Full Paper

Assessment Of Problems Associated With Engineering Assets Management Practices In Food Manufacturing Companies In Nigeria

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Abstract

Asset management offers a systematic approach to realizing the extent of the problem and providing a mechanism for improvement. This paper assessed the problems associated with engineering assets management (EAM) practices in small and medium-scale food manufacturing companies in Nigeria. Data were collected using questionnaire from selected 30 food manufacturing companies registered with National Agency for Food and Drug Administration and Control (NAFDAC), in the study area. The questionnaire was administered on top officials in the companies. The data were analyzed using both descriptive and inferential statistics. The study has shown that several activities and practices involved in the food manufacturing companies were error-provoking and are impediments to a better management of engineering assets. Factors that caused engineering assets failures (downtime) in food companies include; equipment design, purchase, storage (inventory), installation, and operation and maintenance. However, priorities should be placed on the fundamentals of asset management, that is, understanding and defining the level of service. Also, more efforts should be put in staff development in order to expand their knowledge and skills of maintenance staffs in specialized areas of engineering assets management practices.

Keywords: *Asset management, engineering assets management, failures and errors.*

1. Introduction

Asset management has been described as a philosophy that guides facilities management and maintenance management [1]. This is because it addresses the front end of the issue that concerns everybody. It appears to be growing in all directions. A few years ago it was the label placed on managing money; now that the term has found acceptance for managing physical assets, the label is being stuck onto just about every aspect, from conceptual design to maintenance, to whole cities, including some obscure practices such as using neural networks for asset failure analyses [2].

Despite the wealth of service information available, a high expenditure on maintenance effort still occurs at the equipment procurement stage. Clearly the objective of the procurement process is to achieve minimum total life cost. However, the positions and behaviour adopted by purchaser and supplier operating in the situation of structured conflict, can result in a sub-optimum, low reliability, poor maintainability, high operating cost solution [3]. While the supplier of assets believes that he has cut down the capital costs to the bone, the purchaser believes he has paid over the odds and the need for maintenance is considered to have diminished accordingly. Also, he continued by saying that the designer and manufacturer could help eliminate a large proportion of future failures and associated costs due to weakness in design and manufacture. But it appears that few manufacturers appreciate how their equipment functions during the designated life-cycle. However, designers of infrastructure have a good grasp of the material sciences with which they work. They know the stress, strain characteristics and some of the limitations of applicability; even the limitations of minor elements such as paints and sealants. Generally, the more sophisticated the materials the more is known about their behaviour and qualities. Unless the owner of the asset has the desire to understand the design limitations or has the requisite knowledge and experience, the care of the asset will be in jeopardy, probably under-funded and inadequately maintained. Inadequate maintenance may not be in terms of effort but in terms of appropriateness [2]. For example it takes the same effort to put the wrong lubricant in a gearbox.

The well-known traditional, and yet subjective, methods of monitoring the condition of equipment rely on the identification of faults which are evident as vibration noise, overheating, leaks and surface deterioration. These are still good indicators of machine condition. However, improvements in the subjective and qualitative methods of seeing, touching and hearing are increasingly being sought. Techniques using new sensors and data logging and analysis systems, which allow the physical attributes of equipment to be monitored and recorded, are increasing in sophistication. The condition monitoring techniques most widely featured are vibration monitoring and wear debris analysis. The benefits arising from condition based maintenance are clear and result from the ability to prevent a failure occurring in situations where the indication of a problem is detected in sufficient time to do something about it [4].

This problem could be brought about by several factors: lack of trained technicians to care for the asset, lack of comprehensive maintenance documentation, importation of technology without corresponding technology transfer or skills development, lack of appreciation of life cycle costing (cost of ownership), pride and acclamation in acquisition but lower appreciation of ongoing care needs (life cycle costing), lack of long-term interest in ensuring the success of the asset (e.g. acquisition for immediate political advantage), and changing priorities - usually political/economic. However, the lack of experience, knowledge and trained personnel is often a major factor for premature infrastructure degradation, whether a power station, road, airport or other works with a significant technology component. Much of this is related to a lack of awareness, by the user, of the need for care [2]. It has been noted [4] that capability building is central to organizational performance, and it requires a systematic management approach to learning and development as an integral part of workforce planning. However, it is well known that the successes or failures of any change in the organization and procedures depend largely upon the individuals who carry out those changes and subsequently work with them. A much efficient and effective achievements of engineering assets management practices in food manufacturing companies towards an increased maintenance function depends on the capability and development of people involved.

