STIMULATING PRODUCTIVITY THROUGH MAINTENANCE MANAGEMENT: THE NIGERIAN EXPERIENCE

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Abstract
Owners of organization are basically concerned with how to enhance output and increase sales. To achieve that, lot of scholarly efforts have been engineered and re-engineered. This study examined how this basic effort that defines in this context productivity can be enhanced through the maintenance management of equipment and machinery. To put the work in perspective, certain hypotheses were formulated, though two could not be tested because of unavailability of date, using ANOVA, it was observed that equipment servicing, and equipment repairs which are dimensions of maintenance significantly impact sales volume and level of patronage. Consequently, the study recommended maintenance consciousness and implementation in addition to other scholarly recommended postulations if productivity will be enhanced.

Keywords: Maintenance Management, Servicing, Repairs, Productivity, Sales Volume, Patronage, Output.

Introduction

Productivity is a critical concern in socio-economic development of all Nations (Inyang, 2002). It guarantees utility and standard of living for the individuals, profit for shareholders, wages for the workers and taxes for the government. It behoves on managers to mobilize available resources to carry out production to meet up predetermined goals. Due to its importance, several approaches have been advanced on how to improve productivity such as motivating employees, training and development, time management, team work, participatory leadership style and inventory management and control (Taylor, 1914; Fayol, 1930; Mayo 1953; McGregor 1950; Maslow 1960); job satisfaction (Parida & Kumar, 2009). A review of the compendium of literatures reveals that they are workers based approach.

Today productions are mechanized or almost automated far away from the beginning of industrial revolution era when most production is manual based. Even in industrial operation that is not fully automated mechanized, there is a combination of machine with some sort of manual operation. This is the stage of most industrial setting in most under developed economies. It will be fatal therefore to consider key drivers of increased productivity in the context of workers-based approach even if it is the man that operates the machine because it is only machines that are in good working condition that can be operated by the man. It was maybe in the realization of this that informed the national workshop on productivity in Nigeria to identify four (4) main causes of productivity in Nigeria as economics, sociological, managerial and technological equipment and machineries (Nwachukwu, 1992).

Given the growth of industry and contemporary nature of production, there arise the needs of balance between the man at work and the machine for the work. With the mechanized state of production one can assert that the degree of productivity to a large extent depends on the fitness and operational nature and state of the equipment and machinery. To attain this state of fitness and operation, the machine must be effectively maintained. More so because machines and equipment continually wear and tear, they need good maintenance to ensure that they operate efficiently since breakdown may result in loss of profit and market share (Mac'Odo 2008).

Plant maintenance refers to the methods, strategies and practices used to keep an industrial factory running efficiently. That may be through inspections, repairs, service, overhaul and replacement (Saale, 2007). Proper maintenance of machineries and equipment and other support facilities used in production is a critical requirement for not only keeping the production system in stable and optimal operating level but also play a significant role in the production or output level. Plant maintenance as a proposition to enhancing organizational productivity has its peculiar challenges: cost/wastage implication of the type of maintenance to adopt, the choice of which to adopt also becomes a critical management issue. Increased productivity can be achieved through maintenance but how well a manager selects and balances the maintenance approach makes the difference in terms of output and profit (Saale, 2007).

A critical review shows evidence of volumes of scholarly work done on this topic both internationally and locally (Saale 2007, Mac'Odo 2005). Most extant studies on the subject matter reviewed did consider the impact of maintenance on organizational productivity within the Nigerian context. A closer attempt was undertaken by Parida and Kumar (2009); Swanson (2000) and Martin (2005) where the issues examined, though not within the Nigerian context, bordered on maintenance productivity and performance measurement; measuring maintenance performance in search for a maintenance productivity index; linking maintenance strategies to performance; from high performance to high productivity: what managers need to know about generation Y; and the role of maintenance in improving companies' productivity and profitability respectively. The departure of this study from several other studies therefore is that it examines the impact of maintenance in productivity of public parastatal in the Nigerian work setting of the production process that is based on product data in the form of prices, quantity of input and quantity of output.

Organizations been efficiency seeking ventures have not only desired productivity but a continuous increased productivity or productivity growth. This is important to the firm because it guarantees more real income that may enable the firm to meet its obligation to its stakeholders. To achieve increased productivity, certain drivers have been identified by United Kingdom Office for natural statistics to include investment in physical capital including purchase and repair and maintenance of machinery, equipment and building (Schreyor, 2013); innovation, skill disposition, entrepreneurship and competitiveness. From the foregoing and from extant literature on the subject matter one can see that there are many different productivity measures. The choice of which to study or examine depends on the purpose of the study or data availability (Saale, 2007). In this study, the productivity measure that will be adopted is profitability, output and sales, structural from the work of Schreyor (2013). Profitability is the excess of income over expenditure generated from the activities of the business. This is an important measure of productivity because without it the business firm will not survive in the long run. Measuring past, current and post at future profitability is important because it gives an idea of the performance of the firm (Ayres & Warr, 2012). Increased productivity translates into increased profit holding all things constant. This is one of the most important tasks of the business manager since a firm that is highly profitable has the ability to reward its owners and other stakeholders with large returns (Paul 1992). Output can mean the number of products created with a given period of time in a real sector context (Rana & Koroitamana, 2016) or amount of service delivery in a service sector (Schdeyer, 2013). The increase in output which defines increased profit or service delivery also translates into increased revenue and profit sales measure the amount of goods or services marketable within a given time. An increased sale means the acceptability of the product or service with several attendant marketing benefits.

