

## Total Productive Maintenance and Performance of Bottling Company Plants in Edo State.

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### Abstract

The broad objective of this paper is to determine the effect of total productive maintenance on performance of selected bottling company plants in Edo State. Specifically, this paper seeks to ascertain the effect of planned maintenance on the competitive advantage of selected bottling company plants in Edo State. Survey research design was adopted for the study, a total population of two hundred and sixty nine (269) was used for the study, census sampling method was used for the study because the population is a manageable size, the data collection tool employed by the researcher was the questionnaire, while the analysis of the data was done using the linear regression analysis. The findings revealed that planned maintenance impacts the competitive advantage of selected bottling company plants in Edo State since ( $F = 223.041$ ;  $R^2 = 0.832$ ;  $P < .05$ ). The researchers therefore concluded that total productive maintenance impacts the performance of the companies in focus. It was against this backdrop that the researchers recommended that heads of the production department of the companies in focus should ensure the enactment of a schedule geared towards regularly maintaining their production equipments and an orientation of new employees on the importance of equipment maintenance should be done by heads of the production department of the companies in focus.

Keywords: Total Productive Maintenance, Performance, Planned Maintenance, Competitive Advantage.

### Introduction

#### Background of the Study

In today's highly competitive and dynamic global business environment, organizations all over the globe are required to deliver world class products and services (Ahuja & Kumar, 2009; Psomas & Fotopoulos, 2009). In pursuit of attaining this goal, organizations have been acquiring competitive strengths through the adoption of world class strategies like Total Productive Maintenance (TPM) (Leonard, 2010). This gives credence to the determination of the effect of total productive maintenance on performance of selected bottling company plants in Edo State, Nigeria. TPM in reality is not a new subject. It was first introduced in Japan back in 1971, as an offshoot of the Toyota Production System and it was made popular by the Japan Institute of Plant Maintenance (JIPM). It was only in the 1990's that JIPM actually opened its door, its secret about TPM, to the western world with its first TPM Instructors' class in the English language. Since then, many books, articles and literatures have been written in English about TPM (Gosavi, 2006).

This world class strategy (TPM) has gain prominence in business organizations during the last five decades and have conquered today's organizational arena (Ahuja & Khamba, 2008; Hernandez, 2010; Sharma & Kodali, 2008). The benefits achieved through the implementation of total productive maintenance in business organizations have been widely reported in management literature; this has led to the continuous interest in the concept (Ahuja & Khamba, 2008; Koc, 2007).

Many leading organizations during the last decade have been using TPM as a competitive strategy. For example, leading American organizations like Proctor and Gamble, DuPont, Eastman Chemical, Ford, AT & T and Texas Instruments have adopted TPM as a tool for enriching competitiveness (Ahuja & Khamba, 2008). Though the concept Total Productive Maintenance is not new to the Nigerian environment, some Nigerian business organizations have not effectively applied this strategy. In management literature, several

researchers have reported the power of TPM. Ireland and Dale (2001) stated that, the TPM program aids an organization to strive continuously for producing non-defective products which by extension impacts its performance level.

Organizational performance has been central to the attention of scholars as it is one of the most important construct for measuring the effectiveness of an organization (Combs, Crook, & Shook, 2005). Business performance for some time now has been seen to be associated with total productive maintenance. According to Richard, (2009) organizational performance encompasses some specific areas of firm outcomes: (a) financial performance (profits, return on assets, return on investment, etc.); (b) product (service) market performance (sales, market share, firm innovation, competitive advantage etc.); and (c) shareholder return (total shareholder return, economic value added, etc.).

Though some managers of business organizations have not been able to successfully implement total productive maintenance in their organization, an effective implementation of TPM could impact the performance of an organization (Ireland & Dale, 2001). A non-financial performance indicator was used for the study.

The bottling company plants used for this study are Nigerian bottling company (Eyaen) and seven up bottling company (Oluku) plants located in Benin City Edo State. The production department of these companies is the focal point of this study.

### **Statement of the Problem**

The inability of the production managers of the companies in focus to employ a unique strategy geared towards ensuring the regular maintenance of their production equipments and machines has necessitated this study. This is because observations made by the researchers revealed that in a bid to minimize cost, heads of the production department do not maintain their equipments regularly according to the standard of their sister companies overseas. This by extension could impact the competitive position and by extension the overall performance level of the companies in focus.

### **Objective of the Study**

The broad objective of this paper is to determine the effect of total productive maintenance on performance of selected bottling company plants in Edo State.

Specifically, this study seeks to ascertain the effect of planned maintenance on the competitive advantage of selected bottling company plants in Edo State.

### **Research Question**

What is the effect of planned maintenance on competitive advantage of selected bottling company plants in Edo State?

### **Research Hypothesis**

Ho: The relationship between planned maintenance and competitive advantage of selected bottling company plants in Edo State is not significant and positive.

### **Review of Related Literature**

#### **Conceptual Review**

#### **Total Productive Maintenance**

Total Productive Maintenance seeks to maximize equipment effectiveness throughout the lifetime of the production equipment. It strives to maintain the equipment in optimum condition in order to prevent unexpected breakdown, speed losses and quality defects.

Total Productive Maintenance initiatives in production help in streamlining the manufacturing and other business functions and garnering sustained profits (Ahuja and Khamba, 2007). TPM is adopted, in order to strengthen the manufacturing business performance and to achieve a world-class performance (Swanson 2001; McKone, Schroeder & Cua, 2001).

