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Maintenance Culture And Performance Of Selected Manufacturing Firms In Benue State, Nigeria.

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Abstract

Manufacturing firms in Nigeria continuously face the problem of stoppage of production processes and high cost of repair due to inadequate knowledge of maintenance culture. The study seeks to examine the extent to which maintenance culture influences performance of selected manufacturing firms in Benue State, Nigeria. The specific objective is to ascertain the extent to which preventive maintenance influences product delivery of selected firms. The study adopted survey design with a population of two hundred and thirty three (233) and a sample size of one hundred and forty seven (147) derived using Taro Yamane's formula for finite population. Questionnaire was used as instrument for data collection. Data collected were analyzed with the use of Pearson Product Moment Correlation. The r value was subjected to a t-test of significance. Result shows that preventive maintenance significantly influences product delivery of the selected firms. The study recommended among others that firms should continuously adopt preventive and corrective measures of maintenance to reduce cost of repairs and intermittent stoppage of production processes. Firms should embark on continuous training programmes for their maintenance personnel as a pillar for proper maintenance culture development.

INTRODUCTION

Background of the Study

Today's market conditions place great emphasis on variety, performance and quality of products. In order to meet these requirements, manufacturers have been compelled to utilize complex and sophisticated machines. Over time, the driving need to meet and improve on the requirements has shifted the trend of manufacturing to high levels of automation (Raouf& Ben-Daya, 1995). The objective behind automation is to achieve higher productivity and profit in order to effectively stay competitive in business. High levels of automation require that the machines employed operate without trouble and this requirement has changed the technology and operating philosophy of manufacturing industry around the world (Mishra & Pathak, 2006). Despite the success chalked in the automation, one key factor that necessitates consideration is cost maintenance. The high and rising costs of modern production machines as well as high maintenance costs are developments that compel manufacturing firms to pay attention to the culture that promotes maintenance.

Furthermore, technology is becoming increasingly complex, with electronics, robotics and computer control now influencing every aspect of manufacturing and maintenance. This has led to many changes in maintenance activities. Special and continuous training programmes

are required to provide relevant knowledge, understanding and skills to service the increasingly specialized equipments and keep up to development in industry (Mishra & Pathak, 2006).Bamgboye, (2006) posits that maintenance is the art of bringing back the operating condition of an asset into the normal functioning at a minimum cost capable of enhancing the life span of the item. In other words, maintenance is the ability and skill of keeping infrastructures available for normal use and the designed life span of many infrastructures are at present very low in Nigeria (Uma, Obikwe&Ihezukwu, 2014). Life span enhancement necessitates a culture of adequate maintenance.

The concept of culture has various perspectives. However, for the purpose of this work, culture is perceived as a key that influences behaviour of getting things done the right way without which there is a hindrance of the attainment of goals. It is shaped by the interaction between individuals and groups that share the value, perception and goals they have assimilated from previous generation which continued in other generations. Culture in the context of a work organisation is put in place when social relationships among members influence their pattern of thinking and behaviour (Wilkins, 1994; Breden, 2006; Sani, Muhammed, Shukor, and Awang,, 2011). This implies that maintenance culture brings to bare the adoption of the attitude of ensuring regular servicing, repairs and maintenance of working assets or established system so as to guarantee their continuous usefulness.

In Nigeria, the concept seems to be very new. Manufacturing firms in Nigeria like dangote cement company, Gboko, Benue breweries limited and Nigeria bottling company plc Makurdi have invested so much on infrastructure, equipment and machines but have not given adequate attention to its maintenance and so very low results are realized in the use of assets, which lead to "poor maintenance culture." The situation in these firms can be attributed to poorly equipped maintenance departments, insufficient funding for operation and maintenance, lack of spare parts, transfer of plants without enough manpower requirements on ground, insufficient monitoring and lack of preventive and corrective maintenance strategies.

In view of the above, this study seeks to examine the extent to which maintenance culture influence performance of selected manufacturing firms in Benue state.

