations and
to some extend photographs for physical identification has played a significant role all along on
extraction of information.

Capital and recurrent data entered in excel spread sheets have given relevant details on the
most recurring problems / constraints and the cost implications for the past two years on
projects undertaken up to July 2004. Two years duration has been considered by the researcher to be appropriate owing to reliability on the accuracy of the data since by then, Kenya Airways IT systems network was in place and most of the crucial information was entered accordingly in the computers.

3.4 Bulk fillers data

Corporate documents are supposed to be stored safely for at least five years prior to disposal exercise. Kenya Airways has therefore invested heavily on storage of such data preserved in hardware form. Every department has steel metal containers similar in size and make to ones used by transit trucks. These are properly mounted on hard precast concrete pad foundations and locked in appropriate means for safe storage of documents. All the containers are restricted in one central place a few metres from major office blocks such as block B and A. They are formulated to take two level floors, which are accessed with fabricated metal frame with convenient railings for safety. Only documents whose age exceeds at least one year and above are stored here. Documents store inside these bulk fillers are free from all weather related elements and can be accessed with ease. However, users have to walk a few metres to link them. Finance department followed by human resources has the lions share on the quantity of bulk fillers. Remarks from the Director for finance has that, there is future proposals to convert the current mode of information storage to microfilming which has a range of advantages over bulk filler.

3.5 Primary data

Most of crucial details have been obtained from properties and facilities and other relevant divisions and reflects budgets, number of employees, level of staff skills, amount of work performed against the requested/ the expected. Also reflected are the proposed budgets for capital/ recurrent projects against their respective approved ones, list/ number of proposed projects against approved and enforced ones for the last two years. All this and many other related data is clearly presented as is illustrated in the subsequent text.

3.6 Secondary data

Most of the required information data has been facilitated though well formulated questionnaires and interviews, which targeted the building maintenance team, the relevant users, and other crucial members of the construction industry in general. In order to articulate the obtained data
in a more comprehensible form such pie charts, bar charts, histograms and other similar modes of data presentation, the information has further undergone various tabulation as will later be illustrated in the text to follow.

3.6.1 Synthesizing of data

The major objective of further synthesis of data is to enhance a more data friendly details for ease of prompt assimilation of the conveyed message. For instance to measure professional skills of a carpenter, the researcher has obtained from the manager properties and faculties details indicating that, he shall be expected to be having: Kenyan Identity card, be form four leaver with at least Davison three, professional skills of at least technician craft three, working experience of at least three years with proven performance, computer literate, fluent in at least English and Kiswahili, be having a certificate of good conduct from the Kenya government, sane and physically fit. The information obtained from the questionnaire and primary data from the manager of human resources would be entered accordingly, compare this against the established bench marks and prorate accordingly to arrive to an appropriate of individual skills expressed in terms of percentage. The individual skills are then summed for all the carpenters and mean average obtained. The average percentage level is then used as weighing measure of the current professional skills of carpenters at Kenya Airways. This is then compared with the expected 100% skills and the respective analysis derived using this criteria. See the figure in the next page.

Table: 3.1 Kenya airways building maintenance establishment

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Number of maintenance staff</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In place (1)</td>
<td>Establishment (2)</td>
<td>(1/2)</td>
</tr>
<tr>
<td>1</td>
<td>Carpenters</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Electricians</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Masons</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Plumbers</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Painters</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Metal fabricators</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Maintenance Officer</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Property Administrator</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Manager</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: Own field study, July 2004
Observation made - facilities requiring outsourcing

There are several number of building facilities, which the researcher noticed, are among areas of major concern on recurrent expenditure namely Air conditioners, Automatic hand driers, lift, bore water pumps, electrical switch gear and generators. There a major outcry from the users that the level of performance manifested upon these items requires a lot to be desired. Even though Kenya Airways has invested heavily on this facilities (air conditioners, generators, water pumps and hand driers), the current approach on their servicing is below the acceptable level of performance as is illustrated on the table below.

3.7.1 Tools identified used for implementation process

Information extracted from the questionnaires indicates that building maintenance has various methods which they adopt on execution process namely: Service request form, Piece rate form, the local intranet, verbal requests, Purchase demand Indent (Pdi), Capital Expenditure request form, Stores issue voucher (SIV), telephone and fax.

Fig: 3.2 typical capital expenditure request form.

Source: Own field survey, 2004
3.7.1.1 Service request form

This is a form, which has been formulated for entering of information by the users demanding services to be rendered to them by the building maintenance team. The originator-user fills the particulars of the services such as what he/she wants to be done, where, urgency, at what cost center, date originated and his physical contact-telephone extension. His manager is supposed to check and get it stamped with respective rubber stamp justifying that, it is really originated and checked by the key parties.

Traditionally, the filled up form is supposed to be delivered to the manager properties who then delegates accordingly to the building maintenance officer for further action. The building maintenance officer is supposed to diagnose the request and advice accordingly to the trade's staff if it falls within their scope - (recurrent) or the manager if it falls within the capital budget. In most cases, the building maintenance officer would raise a Pdi and a capital request form after confirming with his manager that, it's really appropriate and necessary to enforce it.

The procedure for the raising of P.d.i and capital expenditure request for is similar to the service request form; however, more weight is focused on the budget. One is supposed to ensure, that service requested had been budgeted for, that budget is not exceeded and all other related documents such as the executive summary is documented detailing that, that there is really a demand for the service requested for.

3.7.1.2 Internet/Intranet

Requests done through e-mails have their shortcomings in the sense; the originators cannot sign the request copies in software form. Note that, as it will be illustrated in the data analyses, not all building maintenance staff is computer literate. The researcher noticed that, even though over 90% have computers, hardly 25% use either internet or intranet facilities provided for!