In the light of the rewarded works, I will consider the dimension of maintenance management and preventive maintenance after the works of Banjoko (1996) and Mac'Odo (2002), considering these are the two main dichotomies.

LITERATURE REVIEW

The Nature and Concept of Maintenance in Organizational Productivity

Equipment maintenance and system reliability are important factors that affect organizational ability to provide quality and timely services to customers and enhance competitiveness. Maintenance functioning is therefore vital for sustainable performance of any manufacturing plant. Swanson (2000) sees maintenance as a combination of all technical and associated administration activities required to keep equipment, machinery and other physical assets in the desired condition. The maintenance engineering society of Australia (MESA) as cited in Tsang (1998) defines maintenance as the engineering decisions and associated actions necessary for optimising equipment capacity. Summarily, maintenance could mean all the methods, strategies and practices used to keep a production process or system in stable and good working conditions. The best machines will neither work satisfactorily nor last long if they are left un-serviced or uncared for. Maintenance management therefore is the direction and organization of resources in order to control the availability and performance of industrial plant to some specified level with some defined objectives which include ensuring the plant functionality, safety effectiveness and efficiency of operation (Mac'Odo 2002, Banjoko, 1996).

Once the maintenance objectives are outlined, maintenance strategy formulation is necessary to help decide which type of maintenance needs to be done, when to do it and how often it can be done (Punjala, 2008). The different type of maintenance policy available to an organization is breakdown maintenance, preventive/predictive maintenance, proactive maintenance, total production maintenance and reliability centre maintenance (Saale 2006, Tokutaro 1994, Banjoko 1996; Mac'Odo 2002). Breakdown maintenance is an emergency measure designed to put the broken down machine back to workable form. It requires fixing when broken down. Preventive Maintenance is the measure adopted such as periodic checks and servicing to guide against breakdown of equipment. It is a form of scheduled maintenance. Proactive is a type of maintenance carried out on any source of failure detected to guide against breakdown. Predictive maintenance is a type of maintenance that is carried out based on the perceived conditioned of equipment, thus it requires condition-based monitoring.

Productivity

Productivity is commonly defined as a ratio of a volume measure of output to input (OECD, 2013). Expatiating this definition, Kohli (2013) sees productivity as a ratio of output, thus, it is a measure of total output per one unit of total input. A review of the definition in management literature bordering on the concept of productivity reveals that there is neither a unique purpose nor a single measure for it. For measurability and operationalization of the concept, Schreger (2013) definition will be adopted here. Schreger (2013) sees productivity as a numerical expression of the production process that is based on production data in the form of prices, quantity of input and quality of output.

Organizations been efficiency seeking ventures have not only desired productivity but a continuous increased productivity or productivity growth. This is important to the firm because it guarantees more real income that may enable the firm to meet its obligation to its stakeholders. To achieve this increased productivity, certain drivers have been identified by United Kingdom office for national statistics to include investment on physical capital including purchase and repair and maintenance of machinery, equipment and building (Tsang, 1998); innovation , skill disposition, entrepreneurship and competitiveness. From the foregoing and from extant literature on the subject matter, one can see that there are many different productivity measures. The choice of which to study or examine depends on the purpose of the study or date availability (Schreyor, 2013); in this study, the productivity, output and sales are extracted from the work of Schreyor (2013). Profitability is the excess of income over expenditure generated from the activities of the business. This is an important measure of productivity because without it the business firm will not survive in the long run. Measuring past, current and post and projecting the future profitability is important because it gives an idea of the performance of firm (Ayres & Warr, 2002). Increased productivity translates into increased profit holding all things constant. This is one of the most important tasks of the business manager since a firm that is highly profitable has the ability to reward its owners and other stakeholders with large returns (Paul 1992).

Output can mean the number of products created with a given period of time in a real sector context (Martin, 2005) or amount of service delivery in a service sector (Schreyer, 2013). The increase in output or amount of service delivered which defines increased productivity also translates into increased revenue and profit. Sales on the other hand mean the amount of goods or services marketable within a given period of time. Increased sales mean the acceptability of the product or service which generates several other attendant marketing benefits.