Statement of the Problem

There exists general information which is easily accessible about the location, products and activities of manufacturing companies. However there is insufficiency of information on maintenance activities being undertaken within the industry. Adejuyigbe, (2006) reports that there are some levels of maintenance activities taking place within manufacturing industries but offer no specific details; for example the type of maintenance strategy adopted, equipment and technology employed, the role of the maintenance manager, training, documentation and influence on performance among others.

Maintenance culture such as preventive and corrective approaches which comprise of provision for adequate care of the hard earned infrastructure have not gained ground in the consciousness of resource managers in the manufacturing firms over the years. This condition has resulted in abandoned factory plants, dilapidated buildings, deserted vehicles with minor problems, moribund industries and a host of other properties which have little or insignificant problems. The ugly consequence is economic stagnation, poor quality, huge operating cost to these firms and subsequent collapse which aggregate to national economy. This study therefore seeks to examine the extent to which maintenance culture affects performance of selected manufacturing firms in Benue State.

Objectives of the Study

The broad objective of the study is to ascertain the influence of maintenance culture on performance of selected manufacturing firms in Benue State.

The specific objective is to;
Examine the extent to which preventive maintenance influence product quality of selected manufacturing firms in Benue State.
Here, maintenance culture is decomposed into preventive maintenance while performance is decomposed into product quality.

Research Question

To what extent does preventive maintenance influence product quality of selected manufacturing firms in Benue State?

Research Hypothesis

H_1: preventive maintenance significantly influence Product quality of selected manufacturing firms in Benue State (Dangote cement company plc, Nigeria bottling company and Benue breweries)

REVIEW OF RELATED LITERATURE

Conceptual Review

The Concept of Maintenance

There are many definitions of maintenance. Telang and Telang (2010) define maintenance as "the combination of all technical and related administrative actions including supervision, with an aim to retain an item in, or restore it to a state in which it can perform a required function". This definition clearly identifies two distinct activities in maintenance; the technical and the administrative. The technical activities are grouped under maintenance engineering and deal with the actual tasks carried out on equipment while the administrative activities are grouped under maintenance management and basically deal with the management aspects of maintenance. Al-Naija (2007), observes that maintenance is a means to maintain and improve the quality of the elements involved in a production process, continuously and cost-effectively through detecting and controlling the deviations in the condition of a production process. Maintenance can be summarized as the repair and upkeep of existing equipment, buildings and facilities to keep them in a safe, effective and desired condition so that they can meet their intended purpose (Eti,Ogaji, & Probert, 2006; Adeniyi, 2004).

Maintenance strategies are generally categorized as corrective (reactive) and preventive (proactive). The corrective maintenance is an unscheduled maintenance attempting to restore a system after a failure occurs. The preventive maintenance on the other hand is to schedule proactive maintenance routinely by designed inspection, detection, and repair/replacement (Adeyeri,Kareem, Ayodeji, &Emovon, 2011).

Maintenance Culture

Culture is difficult to define because it have multitude concept, each with own slight variation depending on the focus of study. It is a way of life which consist language, arts and thought, spiritually, social activity and interaction. Generally, culture is acknowledged as encompassing inherited ideas, beliefs, values and knowledge that contribute the shared bases of social actions (Schein 1999; Morgan 1986; Mark, Ogaji, & Probert, 2006). Culture is the key that influences behaviour of getting things done the right way without which would hinder the goals from being achieved (Brendan, 2006; Wilkin, 1994).Culture is shaped by the interaction between

individual and groups shared the value, perception and goal they have learned previous generation continues to generation. The context of culture has been use in organisation when culture is created in the organisation of social relationship among members through way thinking, behavior and belief. In general, culture is defined as the overall activity of human behavior, the arts, belief, values, attitudes, practices, and all human works and ideas that influences each member in the organisation.

Culture in an organisation is a pattern of shared basic assumptions that the group learned as it solve its problem of external adaptation and internal integration that has worked well enough to be considered valid and therefore, to be taught to new members as a correct way to perceive, think and feel in relation to those problems (Sodiki, 2001). Schein (1985), maintains that the significance of cultural approach to maintenance activities is that it allows a general view of the social dynamics in a complex and diverse domain.