3.7.1.3 Fax/telephones

Users in outstations offices adopt fax and telephone for making their request. However, whereas fax is reliable for its accommodation of formal originating properties for evidence, telephone is not considered to be over 50% reliable. Even though telephone voice service is networked for retrieving messages, again there is high level of ignorance upon the users and the building maintenance to fully exploit the facility.
Chapter Four: Data Collection, Presentation And Analysis

4.0 Introduction

The research undertaking endeavored to investigate problems and constraints experienced by managers in building maintenance the case of the study being Kenya airways head office and base in Nairobi. The scope of data has focused primary and secondary details, which are subsequently analyzed accordingly to justify the hypothesis and assumptions all geared to address the objectives of this research.

4.1 Establishing of building maintenance team

The details of the number of the respective staff were obtained from the manager properties and facilities. The following is breakdown of his building maintenance team against the proposed establishment. see figure 4.0

Table: 4.1 Report of Kenya Airways building maintenance team

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Number of maintenance staff</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In place (Col. 1)</td>
<td>Establishment (Col. 2)</td>
<td>Col. 1 &amp; 2</td>
</tr>
<tr>
<td>1</td>
<td>Carpenters</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Electricians</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Masons</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Plumbers</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Painters</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Metal fabricators</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Maintenance Officer</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Property Administrator</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Manager</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: Own field survey, July 2004

From the above tables we establish that:

* There are three positions without the respective staff in place namely, the metal fabricator, the property administrator and that of the maintenance officer properties and facilities.

* The posts of the mason, plumber, painter and that of manager properties and facilities are understaffed by at least one staff each and this is likely to contribute negatively on the performance level of building maintenance team.
The fact that, the posts of property administrator and that of maintenance officer are currently vacant implies that the manager is overworked and this in one way or the other affects the performance level of his division as a whole.

In order to establish the earlier assumptions and the related hypothesis in the quantity & quality of staff against the level established by Kenya Airways management, the data above was further subjected to further tabulation and represented in Figure 4.1 below:

**Figure: 4.1 Report of Kenya Airways building maintenance team**

<table>
<thead>
<tr>
<th>Kenya Airways building maintenance establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Bar chart showing staff types and their percentages" /></td>
</tr>
</tbody>
</table>

Source: Own field survey, July 2004
The report indicates that there are three gaps existing within the organization chart of building maintenance team i.e. position of metal fabricator, Property administrator and that of Building maintenance officer. This is likely to contribute negatively on the following:

- The manager's performance level is likely to go down particularly on issues, which require a lot of documentation and physical pursuing. He is spending a lot of time dealing with his subordinate team rather than delegating to them either through the building maintenance officer or the property administrator.
- The quality and output of the building maintenance team is likely to go down, as they need the input of maintenance officer/administrator to diagnose the arising items prior to the execution process.

The data was further represented in percentage to illustrate further the image of the respective staff demand in the establishment. See the figure in the next page. In this case, 100% indicates full representation of the staff in the respective trade and 0% represents understaffing thus calling for respective staff to be recruited for effective performance. 50% implies that, there is deficit of the respective staff similar number to that currently present. Unless the current staff is overworked through say overtime, then, the established demand on services delivered cannot be fully met within the acceptable time. In actual fact, 0% and 50% represents constraints and problems already experienced owing to understaffing within the building maintenance team.
Table: 4.1 Report of Kenya Airways building maintenance team

<table>
<thead>
<tr>
<th>Carpenters</th>
<th>Electricians</th>
<th>Masons</th>
<th>Plumbers</th>
<th>Painters</th>
<th>Metal Fabricators</th>
<th>Building Maint Officer</th>
<th>Property Admin</th>
<th>Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: Own field survey, July 2004

4.3 Observation made - facilities requiring outsourcing

The researcher noted from the users and the state at which the following facilities were performing that, their level of performance was by far below the acceptable standards. He therefore collected the details and presented it in the table below in order to establish the causes of the problems and constraints on the ground. see table 4.2 below.

The facilities noted were among areas of major concern and most of their expenditure fell on recurrent expenditure. The noted facilities were Air conditioners, Automatic hand driers, lifts, bore water pumps, electrical switchgear and generators.
### Building maintenance facilities requiring Outsourcing services

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Quantity</th>
<th>Level of performance (%)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air conditioner</td>
<td>26</td>
<td>75</td>
<td>No service contract</td>
</tr>
<tr>
<td>2</td>
<td>Generators</td>
<td>6</td>
<td>85</td>
<td>Expired</td>
</tr>
<tr>
<td>3</td>
<td>Switch gear</td>
<td>1</td>
<td>95</td>
<td>Expired</td>
</tr>
<tr>
<td>4</td>
<td>Hand-driers</td>
<td>32</td>
<td>75</td>
<td>No service contract</td>
</tr>
<tr>
<td>5</td>
<td>Bore-hole water pump</td>
<td>2</td>
<td>90</td>
<td>Has expired</td>
</tr>
<tr>
<td>6</td>
<td>Lifts</td>
<td>2</td>
<td>75</td>
<td>Has expired</td>
</tr>
<tr>
<td>7</td>
<td>Photocopying machines</td>
<td>8</td>
<td>95</td>
<td>Service contract in place</td>
</tr>
</tbody>
</table>

Source: Own field survey, July 2004

The percentages have been derived after taking the data of number of days per month the respective facilities have been reported not performing owing to defect or faults. The data for at least per annum was taken total number of none performance expressed as a percentage of total number of days per annum and the resultants resulted were then transferred to the respective column in the above table. It was noted that the maintenance team doesn’t have the required skills to meet the demand arising from the above mechanical facilities. In order to explore further details on the table 4.1 above, the data was represented in a more detailed form to facilitate for a more appropriate analysis against the respective mechanical facilities. See figure 4.2.
Fig: 4.2 Building facilities requiring outsourcing services

