FACTORS AFFECTING BEST MAINTENANCE PRACTICE IN TANZANIA PUBLIC SECTOR

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ABSTRACT

Best maintenance practice is a big problem in the public sector infrastructures. Investing is one thing; but managing and maintaining assets is a culture to be cultivated. The aims of this paper was to investigate factors affecting best maintenance practice and explore ways in which maintenance and facilities management techniques can be employed towards achieving solutions of best maintenance practice in Tanzania public sector. The research method used included literature review, data collection, questionnaires, interviews and observations. A total number of 100 questionnaires were then distributed and thereafter the collected data was analysed. The study identifies that factors affecting best maintenance practices in public sectors being factors on Maintenance management plans and procedures such as: Planning and scheduling, Resource planning, Materials management, Maintenance policy and strategy, Maintenance culture, Maintenance task execution, Budgeting, Renovation program, Data recording and all of which seriously lack in the public sectors. The Relative Importance Index (RII) was used to determine the significance of each factor by respondents rating. Ultimately, recommendations to improve the maintenance best practices in Tanzania were outlined as; firstly to establish maintenance policy; secondly to establish national maintenance board (authority); and lastly to Institute specialized maintenance curriculum at a technical level for both the undergraduates and post graduates.

Key words: Maintenance Management, Maintenance Policy, Maintenance Culture, Tanzania
1. INTRODUCTION

A public sector is a very important sector in the economy of every country. It is a sector that provides services that are offered by the government. The composition of its activities varies from country to country. In Tanzania, the public sector includes services such as the police, military, infrastructures (public roads, railways, water supply, sewers, electrical grids, telecommunications, etc.), public education and health care services.

The public sector represent significant investment of tax payer’s money, hence the need for its preservation is very worth (Akomah and Quayson, 2016) [1]. Owing to lack of maintenance culture in the country most of the public properties are left without maintenance (Bavu et al., 1997) [2].

The production/services in Tanzania public sector enterprises was reported to have fallen down, and in some cases completely halt due to poor or complete lack of plant, equipment and infrastructure maintenance (Kundi and Masika, 2001) [3].

It is a common practice in the Tanzanian public sector to find most of physical assets are dilapidated, and in fact, most of them like roads, vehicles and machines are beyond economical repair. It is ordinary to find buildings with leaking roofs and doors without locks (Bavu et al., 1997) [2]. For that reason, they are incapable of facilitating economical production or delivering the quality services to meet organizational or Governmental objectives.

This situation costs the government a lot of money in terms of repair and prematurely aged assets replacement. As a result the country's economic growth is retarded due to improper maintenance system or reactive maintenance, which costs a lot of money in terms of operation down time and, or poor quality of service delivery.

Maintenance best practice is a big problem in public and private sector. Investing seems to be easy but managing and maintaining assets has proven not to be our culture.

1.1. Main objective

The main objective of this paper is to investigate factors affecting Best Maintenance Practice in Tanzania public sector.

1.2. Specific Objectives

This paper addresses the following specific objectives:

- To identify factors affecting ineffectiveness of best maintenance practices in the Tanzanian public sector.
- To analyse factors affecting ineffectiveness of best maintenance practice in the public sector.
- To propose strategies for enhancing best maintenance practice in the public sector.
2. FACTORS AFFECTING BEST MAINTENANCE PRACTISE IN TANZANIA PUBLIC SECTOR

Maintenance Implementation Strategy Approach
Best maintenance practices are achieved by having maintenance policy and strategy in place whereas rules and standards are set, however, the development of strategic maintenance plans and implementations are of significant importance and meanwhile the review or benchmarking the execution of maintenance activities provide the room for determining the actual maintenance performance of a certain organization. Over again, based on the policy, an improvement action may be developed as required. See implementation sequence in Figure 1 of the maintenance management process.

Effective maintenance policy and strategy implementation is influenced by various factors such as position of maintenance department in the organization structure, budgetary allocation, contract management, resources planning, communication, data recording and handling, motivation issues, training and development (Chanter, 2005,[4] Victor 2003,[5] Bavu et al., 1997[2]). Successful policy and strategy implementation depends on the effectiveness of an organization and maintenance management. The building maintenance policy states clearly the departmental objectives towards best maintenance practices.

Planning and scheduling tools
Maintenance Planning is a structured process to achieve the efficient and effective delivery of maintenance tasks/ schedules, it consists of management activities focused on meeting the organization’s objectives and achieving service delivery outcomes through an effective maintenance planning. Maintenance planning involves the collection and analysis of all relevant data, strategy and available resources then deploy a process to develop a plan for the short, medium and long term maintenance practices.