Maintenance culture focuses on the design and implementation of a technical procedure that supports the prevention or correction of premature failure of engineering systems with least cost and time without compromising the system performance and safety parameters (Hill, 2005). Developing good maintenance culture in industries requires a human resources organisational framework. The strategies would be based on definite corporate focus and objectives while the functionality of the human element depends on factors like qualification, motivation, inter-personal relationships, training and retraining. It has been found that a good production system is usually backed up by an effective maintenance system; therefore, evaluating maintenance culture is an important ingredient in the effort to enhance productivity in the manufacturing industries (Kelly, 2006; Sodiki, 2001).

The concept of preventive maintenance.

Telsang (2008) notes that preventive maintenance is the routine inspection and service activities designed to detect potential failure conditions and make major adjustments or repairs that will be of help to prevent major operating problem. The preventive maintenance policy is a system of planned and scheduled maintenance. The basic principle involved in this system is "prevention is better than cure" it includes.

1. Proper identification of all items, their documentation and coding
2. Inspection of plant and equipments at regular interval (periodic inspection)
3. Proper cleaning, lubrication of equipments. To upkeep the machine through minor repairs and major overhauls.
4. Failure analysis and planning for their elimination.

Preventive maintenance schedules are normally of two categories

1. Fixed time maintenance (firm) schedule
2. Condition based maintenance.

Joshua (2009) observes that preventive maintenance (PM) is a fundamental, planned maintenance activity designed to improve equipment life and avoid any unplanned maintenance activity. This maintenance includes, Systematic inspection, detection of the entire maintenance which is the foundation of the entire maintenance strategy. Unless the PM program is effective, all subsequent maintenance strategies take longer to implement, incur higher costs, and have a higher probability of failure.

The Concept of Performance

The concept of performance lends itself to an almost infinite variety of definitions, many of which relate to specific contexts or functional perspectives. Anthony (1965) gave a general definition and well-crafted definition of performance, sharing the concept of two primary

components, efficacy and effectiveness. Efficiency refers to performance in terms of inputs and outputs so that the resulting higher volume for a given amount of inputs, means greater efficiency. Effectiveness refers to the performance by the degree to which planned outcomes are achieved (for example: objective to avoid interruptions of supply over a period of time can be regarded as an efficient outcome).

Many previous definitions of performance tended to focus on the size of efficiency, showing financial results as a primary measure of performance. Subsequently, this concept's definitions have evolved, especially with the emergence of the Balanced Scorecard (Kaplan, Norton, 1992) which includes not only the financial perspective, but also the internal perspective, customer perspective and innovation and learning perspective. Performance can be expressed through a balanced set of parameters describing the results and processes to achieve these results. Construction business performance is achieved by balancing and interrelation of at least four forces (Kaplan, Norton, 2001):

- Efficiency of production processes;
- Shareholders' meeting requirements;
- Customer satisfaction;
- Capacity of the growth and development - staff skills (training, satisfaction), the degree of innovation, use of opportunities.

Performance is the execution or accomplishment of work, tasks or goals to a certain level of desired satisfaction. In this study, however, organisational performance is defined in terms of the ability of an organisation to satisfy the desired expectations of three main stakeholders comprising of owners, employees and customers (Aluko, 2003). This is measured in terms of the following parameters:

i. Owners' satisfaction with costs reduction and financial returns or profits from organisational operations.
ii. Employees' satisfaction with the conditions of work, such as wages and remuneration, style of supervision, rapid promotion and the ability of the organisation to guarantee job security.
iii. Employees' expressed a desire to stay with the organisation, i.e., the ability of the organisation to retain its workforce.
iv. Customers' expressed satisfaction with the quality of the products of the organisation.