Source: Own field survey, 2004

Analysis

The following information was established from the analysis in the figure 4.2 below:

- The photocopiers with 96% reflect the best performance
- Hand driers manifest the least performance with 70%.
- The hand driers are the majority facilities and they portray the least level of performance.
- Facilities whose maintenance services have been outsourced portray better performance level e.g. photocopiers as compared to those without e.g. hand driers.
Establishing level of performance level

In order to determine the level of performance manifested by the building maintenance team, data were obtained from the IT network – through the centralized database. The tasks were properly entered in a chronological order, and the descriptions of the type of work were also entered against the technician handling and the duration on the proposed starting and completion date. The actual completion date was also entered which was now used by the researcher to determine performance effectiveness of the building maintenance team. The data in the table below illustrates what the researcher extracted from the common file in the computer, used by the maintenance team to enter all maintenance details. Note that, rather than the technicians entering details themselves, they were using either the secretary of their manager or the third party!

Table: 4.3 Report on work requested, performed & Performed/requested

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
<th>Requested</th>
<th>Performed</th>
<th>Performed/Requested</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001/2002</td>
<td>Job requests</td>
<td>1200</td>
<td>900</td>
<td>0.75</td>
</tr>
<tr>
<td>2002/2003</td>
<td>Job requests</td>
<td>1320</td>
<td>1056</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Source: Own field survey, July 2004

From the table 4.3 we establish the following:

- The output of the building maintenance team was 75% below the expected level by the year 2001/2002 and 80% the year 2002/2003.
- The job requests the year 2002/2003 were 120 more than in the year 2001/2002.
- The figure 4.3 below presents the information in a more detailed form.
Fig. 4.3 Report on work requested, performed & Not performed

![Bar chart showing work requests, performed, and not performed from 2001 to 2002 and 2003 to 2004.]

Source: Own field survey, July 2004

4.5 **Kenya Airways building maintenance staff establishment**

The respective details were obtained as from the manager human resources and confirmed against the manager properties and facilities for a more reliable data. The details were further entered in table 4.4 below for further analysis on Kenya Airways building maintenance staff establishment.
Table: 4.4 Report of Kenya Airways building maintenance staff establishment

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Number of maintenance staff</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>In place (1)</td>
<td>Establishment (2)</td>
</tr>
<tr>
<td>1</td>
<td>Carpenters</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Electricians</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Masons</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Plumbers</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Painters</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Metal fabricators</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Maintenance Officer</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Property Administrator</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Manager</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: Own field survey, July 2004

The report indicates that there are two gaps existing within the organization chart of building maintenance team i.e. position of Property administrator and that of Building maintenance officer. This is likely to contribute negatively on the following:

- The manager's performance is likely to go down particularly on issues, which require a lot of documentation and physical pursuing. He is spending a lot of time dealing with his subordinate team rather than delegating to either building maintenance officer or the property administrator.
- The quality and output of the building maintenance team is likely to go down, as they need the input of maintenance officer/administrator to diagnose the arising items prior to the execution process.
- 0% indicated against the property administrator, metal fabricator and the building maintenance officer implies that, there are already constraints experienced on implementation process and therefore in order to achieve the acceptable level of performance, the managements needs to recruit new staff to fill those gaps.

Since building maintenance officer and the property administrator are the ones who assist the manager on implementation process, their absence implies that, the manager is overworked on subordinate issues and may contribute to overall performance level to the entire division.
4.6 Academic and professional background

Details on academic and professional background were obtained through the manager of human resources. In order to determine the earlier hypothesis on the constraints and problems experienced on the implementation process, details on above factors were compiled and represented on the table below. These factors were considered to be integral tools for serving of users as earlier mentioned in chapter three under tools for implementation process.

Column three shows the % of number of respective staff who has achieved academic level of form three with at least division three and above. Column four shows the % of skills in computer knowledge among the respective building maintenance staff. The researcher obtained this
details through direct interview with the respective staff by focusing on their understanding of computer software, hardware, application tools related to computer skills related to their day today application in their field earlier mentioned in chapter three such as - emails, entering data on spreadsheets which the maintenance use as a common file through the data base systems facilitated by the centralized server, usage of Microsoft word for typing data or writing maintenance job requests. An appropriate % of skills was entered per individual staff per category and an average results established which were later transferred to the table below for further analysis.

Table: 4.5

Kenya Airways

Building maintenance staff report on academic/professional establishment

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>&lt; Or =Form four div. III</th>
<th>Computer literate</th>
<th>Field experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Carpenters</td>
<td>33</td>
<td>25</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>Electricians</td>
<td>50</td>
<td>45</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>Masons</td>
<td>0</td>
<td>25</td>
<td>85</td>
</tr>
<tr>
<td>4</td>
<td>Plumbers</td>
<td>100</td>
<td>25</td>
<td>90</td>
</tr>
<tr>
<td>5</td>
<td>Painters</td>
<td>0</td>
<td>20</td>
<td>65</td>
</tr>
<tr>
<td>6</td>
<td>Metal fabricators</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Maintenance Officer</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>Property Administrator</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>Manager</td>
<td>100</td>
<td>98</td>
<td>95</td>
</tr>
</tbody>
</table>

Source: Own field survey, July 2004
4.6 Kenya Airways building maintenance staff academic, professional & field experience

From the above figure, it is established that:

- The manager properties and facilities has the highest qualifications in all categories backgrounds namely academic, computer and field experience.
- Even though the plumber has good qualifications on the field experience and academic backgrounds, he is among the staff with least computer skills.
- Even though the mason has good field experience but subsequently, he doesn't have the academic background nor computer skills already established by Kenya Airways as he has (0 & 25) % respectively rather than at least 50%.