![Maintenance Management Process chart](http://www.iaeme.com/IJMET/index.asp)

Figure 1 Maintenance Management Process chart: Sourced from Chanter (2005) [4]

http://www.iaeme.com/IJMET/index.asp

editor@iaeme.com
Maintenance planning starts from a clear understanding and review of the company’s corporate policy, strategies and service delivery plans to develop effective equipment and building plans to ensure maintenance priorities and strategies are relevant and in line with business directions. Maintenance planning provides appropriate maintenance programme and procedures for execution of tasks based on frequent basis (daily, weekly, monthly, yearly etc), depending on available maintenance policy, whereas, planning standard and procedures shall also be laid down.

Strategic maintenance plans affects the implementation of maintenance planning practices and equipment condition assessment. Maintenance budget is a significant tool as in all maintenance operations and should not be neglected by any means. Spares of good quality and high skilled manpower are obtained from the available budget. Bowers (2005) [6] commented that maintenance planning should reflect and identify needs, establish goals and allocate fund to meet goals, scheduling maintenance and allocating funds for implementation, the act which is of great importance towards Best maintenance practices. Wall (1993) [7] commented that a system like that of DANIDA project in Tanzania, for accumulating fund and allocating them for entire life of the project should be adopted by other organizations. Documentation, information processing and handling are very important tools in the maintenance planning and implementation. Equipment data need to be captured stored, processed, shared and updated accordingly to match with technology and business demands.

Planning and scheduling maintenance activities is a very difficult issue for a public sector, as it is done and stored manually. Processing and keeping data manually doesn’t provide an effective maintenance planning and scheduling Chanter et al (2005) [4], for that it becomes very difficult to achieve Best maintenance practice.

In most cases, maintenance planning in Tanzania public sector is not computerized. Lukacs (2003) [8] through his research, argues that organizations with proactive attitudes to planning represent the world top organizations in terms of profits margin and return on equity.

Research conducted by Shen Qiping (1997) [9] in Hong Kong and UK revealed that public sectors in many countries have been experiencing a problem of not prioritizing maintenance issues, such as budgeting and resource allocation.

**Effective implementation of maintenance planning and scheduling**

In order for an organization to achieve its objectives effectively, it needs to have a proper integration of maintenance planning and scheduling with policies in place. Yet more, to attain this, it must have an effective exercising of maintenance planning issues and task execution.

Lukacks (2003) [8] in his research identifies that “effective planned tasks can take up to 10 less time and money, and increases workforce capacity by a factor of 1.5-1.6” Planning can simply be started as a process used to develop a course of action. Maintenance planning involves several steps before doing specific repair of the specific job. It is also a process that allows a craft man to work in a safe environment and for high productivity. Moreover, it allows a clear understanding and identification of job to be done and the right parts and tools to be used. Planning and scheduling is a key function that influences maintenance resources planning and utilization (Duffuaa et al, 1997) [10]. Basically planning is to raise work orders a clear picture of
what is to be done or type of repair and service required in a building or piece of equipment.

Maintenance work order provides a clear communication of a problem and what is to be done, at all levels; the top and middle management, and that of the operation level and provides a proper system of capturing data and information of an section or of the whole building.

Kundi et al (2001) [11] argues that maintenance management processes need to work very closely; and interacting to each other in receiving feedbacks from all levels of maintenance management, so as to enhance a clear, strategic and effective building maintenance planning and scheduling.

**Computerized maintenance management**

The emerging and fast growing of new technology, Information and communication technology (ICT) has recently been a very big challenge to most business operations. ICT has a lot of implications to maintenance operations, planning and scheduling. Computer provides a flexible planning and scheduling; data is captured and stored in the central database where everyone who needs information can access (Brinman et al, 2001[12] and Chanter, 2005) [4]. Using a computerized maintenance management system, resources are easily planned and utilized. Spare parts can be easily monitored and regularly updated to couple with actual maintenance demands.

3. MATERIALS AND METHODS

In order to achieve the study objective on investigation of factors affecting Best Maintenance practise in public sector, the methods employed were through: research design, questionnaires design, Sampling of study area, data collection, data analysis, results and discussion.

**Population characteristic and sampling**

The population under study was based on Tanzania public sector and its institutions. The maintenance practices is not unique, it varies from one organization to another due to differences in business operations, culture of organization, size, plant design and layout, financial position, automation, adoptability of new technology (ICT) and the like. The study area was based on such public sectors as, hospitals, schools, offices, transportation, and manufacturing and processing industries, since the maintenance principles and objectives applying to all are the same but only differ in terms of practice and implementation approaches.