There are three views for describing the overall quality of a product. First is the views of the manufacturers, who are primarily concerned with the design, engineering and manufacturing processes involved in fabricating the product. Quality is measured by the degree of conformance to predetermined specifications and standards and deviations from these standards can lead to poor quality and low reliability. Efforts for quality improvement focuse at eliminating defects (components and subsystems that are out of conformance) the need for scrap and rework, and hence overall reduction in production costs.

Second is the view of the consumer or user. To consumers, a high-quality product is one that well satisfies their preferences and expectations. This consideration can include a number of characteristics, some of which contribute little or nothing to the functionality of the product but are significantly in providing customer satisfaction. A third view relating to quality is to consider the product itself as a system and to incorporate those characteristics that pertain directly to the operation and functionality of the product. This approach should include overlap of the manufacturer and customer views.

Theoretical Framework

This study is anchored on the theory of Waid (1983) optimal stopping theory. The theory states that optimal stopping is concerned with the problem of choosing a time to take a particular action, in order to maximize an expected cost/loss. IT is the time at which the desired event occurs and depends on the past i.e that at any time we should be able to decide whether the event that we are waiting for has already happened or not (without looking into the future).

This theory is relevant to this study in the sense that by choosing a time to take a preventive maintenance measure, it will help reduce the cost of maintenance and loss that may incur in the production processes.

Empirical Review

Halim, Mohamed, and Siti (2013) investigated total productive maintenance and manufacturing company in Malaysia. 106 out of 167 copies of questionnaire were retrieved and analysed accordingly. The inter-correlation of TPM team, strategy and planned maintenance indicated significant positive relationship with cost. The perceived reduction of manufacturing cost included production cost, manpower cost, overhead cost, material cost and unit cost. Higher practices were associated with higher cost reductions.

Mahesh and Ram (2010) assessed plant maintenance management practice in automobile industries in Francisco. They adopted a theoretical-conceptual approach specifically devoted to searching and reviewing maintenance practices in manufacturing firms. Their findings showed that the economic category of maintenance task comprise of cost structure of maintenance and production economy. The review also revealed that reliability of plant can be designed in the equipment by engineering, demonstrated by operations in a careful use of the equipment but can only be sustained by proper maintenance culture. Various works reviewed by the authors showed significant relationships between maintenance and performance of firms investigated.
Adeyeri, Kareeem, Ayodele and Emovon (2011) investigated dynamics of maintenance culture as a condition of reduction of material wastage from machines in Lagos metropolis. Structured questionnaire were administered to a vegetable oil and cocoa industries as well as the use of oral interviews. The results obtained from the analysis of data collected from the industries investigated revealed enormous material wastage from 2005-2008 when the industries maintenance approach was purely corrective maintenance. When the preventive maintenance approach was introduced, the material wastage from the machinery was reduced to bear minimum.

Bolaji and Adejuigbe (2012) investigated maintenance culture of manufacturing firms in Akure metropolis. Maintenance departments of some selected industries in Akure metropolitan, Nigeria, were visited for field survey and data acquisition. These industries were Delko Steel and wire industry limited, Afolabi Dinehin and sons limited and Titilayo Plastic industry limited. Nine performance ratios were selected in assessing the overall performance of the maintenance department in the selected industries. These ratios consists of short down intensity, emergency failure intensity, overtime ratio, maintenance production ratio, maintenance cost component, direct maintenance labour cost, cost of supplies and spare parts and monthly stock turnover. Virtually, all the performance ratios indicated poor performance in each production/maintenance section. The year of purchase of most equipment has between 1973 and 1998. The number of breakdown of machines has between 2-9 times per year. Number of overtime per day has between 1-12 hours and varies from one machine to another. The incessant breakdown of equipments were attributed to long age and poor maintenance.

Ajiboye and Adedokun (2010) investigated maintenance engineering and productivity in a salt production firm. A descriptive survey design was adopted and questionnaire were designed and administered to some selected firms in Osun State, Nigeria. Findings revealed that when production was just started with machine parts in good conditions the firm was able to achieve its objective for maximum productivity despite the fact that the firm did not introduce proper maintenance culture. Suddenly, a reduction in production of the salt firm was identified due to weakness of the machine parts. This situation resulted in total machine breakdown and increased maintenance cost.