With the field of asset management and maintenance there are many activities which rely upon the availability of appropriate information and the experience of maintenance personnel. The time taken to solve failure problems with a particular machine, and the effectiveness of the cure, can be dependent upon the individuals' understanding of the machine and their past experience of solving similar or identical problems. Difficulties arise when there is a lack of experienced personnel or the experience is vested in very few individuals, or even in one individual who may not always be available when required. This situation exposes the business to an unacceptable level of risk which needs to be minimized [4].

One of the fundamentals of asset management is to understand and define the level of service in terms of functionality and appearance. Understanding, defining and redefining the level of service predicates all subsequent asset management functions such as planning, acquisition, maintenance, operations and budgeting. When the core of asset management is understood as the level of service then asset owners, engineers and finance managers can sit together and move forward by firstly debating the level of service then addressing the associated financial and technical issues. Level of service helps order and also makes sense of the financial and technological issues surrounding asset management. For example it helps comprehend vibration monitoring, computerized maintenance managements systems, reliability, risk management, and skills training. These are related to knowing the asset better and deciding on the most cost-effective means of meeting and sustaining its level of service [2].

The emphasis of Engineering Assets Management (EAM) is clearly on sustainable business outcomes, risk management and value. EAM is concerned with assets throughout the lifecycle. The EAM framework requires a well-structured approach which provides asset managers with the necessary guide to actions on the service level needed [5].

1.1. Engineering Assets Failures

Numerous research studies have shown that over 50% of all equipment fails prematurely after maintenance work has been performed on them. In the most embarrassing cases, the maintenance work performed was intended to prevent the very failures that occurred [6]. The major factors that may contribute to these failures are the following four categories of error encountered in the process:

<u>Human error</u> – occurs where the repair/replace task was not successfully completed due to a lack of knowledge or skill on the part of the person performing the repair. There are two parts to an error - a mental state and a situation. There is limited control over people's mental states, but one can control the situations in which they have to work.

<u>System error</u> – where the equipment was returned to service after high-risk maintenance tasks without the repair having been properly inspected/tested.

<u>Design error</u> – where the capability of the component being replaced is too close to the performance expected of it, and therefore lower capability (quality) parts fail during periods of high performance demand. The remaining higher capability (quality) parts are capable of withstanding all performance demands placed on it.

<u>Parts error</u> – the incorrect part or an inferior quality part has been supplied.

A research work [7] had explained why maintenance activities can be error-provoking. In particular, it argued the futility of trying to change the human condition, when a more effective way of managing maintenance error is to treat error as a normal, expected, and foreseeable aspect of maintenance work, and therefore, manage maintenance error by changing the conditions under which that work is carried out.

The evolution of the EAM is largely in response to the desire to better manage maintenance and associated efforts, and to align internal processes with strategic objectives [5]. Hence this study was designed to assess the problems associated with engineering assets management in the food manufacturing companies in Nigeria.

2. Research Methods

The study covered selected small and medium-scale food manufacturing companies in Lagos, Oyo, Ogun, and Osun States in Southwestern Nigeria. Thirty food manufacturing companies registered with National Agency for Food and Drug Administration and Control (NAFDAC) were selected within the study area according to their relative proportion. The proportions of the sample among the states were as follows; Lagos (40%), Oyo (20%), Ogun (25%) and Osun (15%). Data were obtained through primary and secondary sources. The questionnaire was used to elicit information on issues relating to the objectives of the study. Secondary data were obtained from the companies' records on assets acquisition, maintenance and disposal. The data were analyzed using descriptive and inferential statistics such as frequency distribution, simple percentage (%), analysis of variance (ANOVA) and Duncan Multiple Range Test (DMRT). The DMRT and ANOVA was used to separate the means and establish the significant differences ($P<0.05$) that exist among means with different letters.

3. Results And Discussions

The problems experienced in food companies' EAM as shown in *Table 1* include among others; lack of experienced knowledge and trained technicians (personnel) to properly manage or maintain the assets (2.05*); lack of appreciation of lifecycle costing - cost of ownership (2.00*); lack of comprehensive maintenance

Table 1: Extent to which Factors Affect Company's Engineering Assets Management in the Companies

Factors	Ratings: Frequency (%) 4	3	2	1	Mean Rank
Lack of long-term interest in ensuring the success of the asset (e.g. acquisition for immediate political advantage).	4 (19.0)	3 (14.3)	6 (28.6)	8 (38.1)	2.14 a
Lack of experienced, knowledge and trained technicians (personnel) to care for the assets.	3 (14.3)	4 (19.0)	5 (23.8)	9 (42.9)	2.05 a
Lack of appreciation of life cycle costing (cost of ownership).	2 (9.5)	3 (14.3)	9 (42.9)	7 (33.3)	2.00 a
Lack of comprehensive maintenance documentation	1 (4.8)	4 (19.0)	7 (33.3)	9 (42.9)	1.86[a]
Importation of technology without a corresponding technology transfer or skills development.	1 (4.8)	2 (9.5)	11 (52.4)	7 (33.3)	1.86[a]
Changing priorities (due to political or economic change)	1 (4.8)	3 (14.3)	6 (28.6)	11 (52.4)	1.71[a]