Questionnaires were only distributed in three regions; Mwanza, Dar es Salaam and Morogoro. Number of received questionnaires provided a good picture of maintenance best practices. Targeted respondent were; policy makers (managing directors), strategic formulators (Maintenance managers), implementers (Maintenance engineers, maintenance planners, technicians, artisans) and others. The sample was very representative, manageable and provided detailed, comprehensive, accuracy and precise information.

3.1. Questionnaire design and administration

The questionnaires were used as a basis for data collection from various maintenance personnel and other stakeholders to support the case studies conducted in Public sectors. The questionnaires were designed to capture relevant information on factors affecting ineffectiveness of best maintenance practices in the Tanzanian public sector.
They were categorized into three sections; section “A” was concerned with fundamental maintenance policy issues, section “B” with maintenance planning and scheduling issues and section “C” dealt with maintenance management and issues related to the culture of maintenance.

The factors affecting best maintenance practise were ranked on a Likert scale of 1-5, with the following interpretations as shown in Table I:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Very poor: practice not implemented</td>
</tr>
<tr>
<td>2</td>
<td>Poor: practices do not add value</td>
</tr>
<tr>
<td>3</td>
<td>Good: it is in practice but not very effective</td>
</tr>
<tr>
<td>4</td>
<td>Very Good: it is in place and very effective</td>
</tr>
<tr>
<td>5</td>
<td>Excellent: it is in place, in practice, very effective</td>
</tr>
</tbody>
</table>

The questionnaire focused on the identification of factors that render ineffectiveness of best maintenance practices in the Tanzanian public sector. They were designed to suit a wide range of group of people both maintenance professionals and users.

Descriptive statistics was used to analyse the demographic data of the respondents while Relative Importance Index (RII) was used to analysed respondents score of the factor affecting maintenance best practice. For this study, an ordinal measurement scale of 1 to 5 was used to determine the effect level. Respondents were asked to rate factors affecting best maintenance practise in public sector according to the degree of importance

Relative Importance Index (RII) = \( \frac{\sum W}{AN} \) \( (0 \leq RII \leq 1) \)  

Where:

W- is the weighing given to each factor ranging from 1 to 5. In the study, let say the highest weight in this case it is equivalent to 5 and N is the total number of respondents in the research. The rating of all factors to the degree of significance is based on the value of their relative importance index (RII) as shown in Table II.

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Degree of significance</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Most significant</td>
<td>0.76 and above</td>
</tr>
<tr>
<td>2</td>
<td>Significant</td>
<td>0.67-0.75</td>
</tr>
<tr>
<td>3</td>
<td>Less significant</td>
<td>0.45-0.67</td>
</tr>
<tr>
<td>4</td>
<td>Not significant</td>
<td>0.44 and below</td>
</tr>
</tbody>
</table>

Source: Vanduhe (2012) [13]

4. RESULTS
A total number of 100 questionnaire copies were distributed to the public sector. The targeted groups were maintenance professionals, engineers, maintenance planners, technicians, managers as shown in table 3. The response was 78 out of 100 which is 78%. This achievement was obtained after extension of time and self-effort of the researcher in making a close follow up on questionnaire collection from various sources: such as those through emails and hard copies. Respondents’ summary is as
detailed in Table III below, it shows the respondents distribution by their designation and percentages.

Table III Targeted number of respondents and their designation

<table>
<thead>
<tr>
<th>Sector</th>
<th>Target</th>
<th>Designation</th>
<th>Response</th>
<th>Response</th>
<th>Percentage Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>100</td>
<td>Maintenance Manager</td>
<td>8</td>
<td>78</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineers</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Planners</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technicians</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Artisans</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The study has identified 13 factors affecting Best maintenance practise in Tanzania, these factors have been identified through literature review and ranked according to their relative importance index by respondents rating as presented in Table IV.