In the light of the reviewed works, I have chosen the dimensions of maintenance management as predictive and breakdown maintenance (Banjoko, 1996 & Mac'Odo 2002). Considering this as the two major dichotomies, every other form can be collapsed into this. The measures of productivity adopted in the study are output and sales patterned after the works of Swanson (2000). From the dimension of the dependent variable and the measures of the independent variable some hypotheses have been drawn as shown below:

H_{01}: *Equipment servicing does not significantly impact output*

H_{02}: *Equipment servicing does not significantly impact sales / patronage*

H_{03}: *Repairs do not significantly impact output*

H_{04}: *Repairs do not significantly impact sales / patronage*

H_{05}: *Organisational Type does not significantly moderate Maintenance Management and Productivity*

Methodology

In this investigative research, quasi-experimental design using cross sectional survey was adopted. The study is both at the macro level. My investigation was on the management staff at different strata at the chosen privately owned and publicly managed firms. The study area or geographical location is Nigeria. The population of study is 20 manufacturing firms with accessible time series data in operation for well over 10 years. Constrained by the number of effective government owned firm, and the attempt to devoid this study from bias, 10 firms given the aforementioned criteria was chosen from the privately and publicly owned firm. The study duration is five years (2013 -2017).

S/N	Companies	Servicing /Overhauling (#000000)					Repairs (#000000)					Total output(quantity) Carton/Crates/Barrel					Sales/Patronage/Revenue (#000000)				
	PRIVATELY OWN FIRMS	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
A	**Cement/Limestones**																				
1	Dangote Cements	B	C	C	D	D	C	C	D	E	E	D	D	E	E	E	D	E	E	E	E
2	Lafarge Cements	A	A	B	B	B	A	A	A	A	A	A	A	A	A	A	C	C	C	C	C
B	**Noodles/Foods**																				
1	Dufil Prima Foods	A	A	A	B	B	B	A	A	B	B	A	B	B	C	C	B	B	C	C	D
2	Dangote Pasta	B	C	C	C	C	B	C	C	D	D	A	A	A	A	A	B	B	B	B	B
C	**Drinks**																				
1	Nigerian Bottling Company	B	C	B	C	C	B	A	B	C	C	B	C	C	C	C	B	C	C	C	C
2	Nigerian Breweries	B	B	B	B	B	A	A	B	C	C	B	B	B	B	C	B	B	B	C	C
D	**Textiles /Fabrics**																				
1	African Textile Man Coy	A	A	A	B	B	B	B	B	B	B	A	A	A	A	A	B	B	B	B	B
2	Da Viva Textile	A	A	A	A	A	B	B	B	B	B	A	A	A	A	A	B	B	B	B	B
E	**Cosmetics/Beverages**																				
1	Nestle Nigeria	B	B	B	B	B	B	C	C	C	C	B	B	C	D	D	C	C	D	D	D
2	Unilivers Nigeria	B	B	B	B	B	C	C	C	C	D	B	C	D	D	D	C	D	D	D	D
	GOVT OWNED FIRMS																				
1	NPHC	A	A	A	A	A	A	A	A	A	A						A	A	A	A	A
2	Nigerian coal corporation	A	A	A	A	A	A	A	A	A	A						A	A	A	A	A
3	NITEL	A	A	A	A	A	A	A	A	A	A						A	A	A	A	A
4	Peugeot Automobile	A	A	A	A	A	A	A	A	A	A						A	A	A	A	A
5	Nigerian port Authority	B	B	B	B	B	B	B	B	B	B						C	C	D	D	D
6	Nig Rail way Corp	A	A	A	A	A	A	A	A	A	A						B	B	B	B	B

7	Federal Airport Authority	B	B	C	B	C	C	C	C	C	C						C	C	D	D	D
8	Harcourt Refinery Com ltd	A	A	B	B	B	C	C	C	C	C						A	B	B	B	B
9	NNPC	B	B	B	C	C	C	C	C	D	D						E	E	E	E	E
10	Bank of Agriculture	A	A	A	A	A	A	A	A	A	A						A	A	A	A	A

S/N	Companies	Servicing /Overhauling (#000000)					Repairs (#000000)					Total output(quantity) Carton/Crates/Barrel					Sales/Patronage/Revenue (#000000)				
	PRIVATELY OWN FIRMS	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
A	**Cement/Limestones**																				
1	Dangote Cements	1.5-2.5	2.5-3.5	2.5-3.5	3.5-4.5	3.5-4.5	6.5-7.5	6.5-7.5	7.5-8.5	8.5 & above	8.5 & above	20-25	20-25	25 & above	25 & above	25 & above	200-250	250 & above	250 & above	250 & above	250 & above
2	Lafarge Cements	0.5-1.5	0.5-1.5	1.5-2.5	1.5-2.5	1.5-2.5	Less than 5	Less than 5	Less than 5	Less than 5	Less than 5	Less than 10	Less than 10	Less than 10	Less than 10	Less than 10	150-200	150-200	150-200	150-200	150-200
B	**Noodles/Foods**																				
1	Dufil Prima Foods	0.5-1.5	0.5-1.5	0.5-1.5	1,5-2.5	1,5-2.5	5-6.5	Less than 5	Less than 5	5- 6.5	5-6.5	Less than 10	10-15	10-15	15-20	15-20	100-150	100-150	150-200	150-200	200-250
2	Dangote Pasta	1.5-2.5	2.5-3.5	2.5-3.5	2.5-3.5	2.5-3.5	5-6.5	6.5-7.5	6.5-7.5	7.5-8.5	7.5-8.5	Less than 10	Less than 10	Less than 10	Less than 10	Less than 10	100-150	100-150	100-150	100-150	100-150