Source: Field Survey 2010

Key: greatest extent = 4, greater extent = 3, great extent = 2, and no consideration = 1

Means with the same letter are not significantly different (F=0.53, P<0.05).

documentation (1.86*); importation of technology without a corresponding technology transfer or skills development for maintenance (1.86*); and changing priorities due to political or economic change (1.71*). The result implies that food manufacturing companies employ the services of external experts/consultant engineers to manage their engineering assets as a result of lack of experience on the part of their in-house engineers and technicians. The amount of technology (engineering assets) acquired has not been corresponded to the transfer of knowledge and skill development for maintenance. It was also discovered that improper maintenance documentation and inability to appreciate lifecycle costing are part of EAM problems. A report has earlier said that few food manufacturing companies engaged themselves in EAM practices. The four categories of factors that caused failures identified [6] also exist in food manufacturing companies *(Table 2)*. These are: (a) spare parts error; inferior quality (2.86*) and incorrect parts (2.81*), (b) design error; low capability (2.81*) and high capability (2.57*), (c) human error; work situation (2.71*) and mental state (2.57*) and (d) system error; no inspection (2.52*) and after repair (2.38*). These categories of error have to be avoided, eliminated and/or reduced to the minimal if engineering assets must meet production requirements. Other factors *(Table 3)* that were pivotal to failures in food companies' EAM were: (i) equipment design; quality of materials (2.19*) and design inadequacies (2.10*), (ii) purchase; parts availability (2.38*), brand (2.00*), non-provision of manuals (2.00*), price negotiations (1.76*), price differences (1.71*), and poor relationship with manufacturer (1.57*), (iii) storage (inventory); spare parts shortages (2.33*), (iv) Installation (1.76*) and (v) operation and maintenance; planning and scheduling (2.10*), resource availability – human (2.38*), parts (2.43*), tools (2.33*), documentation (2.14*), shop space (1.81*), inadequate inspection (2.19*), poor work quality (2.19*), operator practices (2.05*) and poor quality control (1.95*). These factors were also identified [8]. A report [9] also explained that chronic repairs are often associated with design problems (material quality defects or design inadequacies), inappropriate operator practices or poor quality control in upstream processes.

The use of specialized training outside the firm (2.62*) and vocational training (2.37*) in staff development especially maintenance staff members were underutilized *(Table 4)*. Inspection rounds have always been a part of the maintenance process. Having operations and/or maintenance staff go onto the plant floor, the garage or the engine room and check belts, fittings, seals, fluid levels and other components in an informal manner has been carried out since the Industrial Revolution [10].

4. Conclusion

In conclusion, much attention is need in the practices of EAM in food manufacturing companies in Nigeria if it were to be compared to other advanced countries. The study has established that several activities and practices involved were error-provoking and are impediments to a better management of engineering assets in these companies. Among other factors that caused engineering assets failures (downtime) in food companies are equipment design, purchase, storage (inventory), installation, and operation and maintenance.

However, food manufacturing companies should place priorities on the fundamentals of asset management, that is, understanding and defining the level of service which makes sense of financial and technological issues as well as functionality and appearance. There should be a good relationship between these companies and their assets suppliers/manufacturers. This would enhance feedback on engineering assets design and general behaviour. Also, more efforts should be put in staff development specifically using specialized training and vocational training methods in order to expand knowledge and skills of maintenance staffs in specialized areas of maintenance activities and practices. Factors like human error, system error, design error, and spare parts error that caused EAM failures should be reduced or eliminated. When these are well taken care of, effective assets performance and good productivity are guaranteed.

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Table 2: Level of Contribution of Various Factors to Engineering Assets Management Failures in the Companies

Factors	Ratings: Frequency (%)					Mean Ranting
	5	4	3	2	1	
Human error: Mental state	1 (4.8)	2 (9.5)	8 (38.1)	7 (33.3)	3 (14.3)	2.57[a]
Work situation	2 (9.5)	1 (4.8)	10 (47.6)	5 (23.8)	3 (14.3)	2.71[a]
System error: No inspection	-	2 (9.5)	8 (38.1)	10 (47.6)	1 (4.8)	2.52[a]
After repair	-	1 (4.8)	8 (38.1)	10 (47.6)	2 (9.5)	2.38[a]
Design error: High capability	1 (4.8)	4 (19.0)	4 (19.0)	9 (42.9)	3 (14.3)	2.57[a]
Low capability	-	5 (23.8)	8 (31.8)	7 (33.3)	1 (4.8)	2.81[a]
Spare parts error: Incorrect parts	4 (19.0)	2 (9.5)	3 (14.3)	10 (47.6)	2 (9.5)	2.81[a]
Inferior quality	4 (19.0)	2 (9.5)	4 (19.0)	9 (42.9)	2 (9.5)	2.86[a]

Source: Field Survey 2010

Key: very high = 5, high = 4, medium = 3, low = 2, and no contribution = 1

Means with the same letter are not significantly different (F=0.54, P<0.05).