Source: Own field survey, July 2004

4.6.1 Data analysis;
The carpenters have good field experience (75%) but subsequently, they neither have the computer nor the academic background required as they have (33 & 25) % respectively against 50%.

The painter has the least experience and to make the matter worse doesn’t have either the academic or the computer skills required.

### 4.7 Capital Budget expenditure

For any sound building maintenance implementation process in any organization set up, it augh to be backed by a sound budget backed by an appropriate managerial factors such as good control, planning, organization, supervision and coordination.

In order to establish if there is any problems and constraints emanating from the capital expenditure process, the respective details were obtained from the budget expenditure files of properties and facilities manager. The researcher noted that, they were well-kept and easy to access by any literate party. He further got the actual expenditure details from the I.T computer common file where all entries on expenditure are entered against the respective project and the summed up accordingly. These details were then transferred into table below for further analysis. see the figure in the next page.

#### Table: 4.6 Report on Kenya Airways building maintenance capital expenditure

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
<th>Amount Proposed (KShs.)</th>
<th>Amount Approved (Kshs.)</th>
<th>Deficit (KShs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001/2002</td>
<td>Capital budget</td>
<td>1,200,000,000.00</td>
<td>720,000,000.00</td>
<td>480,000,000.00</td>
</tr>
<tr>
<td>2002/2003</td>
<td>Capital budget</td>
<td>1,200,000,000.00</td>
<td>750,000,000.00</td>
<td>450,000,000.00</td>
</tr>
</tbody>
</table>

Source: Own field survey, July 2004

From the table above, we deduce that:
the amount approved for the capital budget expenditure for the two financial year 2002/2002 and 2002/2003 is almost half that was proposed. This is likely to influence negatively on level of performance due to the deficit created.

If the amount on the proposed budget is derived from list of the proposed projects and their respective amounts, then for effective performance, projects should be executed on structural /priority basis.

**Fig:4.7 Capital budget 2001/2002, 2002/2003**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deficit (KShs)</td>
<td>480,000,000.00</td>
<td>340,000,000.00</td>
</tr>
<tr>
<td>Amount Approved (KShs)</td>
<td>720,000,000.00</td>
<td>840,000,000.00</td>
</tr>
<tr>
<td>Amount Proposed (KShs)</td>
<td>1,200,000,000.00</td>
<td>1,200,000,000.00</td>
</tr>
</tbody>
</table>

Source: Own field survey, July 2004
Table: 4.7 Report on Kenya airways building maintenance capita expenditure

Kenya Airways Head office and base in Nairobi
Capital Budget allocation/Expenditure

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
<th>Amount Proposed Kshs</th>
<th>Amount Approved Kshs</th>
<th>Amount spend Kshs</th>
<th>Deficit (KShs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001/2002</td>
<td>Capital budget</td>
<td>1,200,000,000.00</td>
<td>720,000,000.00</td>
<td>540,000,000.00</td>
<td>480,000,000.00</td>
</tr>
<tr>
<td>2002/2003</td>
<td>Capital budget</td>
<td>1,200,000,000.00</td>
<td>750,000,000.00</td>
<td>600,000,000.00</td>
<td>450,000,000.00</td>
</tr>
</tbody>
</table>

Source: Own field survey, July 2004

Data analysis

From the figure 4.8 below, we establish that, even though the amount approved for the 2001/2002 and 2002/2003 had deficits reflected, still the actual amount spend was still low thus reflection low level of performance generally.

Source: Own field survey, July 2004
was established from the manager that the long process on documentation, the big number of
the directors responsible for approval are the major causes of little progress on expenditure on
capital projects. Also the mode of procurement currently is time consuming.
Testing the hypothesis & establishing the assumptions

**Hypothesis 1:** There is direct relationship between sound implementation process enforced by maintenance manager against his maintenance team and quality/quantity of service delivered to users. The results indicated that, following the existing gap between the manager and his trade's staff, which is created by vacant positions of both the deliver property administrator and the maintenance officer, the manager is too constrained to effectively. Users requested needs to be carefully diagnosed prior to execution process, which is not the case as the manager cannot be jack-of-all-trades. This leads to low performance level both in quality and quantity.

**Hypothesis 2:** Training of the staff influences the awareness on the proper and sound maintenance services delivered. It was established that all the building maintenance staff are not computer literate, only one electrician, one carpenter and the manager have education background of form four and above while the rest are primary level material. The low qualification level in this two criteria has affected the execution process as already noted that they cannot read and send e-mails to respective users, they cannot building maintenance data in IT spread sheets which the manager has created for delegation and cost control purposes. Even though all the building maintenance team has the required field exposure, but subsequently, their weaknesses in computer and academic backgrounds is actually a major set back which is creating significant constraints and problems on their general performance.

**Hypothesis 3:** There is direct relation between the level of decentralization of authority among the hierarchy of power and the performance level of the maintenance team. It has been noted that even though the amount approved in the capital budget for the two consecutive years was below the proposed amounts, still the amount actually spend was surprisingly low. The manager noted that has been caused by the bureaucratic procedures on the approval as is reflected by the long approval procedures on documentation process on capital projects. See the capital expenditure form fig.1.14. It takes a lot of time to register any significant progress on the ground.

**Hypothesis 4:** The building maintenance organization structure is not sound enough to deliver effectively. It was established that there are already gaps created by vacant positions of posts of maintenance officer and that of property administrator and this weakens implementation process and resulting to low performance level of the entire team. Also noted was that, the
The number of staff is not matching with that established and this implies that, the current team cannot cope with service demand unless they outsource certain services.
5.0 Summary

The researcher undertook to investigate problems and constraints experienced by managers in building maintenance the case of study being Kenya Airways Head Office and base in Nairobi. The Objectives being to establish the quantity and quality of maintenance staff work demanded, to establish budget allocation for building maintenance works per annum, to relate the cost of quantity/ quality demanded, to establish the actual cases reported and their respective costs, to establish the actual number and the respective skills of staff in employment, to establish the adequacy/ inadequacy of staff and skills and to measure the actual performance with respect to expected performance.