Ribeiro (2011) explored the status of production equipment in some selected manufacturing firms in Ghana. The objective was to assess the level of maintenance practices by manufacturing firms and the influence the practices have on performance of the surveyed firms. To achieve this objective, questionnaire was designed and administered to a survey involving visits to manufacturing industries in Kumasi, Accra and Tema, all in Ghana. Interviews were also conducted where necessary. Correlational analysis was used to determine the association of maintenance practices with maintenance and production costs, employees' safety, product quality and the frequency of equipment break down. It was found that preventive maintenance was related positively with cost reduction in smaller firms investigated. Analysis also revealed that production managers in large firms found it difficult to appreciate the role of production maintenance. Production loss is probably the greatest loss to manufacturing industry as the entire business depends on output. Hence, the production managers of some surveyed firms found it difficult to release machines for maintenance until a total breakdown is experienced. Even when breakdown occurred, pressure was mounted on maintenance staff to hurriedly repair and get the machine back into the production line. This resulted in high costs of spare parts as well as other related overheads.

SUMMARY OF REVIEWED LITERATURE

Halim et al (2013) investigated total productive maintenance ad manufacturing company in Malaysia. The findings shows a positive significant relationship between the inter-correlation of total productive maintenance (TPM) team, strategy and planned maintenance and cost. Mahesh and Reum (2010) assessed plant maintenance management practice in auto mobile industries in Francisco with the adoption of theoretical-conceptual approach shows that the economic category of maintenance task comprise of cost structure of maintenance and production economy more over Adeyeri et al (2011) in their investigation or dynamics of maintenance culture as a condition of reduction of material wastage from machine in Lagos state. The result obtained from the analysis of data collected through questionnaire and oral interview revealed enormous material wastage from 2005-2008 when the industries maintenance approach was purely corrective maintenance. Still in same line of thought Bolaji and Adejuigbe (2012) investigated maintenance culture of manufacturing firms in Akure metropolis Nigeria. Their finding shows that incessant breakdown of equipment were attributed to long age and poor maintenance. Ajiboye and Adedokun (2010) investigated maintenance engineering and productivity in a salt production firms in Osun state. The finding showed that when production was just started with machine parts in good conditions the firm was able to achieve its objectives for maximum of productivity despite the tact that the firm did not introduce proper maintenance culture. But suddenly experience reduction in production due to total machine breakdown and increased maintenance cost lastly Ribeiro (2011) study on the status of production firms in Ghana. The result revealed that preventive maintenance was related positively with cost reduction in smaller firms investigated.

Various studies reveal showed a positive relation between production maintenance team, strategy. Planned maintenance and cost Italim (2013) Adeyeri et al (2011), Adejuigbe (2010) but non of this studies reviewed has examined the extent maintenance culture influence performance of selected manufacturing firms in Benue state hence specifically the extent to which preventive maintenance influence product quality of selected firms in Benue state. IT is that Yawning gap that this study seeks to fill unlike other researchers.

METHODOLOGY

Research Design

Survey research design was used in this study. The study involves the determination of the extent of the relationship between two variables namely, Maintenance Culture and performance of firms.

Population of the Study

The population of this study comprised of production/Engineering staff of three randomly selected firms out of six manufacturing firms in Benue. The three selected firms are as shown below;

Table 3.1: Population Distribution

S/N	Firms	Number of Employees	Percentage
1	Dangote Cement Company	86	37%
2	Nigeria Bottling Company	76	33%
3	Benue Breweries	71	30%
	Total	233	100%