C	**Drinks**																			
1	Nigerian Bottling Company	1.5-2.5	2.5-3.5	1.5-2.5	2.5-3.5	2.5-3.5	5-6.5	Less than 5	5-6.5	6.5-7.5	6.5-7.5	10-15	15-20	15-20	15-20	15-20	100-150	100-150	100-150	150-200	150-200
2	Nigerian Breweries	1.5-2.5	1.5-2.5	1.5-2.5	1.5-2.5	1.5-2.5	Less than 5	Less than 5	5-6.5	15-20	15-20	10-15	10-15	10-15	10-15	20-25	100-150	100-150	100-150	150-200	150-200
D	**Textiles /Fabrics**																			
1	African Textile Man Coy	0.5-1.5	0.5-1.5	0.5-1.5	1.5-2.5	1.5-2.5	5-6.5	5-6.5	5-6.5	5-6.5	5-6.5	Less than 10	Less than 10	Less than 10	Less than 10	Less than 10	100-150	100-150	100-150	100-150	100-150
2	Da Viva Textile	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	5-6.5	5-6.5	5-6.5	5-6.5	5-6.5	Less than 10	Less than 10	Less than 10	Less than 10	Less than 10	100-150	100-150	100-150	100-150	100-150
E	**Cosmetics/Beverages**																			
1	Nestle Nigeria	1.5-2.5	1.5-2.5	1.5-2.5	1.5-2.5	1.5-2.5	5-6.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5	10-15	10-15	15-20	20-25	20-25	150-200	150-200	200-250	200-250	200-250
2	Unilevers Nigeria	1.5-2.5	1.5-2.5	1.5-2.5	1.5-2.5	1.5-2.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5	7.5-8.5	10-15	15-20	20-25	20-25	20-25	150-200	200-250	200-250	200-250	200-250
	GOVT OWNED FIRMS																			
1	NPHC	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	Less than 5	Less than 5	Less than 5	Less than 5	Less than 5						Less than 100	Less than 100	Less than 100	Less than 100	Less than 100
2	Nigerian coal	0.5-	0.5-	0.5-	0.5-	0.5-	Less	Less	Less	Less	Less						Less	Less	Less	Less	Less

	corporation	1.5	1.5	1.5	1.5	1.5	than 5	than 5	than 5	than 5	than 5						than 100	than 100	than 100	than 100	than 100
3	NITEL	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	Less than 5	Less than 5	Less than 5	Less than 5	Less than 5						Less than 100	Less than 100	Less than 100	Less than 100	Less than 100
4	Peugeot Automobile	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	Less than 5	Less than 5	Less than 5	Less than 5	Less than 5						Less than 100	Less than 100	Less than 100	Less than 100	Less than 100
5	Nigerian port Authority	1.5-2.5	1.5-2.5	1.5-2.5	1.5-2.5	1.5-2.5	5-6.5	5-6.5	5-6.5	5-6.5	5-6.5						150-200	150-200	200-250	200-250	200-250
6	Nig Rail way Corp	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	Less than 5	Less than 5	Less than 5	Less than 5	Less than 5						100-150	100-150	100-150	100-150	100-150
7	Federal Airport Authority	1.5-2.5	1.5-2.5	2.5-3.5	1.5-2.5	2.5-3.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5						150-200	150-200	200-250	200-250	200-250
8	Harcourt Refinery Com ltd	0.5-1.5	0.5-1.5	1.5-2.5	1.5-2.5	1.5-2.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5						Less than 100	100-150	100-150	100-150	100-150
9	NNPC	1.5-2.5	1.5-2.5	1.5-2.5	2.5-3.5	2.5-3.5	6.5-7.5	6.5-7.5	6.5-7.5	7.5-8.5	7.5-8.5						250 & Above	250 & Above	250 & Above	250 & Above	250 & Above
10	Bank of Agriculture	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	0.5-1.5	Less than 5	Less than 5	Less than 5	Less than 5	Less than 5						Less than 100	Less than 100	Less than 100	Less than 100	Less than 100

Key values of dimension and measures for maintenance and productivity

Repairs		**Service**		**Total output**		**Sales/Patronage/Revenue**	
A.	Less than 5	**A.**	0.5 – 1.5	**A.**	Less than 10	**A.**	Less than 100
B.	5 - 6.5	**B.**	1.5 – 2.5	**B.**	10 – 15	**B.**	100 - 150
C.	6.5 - 7.5	**C.**	2.5 – 3.5	**C.**	15 – 20	**C.**	150 - 200
D.	7.5 - 8.5	**D.**	3.5 – 4.5	**D.**	20 – 25	**D.**	200 - 250
E.	8.5 & Above	**E.**	4.5 & Above	**E.**	25 & Above	**E.**	250 & Above

HYPOTHESES TESTING

H_{O1}: Equipment servicing does not significantly impact sales / patronage

Table 1: Summary of Regression Analysis on the impact of equipment servicing on sales/patronage

Variables	N	Mean ± SD	T-value	P-value	F-value	R^2
Sales/Patronage	100	1.5405E8±6.42662 E7	2.909	.004	8.461	.079
Servicing	100	1.7600E6±7.92898 E5				

From Table 1 above, sales/patronage was seen to be affected by equipment servicing. This is because F (1, 98) = 8.461 and P =.004 ($p<0.05$). Also, the coefficient of determination (R^2 = 0.079) revealed that 7.9% of sales/patronage can be explained by equipment servicing. Therefore, null hypothesis is rejected, which implies that equipment servicing significantly impact sales/patronage.