The data was obtained though questionnaires, interviews, direct observations, browsing internet websites, reading journals, newspapers, relevant text books, respective Kenya Airways files both soft and hard wares and practical personal opinions based on extensive field exposure obtained over a period of over ten years.

The research established the following:

- The current Kenya Airways building maintenance organization set up is understaffed and thus cannot meet its day-to-day service obligations effectively.
- The building maintenance staff has inadequate technical, academic and computer skills required to match with the expected level of performance. There is need therefore to upgrade them especially on computer relevant programmes such as excels spreadsheets, MS- word and Ms Outlook. This will enhance on prompt linkage measures with the users accelerate the implementation process in general.
- There is lagging phase on approval of documents which contributes negatively on the overall performance of the building maintenance team.
- The researcher had an ultimate spirit of achieving positive results which can reinforce today’s building management managers and other related parties in the industry on articulation of customer services and operations through understanding the needs of clients, effective communication, focusing on customers accordingly/ timely, exercising courtesy/ credibility, responsiveness and creation of customer hotlines and creation of customer satisfaction surveys.
5.1 **Limitations**

Time was limited throughout for exhaustive data collection and observation. There have been few cases met with minor constraints created by hostile respondents and the researcher treated with suspicion by some individuals due to the fact that this research coincided with the restructuring process at Kenya Airways. Notice of downsizing of the staff was spreading like fire in a plain dry grass in windy day!

5.2 **Conclusion**

Good building management call for total quality in the process-monitoring stem namely: resource allocation, operational sequence, progress control, performance standard, proper records and regular reports.

5.3 **Recommendations**

1. Adopting sound maintenance process namely:
2. Sound information gathering at all level by building maintenance team
3. Building condition survey and diagnosis
4. Enforcement of latent defects, warranties etc.
5. Discussing with user/ clients
6. Priority setting on arising items
7. Initiating maintenance planning measures
8. Administrative actions.
9. Training the staff accordingly on relevant fields periodically (upgrading)
10. Examining procurement methods & contract procedures
11. Upgrading building maintenance staff on communication modes
12. Be aware & exercise maintenance audits
13. Adopt feedback mechanisms - continuous inventory measures on all relevant facilities
5.4 **Areas of further research**

1) Efficiency of the organizational structure with respect to building maintenance
2) Determination of skill and training needs of technical staff.
3) Evaluation of budget basis for maintenance implantation.
4) Establishment of quality standards of maintenance services
## References

### Written texts

<table>
<thead>
<tr>
<th>Name of Author</th>
<th>Year of Publication</th>
<th>Title</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abel G. Mugenda</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Michael Rundell</td>
<td>2002</td>
<td>The Macmillan English Dictionary</td>
<td>Bloomsbury Publishing Plc</td>
</tr>
<tr>
<td>PL Onalo</td>
<td>1986</td>
<td>Land law</td>
<td>Kenya literature</td>
</tr>
<tr>
<td>Tudor Jackson</td>
<td>1988</td>
<td>The Law of Kenya</td>
<td>Bureau, Nairobi</td>
</tr>
<tr>
<td>R. Chudley</td>
<td>1988</td>
<td>Building Finishes, Fittings &amp; Domestic Services</td>
<td>Longman Group Ltd.</td>
</tr>
<tr>
<td>1998,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Santosh Kumar</td>
<td>1977</td>
<td>Water Supply Engineering</td>
<td>Khanna Publishers</td>
</tr>
<tr>
<td>Author</td>
<td>Year(s)</td>
<td>Title</td>
<td>Publisher/Location</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>M. Chacrabort</td>
<td>1990</td>
<td>Estimating, Costing, Specification &amp; valuation in civil Engineering</td>
<td>Author, 2113 Bhabananda Road Calcutta</td>
</tr>
<tr>
<td>V.N Vazirani &amp; SP Chandola</td>
<td>1979</td>
<td>Civil engineering hand book</td>
<td>Khanna Publishers</td>
</tr>
<tr>
<td>R.C Smith</td>
<td>1986</td>
<td>Estimating &amp; Tendering for building Works</td>
<td>Longman</td>
</tr>
<tr>
<td>Peter Burberry</td>
<td>1970, 1972</td>
<td>Environment &amp; Services</td>
<td>Longman</td>
</tr>
<tr>
<td>Raymond</td>
<td>1983 &amp;</td>
<td>Construction Equipment &amp; its management</td>
<td>Longman</td>
</tr>
<tr>
<td>Herrington</td>
<td>1990</td>
<td>Construction Project Administration Practice</td>
<td>Longman</td>
</tr>
<tr>
<td>Allan Ashworth</td>
<td>1988, 1984, 1999</td>
<td>Construction Project Administration Practice</td>
<td>Longman</td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
<td>----------------------------------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>The Architectural Association of Kenya (AAK)</td>
<td>1999</td>
<td>Agreement And Conditions of Contract for Building works</td>
<td>The joint Building Counci, Kenya</td>
</tr>
<tr>
<td>Institute Of Quantity Surveyors</td>
<td></td>
<td>January – March 2004</td>
<td>Tumaini Agencies Ltd.</td>
</tr>
<tr>
<td>Institute Of Quantity Surveyors</td>
<td></td>
<td>Feb 2004</td>
<td>Tumaini Agencies Ltd.</td>
</tr>
<tr>
<td>No.</td>
<td>Author</td>
<td>Year</td>
<td>Title</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------</td>
<td>------</td>
<td>--------------------------------------------------------------</td>
</tr>
<tr>
<td>53</td>
<td>Alman, M.</td>
<td>1989</td>
<td>Barriers to quality in the South African building industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Cornick, T.</td>
<td>1991</td>
<td>Quality Management for Building Design.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Guildford, Surrey</td>
</tr>
<tr>
<td>56</td>
<td>Crosby, P.B.</td>
<td>1984</td>
<td>Quality without tears The art of hassle free management, New York</td>
</tr>
<tr>
<td>58</td>
<td>Lam, S.W., Low, C.M. / Teng, W.A.</td>
<td>1994</td>
<td>ISO 9000 in Construction, Singapore: Building Failures: Diagnosis and Avoidance</td>
</tr>
<tr>
<td>59</td>
<td>Ransom, W.H.</td>
<td>1981</td>
<td>Building Failures: Diagnosis and Avoidance</td>
</tr>
<tr>
<td>62</td>
<td>Nowlan Fs &amp; Heap</td>
<td>1978</td>
<td>Reliability-centred Maintenance</td>
</tr>
<tr>
<td>63</td>
<td>Netherton D:</td>
<td>2000*</td>
<td>SAE's New Standard for RCM&quot;. Maintenance (UK Streamlined RCM in the Nuclear Industry&quot;. Maintenance (UK</td>
</tr>
<tr>
<td>64</td>
<td>Jacobs KS</td>
<td>1997</td>
<td></td>
</tr>
</tbody>
</table>