Table IV Ranking of factors affecting Best Maintenance Practice in Tanzania public sector

<table>
<thead>
<tr>
<th>S/no</th>
<th>Factors</th>
<th>Rank</th>
<th>RII</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maintenance policy and strategy</td>
<td>1</td>
<td>0.83</td>
<td>Most significant</td>
</tr>
<tr>
<td>2</td>
<td>Planning and scheduling</td>
<td>2</td>
<td>0.81</td>
<td>Most significant</td>
</tr>
<tr>
<td>3</td>
<td>Materials management</td>
<td>3</td>
<td>0.79</td>
<td>Most significant</td>
</tr>
<tr>
<td>4</td>
<td>Maintenance culture</td>
<td>4</td>
<td>0.75</td>
<td>Significant</td>
</tr>
<tr>
<td>5</td>
<td>Maintenance task execution</td>
<td>5</td>
<td>0.73</td>
<td>Significant</td>
</tr>
<tr>
<td>6</td>
<td>Budget</td>
<td>6</td>
<td>0.70</td>
<td>Significant</td>
</tr>
<tr>
<td>7</td>
<td>Renovation program</td>
<td>7</td>
<td>0.69</td>
<td>Significant</td>
</tr>
<tr>
<td>8</td>
<td>Data recording and storage</td>
<td>8</td>
<td>0.69</td>
<td>Significant</td>
</tr>
<tr>
<td>9</td>
<td>Reliability analysis</td>
<td>9</td>
<td>0.68</td>
<td>Significant</td>
</tr>
<tr>
<td>10</td>
<td>Resource planning</td>
<td>10</td>
<td>0.67</td>
<td>Significant</td>
</tr>
<tr>
<td>11</td>
<td>Legislation and Environmental laws</td>
<td>11</td>
<td>0.66</td>
<td>Significant</td>
</tr>
<tr>
<td>12</td>
<td>Communication and ICT</td>
<td>12</td>
<td>0.45</td>
<td>Less significant</td>
</tr>
<tr>
<td>13</td>
<td>Contracts management</td>
<td>13</td>
<td>0.41</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

5. DISCUSSIONS

5.1. Discussion on Factors affecting best maintenance practise

The field of maintenance is very broad constituting a lot of issues therefore the study only looked at the fundamental part of maintenance factors that formulates standards and procedures of Best Maintenance Practices in public sector. The study covered, maintenance policy issues, planning and scheduling, and maintenance management and maintenance culture.

- Maintenance policy and strategy:

According to the findings, lack of policy and strategy factor is very important factor and it ranks number one with Relative Importance Index (RII) of 0.83; since most of the public business objectives, maintenance operations strategies have not been integrated to meet business requirement. However, the findings show that no proactive maintenance regime is in place, the public sector enhances only reactive maintenance systems.
• Planning and scheduling:

Findings obtained from the questionnaires analysis show that; in most of the public sector organizations maintenance planning section (planner) does not exist, and a computerized maintenance management system is not used for job planning and spare parts management. Again it has been found that no standard work orders are used. Factor on Planning and scheduling ranks number two with Relative Importance Index (RII) of 0.81. Moreover, the findings reveal that, no equipment or plant register is in place. Yet more, the priorities system used to determine or judge the emergency response on a certain task are missing. Additionally, risks assessments are not conducted effectively, backlog analysis system are not in place and lastly training and development plan for maintenance planners and schedulers is not in place as no maintenance planner available in most of the public organizations.

• Materials management:

Factors on Materials management affects Best Maintenance practise, since insufficient or delays in material supply hinder the maintenance performance. In that view, this factor ranks number three with Relative Importance Index (RII) of 0.79. With regards to research findings, most of the public organizations still use manual system of handling spare parts while records are not kept well. The computerized materials management system has not been used in most of the public institutions, which indicates that no flexible system of handling spares and which can allow spares and other material movement, be tracked easily. Additionally, no effective service level agreement in place, which can control quality of spares parts and other services to be supplied based on the specifications of the contract.

• Maintenance management and maintenance culture:

Lack of Maintenance management and maintenance culture factor to a great extent affect the best maintenance practise, the factors ranks number four with Relative Importance Index (RII) of 0.75. The research findings revealed that; maintenance management and maintenance culture in public sector has greatly contributed in driving maintenance operations inefficiently and ineffectively, as it is the one which set all maintenance policies and strategies to meet business objectives. The results indicate that, no maintenance organization structure is clearly defined and line of authority not well stipulated.

• Maintenance task execution

Lack of Maintenance management and maintenance task execution is the most important factor in the maintenance practices, and it ranks number five in the Relative Importance Index (RII) of 0.73. Maintenance management in the public institutions have failed to establish maintenance quality performance standards frame work, tasks are not identified and clearly defined, responsibilities not put clear, and there is no a team work approach. Moreover, most of the public organizations have not been using properly performance benchmark system in identifying their gaps and establishing improvements or corrective measures.