H_{O2}: Repairs do not significantly impact sales / patronage

Table 2: Summary of Regression Analysis on the impact of equipment servicing on sales/patronage

Variables	N	Mean ± SD	T-value	P-value	F-value	R^2
Sales/Patronage	100	1.5405E8±6.42662 E7	1.750	.083	3.063	.030
Repairs	100	5.3935E6±2.56110 E6				

From Table 1 above, sales/patronage was not seen to be affected by repairs. This is because F (1, 98) = 3.063 and P =.083 ($p>0.05$). Also, the coefficient of determination (R^2 = 0.030) revealed that 3.0% of sales/patronage can be explained by repairs. Therefore, null hypothesis is accepted, which implies that repair does not significantly impact sales/patronage.

H_O: There is no significant difference between privately and Government owned firms on equipment servicing.

Table 3: Summary of ANOVA Analysis on the privately and Government firms on servicing

Variable	Firms	N	Mean ± SD	P-value	F-value
Servicing	Privately Owned	50	2.0600E6±7.93082E 5	.000	16.566
	Government Owned	50	1.4600E6±6.76425E 5		

From Table 3 above, difference exists between privately and Government owned firms. This is because F (1, 98) = 16.566 and P =.000 (p<0.05). Therefore, null hypothesis is accepted, which implies that there is a significant difference between privately and Government owned firm on equipment servicing.

H_O: There is no significant difference between privately and Government owned firms on sales/patronage.

Table 4: Summary of ANOVA Analysis on the privately and Government firms on servicing

Variable	Firms	N	Mean ± SD	P-value	F-value
Sales/Patronage	Privately Owned	50	1.7000E8±5.32131E7	.012	6.502
	Government Owned	50	1.3810E8±7.06666E7		

From Table 4 above, difference exists between privately and Government owned firms. This is because F (1, 98) = 6.502 and P =.012 (p<0.05). Therefore, null hypothesis is accepted, which implies that there is a significant difference between privately and Government owned firm on sales/patronage.

H_0: Organizational type does not significantly moderate Maintenance Management and Productivity

Table 5: Summary of ANOVA Analysis on the organizational type with maintenance management and productivity

	Firms	N	Mean ± SD	P-Value	F-Value
Servicing	Privately Owned	50	2.0600E6±7.93082E5	0.000	16.566
	Government Owned	50	1.4600E6±6.76425E5		
Repairs	Privately Owned	50	26.3120E6±2.8427E5	0.000	14.633
	Government Owned	50	4.4750E6±1.85731E6		

From Table 5 above, difference exists between privately owned firms with maintenance and productivity. This is because F (1, 98) = 16.566 and P =.000 (p<0.05). Also, difference exists between Government owned firms with maintenance and productivity. This is because F (1, 98) = 14.633 and P =.000 (p<0.05).

H_{05}: Organizational Type does not significantly moderate Maintenance Management and Productivity

Descriptive

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Servicing Overhauling	Privately Owned	50	2.0600E6	7.93082E5	1.12159E5	1.8346E6	2.2854E6	1.00E6	4.00E6
	Government Owned	50	1.4600E6	6.76425E5	9.56610E4	1.2678E6	1.6522E6	1.00E6	3.00E6
	Total	100	1.7600E6	7.92898E5	7.92898E4	1.6027E6	1.9173E6	1.00E6	4.00E6
Repairs	Privately Owned	50	6.3120E6	2.84271E6	4.02019E5	5.5041E6	7.1199E6	3.00E6	1.75E7
	Government Owned	50	4.4750E6	1.85731E6	2.62664E5	3.9472E6	5.0028E6	3.00E6	7.00E6
	Total	100	5.3935E6	2.56110E6	2.56110E5	4.8853E6	5.9017E6	3.00E6	1.75E7

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ONEWAY Servicing Overhauling Repairs BY Firms
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  /MISSING ANALYSIS.
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ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Servicing Overhauling	Between Groups	9.000E12	1	9.000E12	16.566	.000
	Within Groups	5.324E13	98	5.433E11		
	Total	6.224E13	99			
Repairs	Between Groups	8.436E13	1	8.436E13	14.633	.000
	Within Groups	5.650E14	98	5.765E12		
	Total	6.494E14	99			

The impact of Equipment servicing and Sales patronage with privately and Government owned firms

```
ONEWAY Servicing Overhauling Sales Patronage BY Firms
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS.
```