*Note: The year 2000 is marked with an asterisk to indicate the possibility of a typo or error in the data.*
Mundy S D: 2000 Completing the Reliability Centered Maintenance Loop at a New Process Facility. Reliability (USA)

Dixey M & Gallimore J 2000 Getting Results from RCM. Maintenance (UK)
Business Plan to manage building maintenance projects
Writing a Business Plan to Business Plan to manage building maintenance projects. ... Business Plan to manage building maintenance projects. ...
www.hjventures.com/business-plan-to/ manage-building-maintenance-projects.html - 14k - Cached - Similar pages

Cycling Tips, Projects: Building, maintenance, racing, repair ...
Cycling Tips, Tutorials, DIY Projects Building, Maintenance, Racing, Repair, Safety Handcycling, Recumbents, Unicycling, Mountain Biking. ... ...
www.knowledgehound.com/topics/cycling.htm - 20k - 1 Aug 2004 - Cached - Similar pages

Classification & Pay
... 5. Prepares and submits financial data on building maintenance projects and needs to be used to plan budget, for cost records, accounting information and in ...
www.state.sd.us/bop/Classification/ClassSpecs/80242.htm - 28k - Cached - Similar pages

Classification & Pay
... Senior Building Maintenance Workers are assigned technical tasks, projects, or a specialty area requiring the incumbent to determine how to do the job, acquire ...
www.state.sd.us/bop/Classification/ClassSpecs/80213.htm - 30k - Cached - Similar pages

UT Board to Consider Building, Maintenance Projects
FOR IMMEDIATE USE FROM UT NEWS CENTER (423-974-2225) JB Oct. 21, 1998. UT Board to Consider Building, Maintenance Projects (450). KNOXVILLE, Tenn. ...
pr.tennessee.edu/news/oct98/utconst.htm - 5k - Cached - Similar pages

Building Maintenance and Construction
... and renovation, roofing, machine/welding, signage and masonry projects. ... Charles Perry, Director for Building Maintenance and Construction Phone: 742-3303 ...
www.physicalplant.ttu.edu/BMC/index.asp - 23k - Cached - Similar pages

JOB SPEC - BUILDING MAINTENANCE SUPERVISOR, JOB CODE 74850
... preliminary time and material cost estimates on proposed projects.; Monitors building maintenance projects to ensure timeliness, correctness, and completion.; ... 
phoenix.gov/JOBSPECS/74850.html - 12k - Cached - Similar pages
JOB CLASSIFICATIONS/SALARY SCHEDULE

... materials. Ability to: Plan, conduct and perform building maintenance projects. Prepare reports, records and budget information. ...
agency.gov/governmentjobs.com/eugene/
default.cfm?action=viewclassspec&ClassSpecID=19664&Agency=658&am... - 20k - 1 Aug 2004 - Cached - Similar pages

Building Maintenance

... Below are some of Building Maintenance Services favorite features. ... Document Linking
Instant linking of tasks to jobs, estimates, projects, customers, employees ...
www.insightdirect.com/ind_8.html - 65k - Cached - Similar pages

Cultural Resource Management:

Maintenance Planning and Management ...

... maintenance objectives and constraints; organizing and specifying maintenance ... maintenance strategies for site, terrain, building envelope, environmental ...
www.uvcs.uvic.ca/crmp/courses/ha489e-main.cfm - 15k - 1 Aug 2004 - Cached - Similar pages

Constraints affecting the development of the water supply and ...

... as compared to new construction are all constraints. ... to the costs of operation and maintenance and to ... The contracts awarded for building even small rural water ...
www.who.int/docstore/water_sanitation_health/wss/constraints.html - 21k - Cached - Similar pages

CBD-212. Buildings and Life-Cycle Costing

... operating and maintenance costs over the economic life of the ... of rehabilitating the existing building vis-à ... maximum savings, given certain constraints of budget ...
www.nrc.ca/irc/cbd/cbd212e.html - 25k - 1 Aug 2004 - Cached - Similar pages

Transportation Problem / Solutions

... MC10 - Maintenance and Construction Activity Coordination. ... Conventional Environmental constraints; High cost of construction; Land use and community resistance ...
www.iteris.com/itsarch/html/mp/problemsolutions_b.htm - 45k - Cached - Similar pages

Public Schools Funding Issues

File Format: PDF/Adobe Acrobat - View as HTML
- An Executive Summary of Assessing the Impact of Fiscal Constraints and Revenue Caps on ... Page 3. BUILDING MAINTENANCE Most Wisconsin schools are over 30 years old ...
www.wisconsinsfuture.org/pdfs/schandmon.pdf - Similar pages
Assessing the Impact of Fiscal Constraints and Revenue Caps...