Table 3: Degree to which Factors caused Failures in Company's Engineering Assets Management

Factors	Ratings: Frequency (%)					Mean Rank
	5	4	3	2	1	
	Equipment design:					
Quality of materials	3 (14.3)	3 (14.3)	1 (4.8)	2 (9.5)	12 (57.1)	2.19[a]
Design inadequacies	1 (4.8)	4 (19.0)	1 (4.8)	5 (23.8)	10 (47.6)	2.10[a]
	Purchase:					
Parts availability	2 (9.5)	4 (19.0)	2 (9.5)	5 (23.8)	8 38.1)	2.38[a]
Brand	2 (9.5)	1 (4.8)	3 (14.3)	4 (19.0)	11 (52.4)	2.00[a]
Manuals not available	2 (9.5)	1 (4.8)	2 (9.5)	6 (28.6)	10 (47.6)	2.00[a]
Price negotiations	2 (9.5)	-	1 (4.8)	6 (28.6)	12 (57.1)	1.76[a]
Price differences	2 (9.5)	-	-	7 (33.3)	12 (57.1)	1.71[a]
Poor relationship	1 (4.8)	1 (4.8)	1 (4.8)	3 (14.3)	15 (71.4)	1.57[a]
Storage (inventory):						
Spare parts shortages	3 (14.3)	4 (19.0)	-	4 (19.0)	10 (47.6)	2.33[a]
Installation	1 (4.8)	1 (4.8)	1 (4.8)	7 (33.3)	11 (52.4)	1.76[a]
Operation/Maintenance:						
Resource Availability; Parts	3 (14.3)	4 (19.0)	1 (4.8)	4 (19.0)	9 (42.9)	2.43[a]
Human	2 (9.5)	4 (19.0)	1 (4.8)	7 (33.3)	7 (33.3)	2.38[a]
Tools	2 (9.5)	5 (23.8)	-	5 (23.8)	9 (42.9)	2.33[a]
Poor documentation	1 (4.8)	5 (23.8)	1 (4.8)	3 (14.3)	11 (52.4)	2.14[a]
Shop space	-	3 (14.3)	2 (9.5)	4 (19.0)	12 (57.1)	1.81[a]
Preventive Maintenance; Inadequate inspection	1 (4.8)	4 (19.0)	2 (9.5)	5 (23.8)	9 (42.9)	2.19[a]
Poor work quality	1 (4.8)	4 (19.0)	2 (9.5)	5 (23.8)	9 (42.9)	2.19[a]
Planning and scheduling	1 (4.8)	3 (14.3)	2 (9.5)	6 (28.6)	9 (42.9)	2.10[a]
Operator practices	2 (9.5)	2 (9.5)	2 (9.5)	4 (19.0)	11 (52.4)	2.05[a]
Poor quality control	2 (9.5)	1 (4.8)	3 (14.3)	3 (14.3)	12 (57.1)	1.95[a]

Source: Field Survey 2010

Key: extremely high = 5, very high = 4, high = 3, fairly high = 2 and low = 1

Means with the same letter are not significantly different (P<0.05).

Table 4: Extent of the Use of Various Methods by the Companies for Staff Development in Engineering Assets Management

Methods used	Ratings: Frequency (%)					Mean Ranting
	5	4	3	2	1	
On-job training	4 (19.0)	11 (52.4)	4 (19.0)	1 (4.8)	1 (4.8)	3.76^a
In-house training	3 (14.3)	10 (47.6)	4 (19.0)	3 (14.3)	1 (4.8)	3.52^a
Specialized training outside the firm	1 (4.8)	4 (19.0)	7 (33.3)	4 (19.0)	5 (23.8)	2.62^b
Vocational training	-	3 (14.3)	10 (47.6)	4 (19.0)	4 (19.0)	2.37^b

Source: Field Survey 2010

Key: very much = 5, much = 4, averagely = 3, slightly = 2, and not at all = 1

Means with the same letter are not significantly different (F=6.92, P<0.05).

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