One way

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
Servicing Overhauling	Between Groups	9.000E12	1	9.000E12	16.566	.000
	Within Groups	5.324E13	98	5.433E11		
	Total	6.224E13	99			
Sales Patronage	Between Groups	2.544E16	1	2.544E16	6.502	.012
	Within Groups	3.834E17	98	3.913E15		
	Total	4.089E17	99			

Descriptive

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Servicing Overhauling	Privately Owned	50	2.0600E6	7.93082E5	1.12159E5	1.8346E6	2.2854E6	1.00E6	4.00E6
	Government Owned	50	1.4600E6	6.76425E5	9.56610E4	1.2678E6	1.6522E6	1.00E6	3.00E6
	Total	100	1.7600E6	7.92898E5	7.92898E4	1.6027E6	1.9173E6	1.00E6	4.00E6
Sales Patronage	Privately Owned	50	1.7000E8	5.32131E7	7.52547E6	1.5488E8	1.8512E8	1.25E8	3.00E8
	Government Owned	50	1.3810E8	7.06666E7	9.99376E6	1.1802E8	1.5818E8	8.00E7	3.00E8
	Total	100	1.5405E8	6.42662E7	6.42662E6	1.4130E8	1.6680E8	8.00E7	3.00E8

Impact of Repairs on Sales /Patronage

```
GET
  FILE='C:\Users\UCHEJE\Documents\Dr Richard\Data Input.sav'.
DATASET NAME DataSet0 WINDOW=FRONT.
ONEWAY Repairs Sales/Patronage BY Firms
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=TUKEY ALPHA(0.05).
```

One way

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Repairs	Between Groups	8.436E13	1	8.436E13	14.633	.000
	Within Groups	5.650E14	98	5.765E12		
	Total	6.494E14	99			
Sales/Patronage	Between Groups	2.544E16	1	2.544E16	6.502	.012
	Within Groups	3.834E17	98	3.913E15		
	Total	4.089E17	99			

Descriptive

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Repairs	Privately Owned	50	6.3120E6	2.84271E6	4.02019E5	5.5041E6	7.1199E6	3.00E6	1.75E7
	Government Owned	50	4.4750E6	1.85731E6	2.62664E5	3.9472E6	5.0028E6	3.00E6	7.00E6
	Total	100	5.3935E6	2.56110E6	2.56110E5	4.8853E6	5.9017E6	3.00E6	1.75E7
Sales/Patronage	Privately Owned	50	1.7000E8	5.32131E7	7.52547E6	1.5488E8	1.8512E8	1.25E8	3.00E8
	Government Owned	50	1.3810E8	7.06666E7	9.99376E6	1.1802E8	1.5818E8	8.00E7	3.00E8
	Total	100	1.5405E8	6.42662E7	6.42662E6	1.4130E8	1.6680E8	8.00E7	3.00E8

Equipment servicing does not significantly impact sales / patronage

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA CHANGE
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT Sales/Patronage
  /METHOD=ENTER Servicing Overhauling
  /RESIDUALS HIST(ZRESID) NORM(ZRESID).
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
Sales/Patronage	1.5405E8	6.42662E7	100
ServicingOverhauling	1.7600E6	7.92898E5	100

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.282[a]	.079	.070	6.19733E7	.079	8.461	1	98	.004

a. Predictors: (Constant), Servicing Overhauling

b. Dependent Variable: Sales/Patronage

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.250E16	1	3.250E16	8.461	.004[a]
	Residual	3.764E17	98	3.841E15		
	Total	4.089E17	99			