Over 50% of schools have delayed purchase of needed equipment and 43% said financial constraints will prevent them from Building Maintenance and Construction.


Housing constraints

constraints consist of land use controls, building codes, fees ... of potential and actual non-governmental constraints upon the maintenance, improvement, or...

ci.carson.ca.us/CityDepartments/DevServ/GenPlan/6-housing_constraints.htm - 101k - Cached - Similar pages

Lighting.com - Professional Lighting: Retail Design Flourishes...

Retail Design Flourishes Despite Constraints ... and -at the same time-meets expectations for energy efficiency, code compliance and maintenance considerations...

www.lighting.com/content.cfm?id=261&sid=17&page=/ - 23k - Cached - Similar pages

PDF] DOE-STD-1067; DOE Standard Guideline to Good Practices for...

File Format: PDF/Adobe Acrobat - View as HTML

... schedules to sustain critical areas, buildings, and individual items ... staging of materials) security constraints - item integrity maintenance c) Temporary...

tis.eh.doe.gov/techstds/standard/std1067/std1067.pdf - Similar pages

Toolkit

... Methodological constraints, Build up progressive experience on PPPs from maintenance contracts to concessions. Use technical assistance...

ru.worldbank.org/Documents/Toolkits/Highways/1_overdiag/12/1221.htm - 18k - Cached - Similar pages
Appendix 1

Letter Of Transmittal

Dear Sir/ Madam

I am an undergraduate student at the University of Nairobi, undertaking a research project on "The problems and Constraints experienced by Building Maintenance managers" – case study of Kenya Airways Head Office and Base. The target being to identify areas, ways and means of promoting prompt delivery of acceptable level of performance, which conforms to "Users" requirements timely and precisely. This is in partial fulfillment of the requirements for the award of a Bachelor of Arts degree in Building Economics and management. Your built up environment has been identified and selected to be included in the study. I therefore request for your assistance by filling the attached questionnaire.

The information given will be for the purpose of research only ad shall be treated confidentially even as the identity of the respondents remains anonymous. The completed questionnaire is to be returned within or on a date two weeks from the date of issuance of the same.

Thanks.

Yours faithfully,

Mativo J.M

(B.A Building Economics and Management Student)
Appendix II

Questionnaire

The questions are grouped according to five areas pertaining to problems and constraints experienced by managers in building maintenance management namely:

1) The Organization structure of the building maintenance team
2) Execution process among the maintenance team
3) Categories of maintenance services rendered
4) Communication mode
5) Bureaucratic process
6) Training of the maintenance team & communication generally
7) Priority or urgent areas

1) The Organization structure of the building maintenance team

a) What is your job designation?
   Administrator □  Staff □

b) How long have you served in the Airline?
   1-3 years □  4-6 years □  7-10 years

c) Are you satisfied with performance level of your building team?
   Yes □  No □
   If no, why?

   ........................................................................................................................................
   ........................................................................................................................................
   ........................................................................................................................................

   d)

e) Do you have adequate team to deliver?
   Yes □  No □
   If no, why?

   ........................................................................................................................................
   ........................................................................................................................................
   ........................................................................................................................................

   f) To what level is authority decentralized within the Kenya Airways?
2) Execution process among the maintenance team

a) How do you delegate tasks?

b) How do you monitor the work progress?

c) Do you think the level of performance of your maintenance team is world class?
   Yes □  No □
   If no, why?

c) Do you experience problems / constraints in your line of execution?
   Yes □  No □
   If yes, what nature are they?

Commend on the remedy measures, which can be adopted to arrest the situation. Within the capacity/ capability of Kenya Airways.
f) Are the building maintenance requests services equal in terms of urgency?
Yes □ No □
If no, why?

3) Categories of maintenance services rendered

a) List down the nature of building maintenance services rendered.

b) Which are priority areas?

c) What monitoring tools are employed to regulate:
Quality of performance?

Completion time?

Payments?

Harmonization of end results against cost incurred?

4) Communication Mode

a) List down how you delegate tasks?

b) Is the approach most appropriate?
   Yes □  No □
   If no, why?

   *

c) How does the users raise request to your team for attendance? List down
d) Is it most appropriate?
Yes □ No □
If no, why?

---

d) Are there problems / constraints experienced on communication line upon your Maintenance team and the users?
Yes □ No □
If no, why?

---

1) **Bureaucratic process**

a) Is there constraints / problems experienced on the current master organization on the following parameters:

---

Procurement of good/services?
Yes □ No □
If yes, what are the causes? List them below.

---

---

---
ii) Commend on the possible remedy measures

(iii) Approval of documents for implementation process?

Yes ☐ No ☐

If yes, at what levels and what are the causes? List them below.

(iv) At implementation process

Yes ☐ No ☐

If yes, at what levels and what are the causes? List them below.

2) Training of the maintenance team
   a) List down your academic background

   b) List down your professional background.

   c) Since you joined Kenya Airways, how many times have you received further training?
d) List your objectives in your line of duty?

 .................................................................
 .................................................................