Source: Field Survey 2015

Sample size

The Sample size for this study is 147 employees (out of a total population of 233) of the three selected manufacturing firms derived with the use of Taro Yamanes' formula for finite population as propounded by Bartlett, Kotrilik and Higgins (2001) as shown below;

$$n = \frac{N}{1 + N(e)^2}$$

Where; n = sample size, N = population; e -= error margin
Substituting in the formula, we have

$$n = \frac{233}{1 + 233(0.05)^2}$$

n = 147

Thus, the sample size is 147 employees of the selected manufacturing firms. However, Bowley's proportional allocation formula was used in determining the proportion of questionnaire to be administered to each firm.

$$ni = n\,\frac{Ni}{N}$$

Where
ni = number of questionnaire allocated to each firm
n = total sample size
Ni = number of employees in each firm
N = population size

Table 3.2: Questionnaire allocated to each firm

S/N	Firms (sampling unit)	Population	Proportion	Sample size	Question
1	Dangote Cement	86	0.36	147	52
2	Nigeria Bottling Coy	76	0.32	147	47
3	Benue Breweries	71	0.32	147	47
	Total	233	1	-	147

Source: Field survey 2015

Sources and Methods of Data

The major sources of data for the study include the primary source and secondary source were gotten from text books, internet and journals. The primary data was collected with use of questionnaire. The structured questionnaire has two parts, part 1 and part 2. Part 1 deals with Background information of the respondents which encompasses such data as gender, educational attainment and location of firm, parts 2 contain ten items organized in a section. The questionnaire was designed using the Likert five point scale ranging from strongly agree to strongly disagree. Face and content validity of the instrument was ensured. In order to establish the reliability of the instrument, the instrument was subjected to test re-test method.

DATA PRESENTATION AND ANALYSIS

The data for the analysis is presented and analyzed in line with research question and hypothesis using appropriate testing statistics. Pearson's Product Moment Correlation was used in analyzing the statistical data with the aim of establishing the strength of relationship between the dependent and independent variables. The test was conducted at 5% level of significance.

The response from the respondent covering the relevant elements of research question are compiled and presented with the mean on a Likert scale ranging from 1 to 5 in a descending order of magnitude.

SA= Strong Agree, Weight 5 points
A = Agree, Weighted 4 point
D = Disagree, Weighted 3 point
SD = Strongly Disagree, Weighted 2 point
UN = Undecided, weighted 1 point

To accept each item, mean of responses must be greater than mean of weighs (μ), otherwise, the item is rejected.

μ= (5+4+3+2+1)/5 =15/5=3
Di = Decision
Ai = Accept
R = Reject

Table 4.1: Response on the extent to which preventive maintenance influence product Quality of the selected firms

S/N	Question Item	Responses							
	Maintenance Culture	SA	A	D	SD	UN	n	$\bar{x}$	Di
	(preventive Maintenance)	5	4	3	2	1			
1	There is formal periodic equipment inspection systems that identify problems before they become perplexing.	25	60	25	30	-	140	3.6	Ai
2	When breakdown occurs, machine are reviewed and adjusted to prevent the problem from reoccurring	38	25	50	27	-	140	3.5	Ai
3	There are measures in place to monitor quality performance	50	40	50	-	-	140	4.0	Ai
4	Preventive maintenance work has the highest priority in the maintenance planning and scheduling effort	60	10	20	50	-	140	3.6	Ai
5	Potential problems are identified and work order are entered to correct them	40	20	30	50	-	140	4.4	Ai
Performance(Quality product)									
6	Standard procedures are designed before breakdown to take care of resulting consequences	35	30	60	15	-	140	4.3	Ai
7	Adequate documentation and manuals relating to maintenance are available to enhance product attribute	50	25	60	5	-	140	4.3	Ai
8	Previous work orders are routinely referred to and used for planning information on maintenance	60	25	40	15	-	140	3.9	Ai
9	Technical resource personal such as engineers and experienced technicians are available to assist teams with quality improvement	50	30	50	10	-	140	3.8	Ai
10	Preventive measures are put in place to maintain and enhance product quality	30	50	55	5	-	140	3.7	Ai

Source: Field Survey [2015]