• Budget:

The factor on lack of budget ranked number six with Relative Importance Index (RII) of 0.70. Research results show that, maintenance budget have not been integrated to meet maintenance demands as well as business objectives. They have been a trend of interfering maintenance budget when money is required for other
unbudgeted activities. However, no effective maintenance budgetary allocation so as to cope with business competition in the market.

- **Renovation Program**

  Research results show that no effective renovation system has been enhanced in public sector. And also, there is no major programme of rehabilitating buildings; they are naturally left to damage to the extent that the occupants’ lives are in danger. This factor on Renovation programs ranks number seven with Relative Importance Index (RII) of 0.69

- **Data recording and storage:**

  Lack of data records and storage affect the best maintenance practise, thus it is found to be significant with Relative Importance Index (RII) of 0.69. The factor ranks number eight. The failure of recording and storing maintenance data is a critical issue in most of the public institutions. The common methods used to date are the manual data recording and filing system. This methods is outdated as is not technologically compatible, because data cannot be easily processed and accessed by other users, cannot be updated easily, additional handling and storage requires time and big space. Computerized method is not famous in most of the public sectors; therefore, it is not mostly used. However, equipment register is not functioning; no equipment history is processed, kept and updated by using manual systems as it is a very tedious jobs.

- **Reliability Analysis:**

  The factor on Reliability analysis ranks number nine with Relative Importance Index (RII) of 0.68. From the findings it has been learnt that; most of the public organizations have not put in place facilities or building failure mode and failure cause analysis in order to determine the source of damage or failure. For example if a building wall crack, no root-cause of the crack is done. In this regards the corrective measures taken could only be temporally measures, as the solution of the problem will not be technically and professionally obtained.

- **Resource planning:**

  Resource planning factor is very important factor and rank number ten with Relative Importance Index (RII) of 0.67. The findings revealed that, the public institutions have not been effectively planning and utilizing available resources for good service delivery. Skills are not well identified and utilized; funds are not allocated based on the priority of the project and its implication to core business.

- **Legislation and Environmental laws:**

  Lack of Legislation and Environmental policies was ranked number eleven with Relative Importance Index (RII) of 12. The finding shows that; environmental policies are not in place and if there is any they are not effectively practiced. However, staff members are not trained and involved in environmental management in most of the public institutions. Thus, maintenance operations are done without complying with international and government environmental rules and regulations.

- **Information and communication technology:**

  Planning and scheduling of maintenance tasks are best and effectively practiced through the use of computerized maintenance system (Gupta, 2004) [14]. A Computerized Maintenance Management Systems is still a big challenge to the public sector in Tanzania. Gupta et al (2004) [14].The factor ranked twelfth and it is less
significant. The factor ranked thirteenth with Relative Importance Index (RII) of 0.45. Hence it is less significant.

- **Contract Management**
  The management of contracts enables obtaining of appropriate contractors, monitoring building maintenance contracts, achieving best maintenance standards. Additionally maintain appropriate material stock level and enhances competitive performance. General results show that the public sector still not performing good on contract management. Lack of good contract management was ranked number thirteenth with Relative Importance Index (RII) of 0.41. The factor is not significant.

**Conclusion**
This paper has examined factors that affect best maintenance practice and recommendations have been drawn to improve maintenance practices in Tanzania public institutions so as to embark and establish sustainable and Best Maintenance Practices which match with business objective and customer requirements. The paper also highlights the magnitude of the maintenance inadequacies in public institutions which need urgent improvement.

6. **RECOMMENDATIONS**

**General Recommendations**
The paper further observed that there is neither maintenance policy, nor national, regional, or other maintenance bodies that deal with maintenance of equipment. It is recommended that, the government should:

- Establish maintenance policy;
- Establish national maintenance board (authority);
- Institute specialized maintenance curriculum at technician level; undergraduate and post graduate.

The established maintenance management system should monitor maintenance knowledge accumulation and the process of learning, which in turn build human capital and skills in industries. Moreover, the body should be capable of advising the government, ministries, industries and other bodies on issues related to the acquisition of technologies and its maintenance.

**Specific Recommendations**
Specific recommendations have been made on the public sector institutions to; clearly define, establish and integrate maintenance policy and strategies into business operations and critically analyse and execute maintenance tasks. Training and development should be enhanced so as to improve available skills. However, the use of computerized maintenance management is of great importance to effect materials management and maintenance data capturing and storage. Maintenance budget planning and control has to be integrated to match with maintenance demands. Proper resource planning and utilization should be enhanced by ensuring that personnel with the right skills are available and are well utilized. Maintenance department should ensure that maintenance planning section is in place and well utilized.
REFERENCES