3) **Priority or urgent areas**
List the most critical areas for service delivery and the reason why

 .................................................................
 .................................................................
 .................................................................
 .................................................................
Appendix III

Observation Checklist

1. **Industrial Buildings**
   - Hanger details Existing
   - Hanger Under construction

2. **Warehouses**
   - Block A & B Refurbishment
   - Internal & External refurbishment works
   - Ware houses (Block H) roof refurbishment
   - Ditto Block D – commercial stores
   - Ditto inside details

3. **Sales Offices**

4. **Hub Offices**

5. **Infrastructural services**
   a. **Fire suppression**
      - Water hydrants
      - Sprinkler
      - Foam & water mixed
      - Portables – Carbon
      - Energen – Clean expensive (clean agent)
      - Hosieries
      - Oscillating monitors
   
   b. **Water Services**
      - Main Water storage tanks –100 cubic litres (Underground)
      - Medium Water storage tank approximately 11.9 cubic metres
- Standard individual block storage tanks
- General Plumbing & reticulation systems

c. **External Works**
- Roads & Car parks
- Service water drains
- Landscaping
- Foul sewer drains
- Pedestrian paths

d. **I.T services**

Structured cabling
Trunking

e. **Electrical services**
- Generators
- Main switch gears
- Lighting fittings
- Electrical accessories
- Lifts
- Electrical accessories

f. **Mechanical Ventilation**
- Air conditioners

g. **Communication Facilities**
- Aerial Masts
- PBAX machines

6. **Movable fittings**
- Furniture
- Carpets
- Blinds
- Curtains
Appendix IV

Interview Schedule

The respondents are hereby reassured of the confidentiality of the information given as their identities remain anonymous

Finance/ Human Resources/ Office Departments

- How do you go about recruiting building maintenance staff?
- Do you have mechanism of monitoring the overall performance of the recruited maintenance staff?
- What remedy measures have you put in place on terms and conditions of handling emergency requests enforced by building maintenance tasks?
- Are they given any specific training on issues of building maintenance for instance, how to evaluate the necessity of the requested work, most appropriate procedure to adopt, specifications pertaining to materials to be adopted and general workmanship standards?
- If yes, do you test their performance from time to time?
- Are there any permanent workshops for respective trades technicians handling building maintenance projects?
- If yes, what kind of plants and equipments facilities have been put in place for implementation process?
- Do you budget for capital and recurrent building maintenance demands?
- If yes, how do you go about it?
- How do you monitor payment process?
- What are the major constraints in your execution implementation process?
- What do you think/ consider can be done to clear constraints?
- What would you think/consider missing that would enhance the performance of your duties?
A REVIEW OF FACTORS AFFECTING BUILDING DEFECTS IN SINGAPORE

Po Seng Kian
Lecturer, Department of Civil Engineering, Faculty of Civil Engineering and Planning
Petra Christian University

ABSTRACT

In developing countries, building maintenance technology is currently vastly underrated and ignored by owners, managers, and professionals. The building and construction authority of Singapore (BCA) has identified that the complaints about building defects have gone up in recent years with common problems such as leaky roof and walls, floor defect, and improper outlet pipe. This paper presents a brief description on building defect in use for commercial building as well as residential buildings in Singapore. The main objective is to highlight the important problems and suggest a greater participation of professionals in building maintenance. It also provides some site investigations photographs of various defects, which is expected to be useful for builders, architects, and others who deal with building materials.

Keywords: building defect, common problem, prevention, quality control.
Building maintenance technology is a topic that a building surveyor must be familiar with and it entails an endless learning process which goes hand in hand with working experience. When you start tackling a building defect, at the first instance, you have to identify the causes of it; followed by detailed diagnosis and collection of useful information before deciding on an appropriate method of repair. On 24 April 2004, Mr. Richard Cheung, Immediate Past BSD Chairman, was invited to share with us his experience in tackling typical building defects in Hong Kong.

Being an experienced building surveyor, Mr. Cheung felt that young practitioners would normally fail to appreciate the importance of choosing a suitable repair method for building defects. It explained why he started the presentation by asking? What are the causes of common building defects in Hong Kong?? In fact, a building defect might be caused by a number of reasons, including design deficiencies, poor workmanship, unsuitable materials, illegal alteration and addition, lack of maintenance/management and overloading. The inability to identify the attribute of the defects might not improve the situation but the carrying out of incorrect repair would more often than not worsen the defects. Mr. Cheung introduced various kinds of testing method; starting from simple methods like water test for water seepage problem, tell-tales for crack monitoring to sophisticated technologies like infra-red thermo-graphic and thermo-tracer. Besides, Mr. Cheung also reminded us that poor design and discomfort to the occupants would also be regarded as building defects, such as poorly applied sealant, illy designed floor drain etc.

Mr. Cheung also kept on reminding us to think about the rationale behind and purposes of doing any tests and conducting any condition survey because good planning would usually help us to solve the problems faster. Some special building maintenance cases were examined and it dawned upon us that maintenance works are not simple tasks.

The presentation was informative, interactive and interesting. Many questions were raised which led to a series of discussions. Learning from Mr. Cheung is enjoyable and we look forward to another chance to acquire invaluable experience from him.
Many companies spend over 50 percent of their installation real property maintenance funds on maintenance and repair (M&R) of buildings. It is difficult to allocate these funds optimally without structured, objective condition rating and functionality rating procedures, component remaining service life determinations, and easily developed short- and long-range work plans based on a sound investment strategy and prioritization criteria.

Also, key components may not be inspected adequately and deficiencies are often overlooked. The total result is that work cannot be planned, programmed, and budgeted efficiently. The large number of buildings on installations increases the difficulty of budgeting effectively and allocating funds to areas that most urgently need attention.

In addition, it is difficult to establish effective preventive maintenance programs, or to even set work priorities. Without objectivity in work planning, cost-effective M&R programs cannot be sustained. Mission-support capabilities, quality of life, and past investment in facilities are jeopardized.
A Few of the Problems...

Aging and neglected facilities put mission, quality of life, and facility investment at risk

What's going to happen? How will I be able to...?

Uncertainty about the future

"Ad hoc" and reactionary management

Inspection is expensive and of questionable value, per se

Inadequate funds for proper facility M&R

Not enough people to continue doing "business as usual"