Table 4.2 Distribution and Responses of Questionnaire

s/n	Firm	No Distributed	No returned	% of Responses
1	Dangote	53	50	34%
2	Nigeria bottling	47	44	29%
3	Benue Breweries	47	46	31%
	Total	147	140	94%

From table 4.2 147 copies of questionnaire were distributed to the selected firms and only 140 respondents returned their completed questionnaire recording 94% retuned response

Test of Hypothesis

Ho: preventive maintenance does not significantly influence product quality of selected firms

Hi : preventive maintenance significantly influence product quality of selected firms

S/N	X	Y	X^2	Y^2	XY
1	85	55	7225	3025	4675
2	63	77	3969	5929	4851
3	90	50	8100	2500	4500
4	70	70	4900	4900	4900
5	60	80	3600	6400	4800
6	65	75	4225	5625	4875
7	75	65	5625	4225	4875
8	85	55	7225	3025	4675
9	80	60	6400	3600	4800
10	80	60	6400	3600	4800
∑	753	647	57669	42829	47751

Product moment correlation coefficient (r) calculated

$$r = \frac{N\sum xy - (\sum x)(y)}{\sqrt{[N\sum x^2 - (\sum x)^2\,[N\sum y^2 - (y)^2]}}$$

Where
N = Number of pairs of scores
Σxy = Sum of the products of paired scores
Σx = Sum of x scores
Σy = Sum of y scores
Σx^2 = Sum of squared x scores
Σy^2 = Sum of squared y scores

$$r = \frac{10[47751] - (753) * [647]}{\sqrt{10\,(57669) - (753)^2 * [10\,[47829] - (649)^2}}$$

$$r = \frac{9681}{\sqrt{(552{,}678{,}609}}$$

$$r = 0.51$$

Test of the significance of r
To do this, the null and the alternate hypothesis are stated as follows
Ho: e =o (there is no linear relationship between x and y)
Ho: e≠ o (there is a linear relationship between x and y)
The test for significance for r is a 't' test and the formula for the test statistics is given as

$$t = r\sqrt{n-2/1-(r)^2}$$

$$t = \frac{0{,}5\sqrt{10}-2}{1-(0.51)2}$$

$$t = \frac{1.1597}{0.8319}$$

$$t = 1.89$$

t critical at 8 degree of freedom and 5% level of significance equal to 1.860

Decision
Accept Ho when t cal is less than t crit otherwise
Reject Ho and uphold Hi

Since t cal 1.89 is greater than t crit. We reject the null hypothesis and accept the alternate hypothesis which signifies that preventive maintenance significantly influence product quality of Dangote cement plc, Nigeria bottling company and Benue breweries Makurdi

DISCUSSION OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

Discussion of findings

From the result obtained, it was seen that preventive maintenance influences the product quality of the selected firms. Though the correlation coefficient showed a value of 0.51 regarded as moderate relationship, the significant test shows that maintenance culture significantly influence product quality of the selected firms at 5% level of significance. The result of this study is consistent with the findings of Ribeiro (2011) that preventive maintenance is related positively with cost reduction in smaller firms investigated

Conclusion

In view of the above findings, the study concludes that preventive maintenance significantly influences product delivery of manufacturing firms in Benue State, Nigeria. The result of product moment correlation coefficient 0.51 and test of significance of 1.89 shows that preventive maintenance significantly influence product quality of Dangote cement company, Nigeria bottling company and Benue breweries Makurdi which are the selected firms for the study. The implication is that adequate preventive measure will reduce rate of machine breakdown, cost and ensure continuous operation of the machine for optimum product delivery and the maintenance of quality standard.

Recommendations

In the light of the findings the study recommends that ;

1. The firms in addition to the implementation of preventive measures of maintenance should ensure that other corrective measures are in place to reduce the rate of breakdown of machine and reduce the cost associated with repair and spare parts
2. Management should develop continuous training programmes for maintenance personnel as a pillar for proper maintenance culture development.
3. Designs, purchases and new installations should be meticulously evaluated before decisions on such issues are made to forestall inadequacy in maintenance personnel skills and spare parts.

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