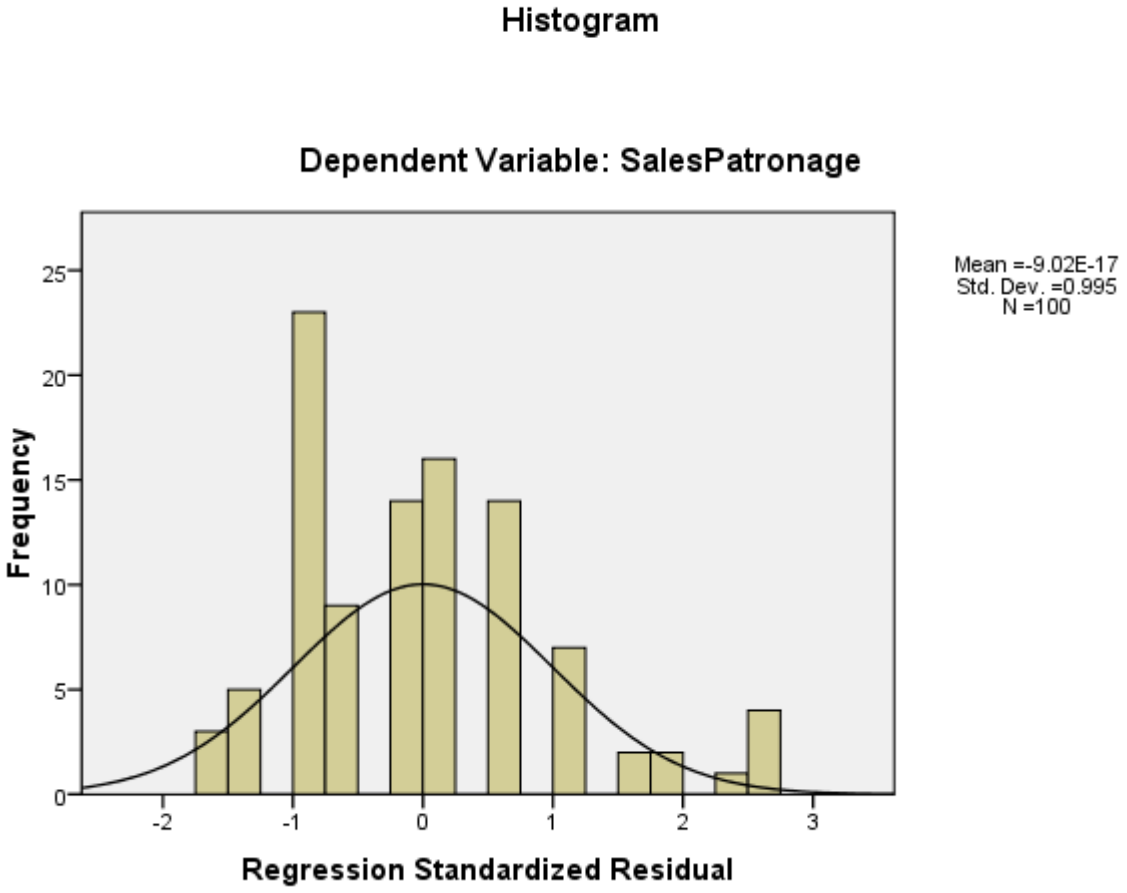
a. Predictors: (Constant), Servicing Overhauling

b. Dependent Variable: Sales/Patronage

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.138E8	1.515E7		7.513	.000
	ServicingOverhauling	22.850	7.855	.282	2.909	.004

a. Dependent Variable: Sales/Patronage



Repairs do not significantly impact sales / patronage

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA CHANGE
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT Sales/Patronage
  /METHOD=ENTER Repairs
  /RESIDUALS HIST(ZRESID) NORM(ZRESID).
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
Sales/Patronage	1.5405E8	6.42662E7	100
Repairs	5.3935E6	2.56110E6	100

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.174[a]	.030	.020	6.36068E7	.030	3.063	1	98	.083

a. Predictors: (Constant), Repairs

b. Dependent Variable:
Sales/Patronage

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.239E16	1	1.239E16	3.063	.083[a]
	Residual	3.965E17	98	4.046E15		
	Total	4.089E17	99			

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.239E16	1	1.239E16	3.063	.083[a]
	Residual	3.965E17	98	4.046E15		
	Total	4.089E17	99			

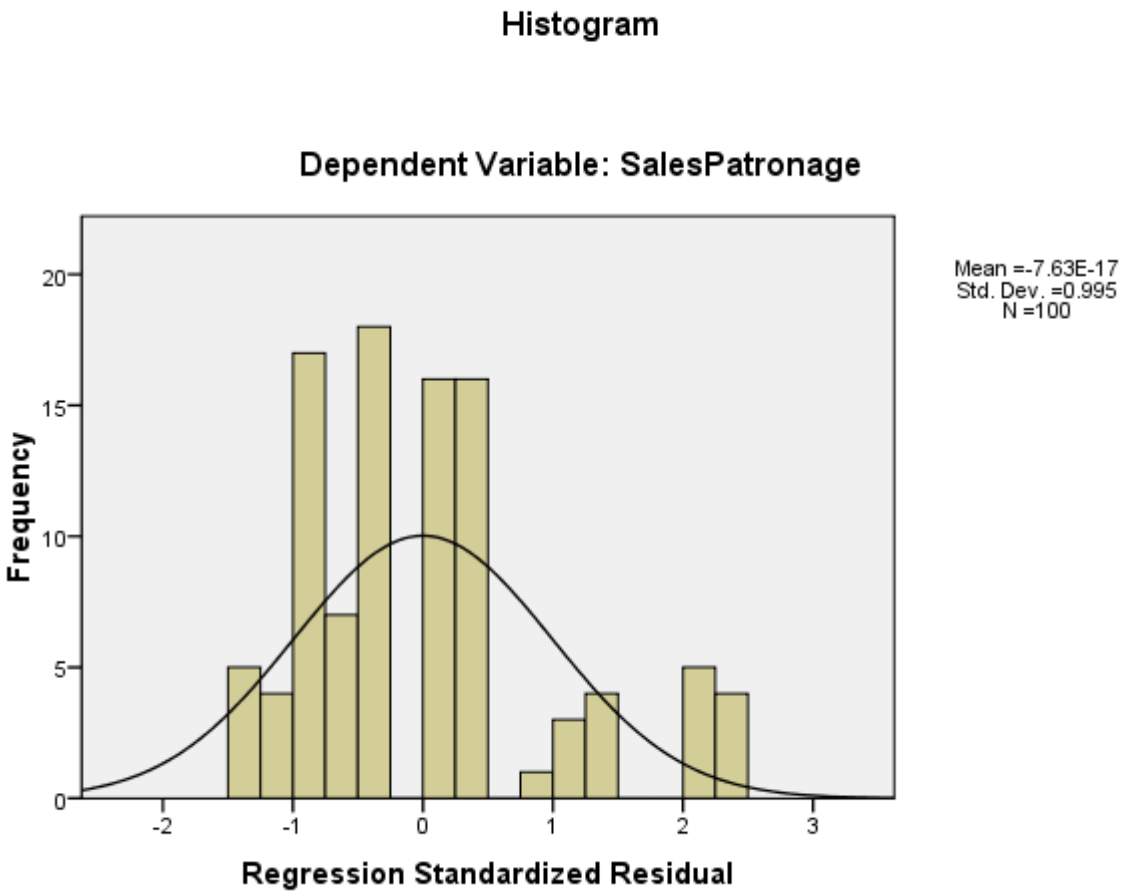
a. Predictors: (Constant), Repairs

b. Dependent Variable: Sales/Patronage

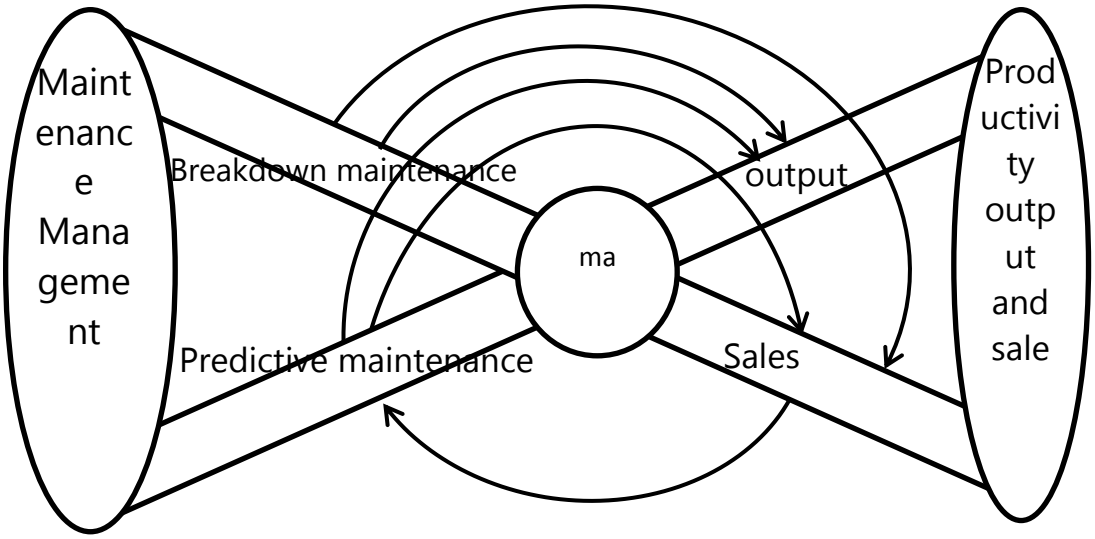
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.305E8	1.489E7		8.764	.000
	Repairs	4.369	2.496	.174	1.750	.083

a. Dependent Variable: Sales/Patronage



Therefore, null hypothesis is rejected, which implies that organizational type significantly moderate maintenance management and productivity



DISCUSSION, CONCLUSION AND RECOMMENDATION

Organisation owners are basically concerned about how output and sales volume can be enhanced since those translate into increased profit. Along lots of postulations and theories, this study attempts an examination of maintenance management which is aimed at keeping the equipment and facility at optimal productivity level and install capacity. The philosophy of this study is that if equipment and facilities are maintained, they will perform at an installed capacity and productivity level. This will translate into enhanced output, increased sales and increased profitability. From basic hypotheses which were drawn, due to unavailability of data only two of the hypotheses were tested using ANOVA.

Data on output for government owned firms were not available. Findings reveal that equipment services impact sales volume patronage and also that repairs significantly impact on sales volume and patronage. Summarily therefore, it can be held that maintenance management (services and repairs) significantly impact sales volume patronage (productivity).

The findings of these hypotheses collaborated the worries of Mohamed and Anis (2018), Wenteng, Jianshe & Kexia (2014) and Anil & Emosi (2016). Though their studies were conducted in different contexts and in different columns, the findings show that there is a relationship between maintenance management and the chosen objective issues. If equipment

and facilities are maintained they will work according to install capacity and this guarantees increased output and increased sales given the competitive quality of the goods and services.

Consequent on the findings, it is recommended that firms should repair and service their equipment regularly to enhance optimal function ability of the equipment for increased output and sales. It is observed that privately owned firms' budgetary allocation and attention to the maintenance policy and effort is comparatively better than public owned firms and thus also have a comparative higher output and sales/patronage than public owned firm. It can be concluded therefore that maintenance consciousness and application is a guarantee for comparative edge and better performance and enhanced productively.

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