TPM in reality is not a new subject. It was first introduced in Japan back in 1971, as an offshoot of the Toyota Production System and it was made popular by the Japan Institute of Plant Maintenance (JIPM). It was only in the 1990's that JIPM actually opened its door, its secret about TPM, to the western world with

its first TPM Instructors' class in the English language. Since then, many books, articles and literatures have been written in English about TPM (Gosavi, 2006).

TPM activities in a manufacturing company secure the physical improvement of personnel, equipment and the company as a whole. TPM activities target to improve equipment effectiveness and eventually to secure zero equipment failures, zero defects and reworks, and zero industrial accidents. TPM is focused on improving all the big picture indicators of manufacturing success (Samuel, John, Shi & Qi 2002). TPM is also very much about safety, asset utilisation, expanding capacity without investment in new equipment or people, continuing to lower the cost of equipment maintenance and improve equipment uptime. TPM is a resource-based approach where all employees are responsible for contributing to avoid equipment deterioration, breakdowns, failures and stoppages (Seng, Jantan & Ramayah, 2005). Implementing TPM requires a long-term commitment with the support of management to achieve the benefits of equipment effectiveness and operational excellence. The eight TPM

pillars are: Asset Productivity, Autonomous Maintenance, Planned Maintenance, Training and Education, Maintenance Prevention, Quality Maintenance, Office TPM, and Safety and Environment that encompass almost all areas in operating a factory (Bamber, 2003).

From the foregoing, total productive maintenance is a wholistic approach that specifies an effective functioning of the component parts/sub systems of an organization.

### **Planned Maintenance**

Stephenson (2018) sees planned maintenance as a proactive approach to maintenance in which maintenance is scheduled to take place on a regular basis. The type of work to be done and the frequency varies based on the equipment being maintained, and the environment in which it is operating. The primary objective of planned maintenance is to maximize equipment performance by keeping equipment running safely for as long as possible, without that equipment will deteriorate or have unplanned outages (Stephenson, 2018). Planned maintenance is any variety of scheduled maintenance to an object or item of equipment. Planned maintenance helps an equipment to operate correctly and it helps in the avoidance of any unscheduled breakdown or downtime in an organization (Wood, 2003).

A review of the definitions of scholars shows that planned maintenance is a well thought process by the management of any organization that strives for equipment efficiency and effectiveness.

### **Organizational Performance**

Organizational performance is a socially constructed phenomenon that is subjective, complex, and particularly hard to measure in most business organizations (Au 1996; Anspach 1991). According to Wikipedia, (2008) organizational performance comprises the actual output or results of an organization as measured against its intended outputs (or goals and objectives).

According to Richard, (2009) organizational performance encompasses some specific areas of firm outcomes: (a) financial performance (profits, return on assets, return on investment, etc.); (b) product (service) market performance (sales, market share, firm innovation, competitive advantage etc.); and (c) shareholder return (total shareholder return, economic value added, etc.). According to Upadhaya, Munir and Blount (2014) an organization is regarded as effective when it has a high performance level. This study is centered on a non-financial performance indicator.

The foregoing shows that organizational performance shows how well an organization is functioning.

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### **Competitive Advantage**

Firms that earn persistently higher levels of profit than competitors have a competitive advantage (Grant, 2008). A variety of theories within the strategy domain address competitive advantage as a way of explaining how management decisions or market factors lead to superior economic performance. According to Rayport and Jaworski (2004) to have a competitive advantage a firm must create superior value for buyers by offering lower prices than competitors for equivalent services or by providing unique services that a buyer is willing to pay for at a premium price. Using this definition, a given firm must devise a competitive strategy that is able to establish a profitable and sustainable position relative to competitors. Grant (2008) asserts that building unique and valued know-how and capabilities that rivals cannot easily imitate entails having a competitive advantage. Rayport and Jaworski (2004) assert that an organization's interface with its

customer is its sole aim of striving to gain a competitive advantage over its competitors. Walsh, Enz, and Canina (2008) assert that when an organization has a competitive advantage over its competitors, it could positively affect the profitability of the organization.

A review of the definition of the concept by various scholars shows that an organization could have a competitive advantage when it has the ability to satisfy customers better than others.

### **Theoretical Framework**

This study is anchored on Maintenance Management Theory Propounded by Sack (1963). Visser (1998) observed that this theory is a relatively young academic discipline. The work of Sack (1963) was improved upon by Newborough (1967), Mann and Heintzelman (1976) and Kelly and Harns (1978). Maintenance management theory emphasizes the scheduled maintenance of equipments and machines of an organization. This theory is relevant to this study because the planned maintenance of the equipments and machines of the companies in focus could impact the competitive position of these companies.

### **Empirical Review**

Bakri (2015) examined the impact of total productive maintenance on performance of selected automotive companies in Malaysia. Case study research design was used for the study, questionnaire was the data collection tool employed, regression analysis was used to analyse the collected data. Findings of the study revealed that total productive maintenance impacts the performance of the automotive companies in focus.

Nzewi, Chiekezie and Arachie (2016) examined the relationship between total productivity maintenance and the performance of selected aluminium firms in Anambra State. The study employed a correlation research design, a population of 399 was used for the study, while a sample size of 200 was determined using Taro Yamane sampling technique. Questionnaire was the data collection tool employed and pearson product moment correlation coefficient was used to analyse the collected data. Findings revealed that maintenance autonomy has a significant positive relationship with employee commitment.

Renganathan (2014) examined the impact of total productive maintenance practices on the performance of selected manufacturing companies in Malaysia. Secondary source of data was utilized for the study, regression analysis was used to analyse the collected data. The findings revealed that total maintenance practices impacts the performance of the focused companies.

Ajiboye and Adedokun (2010) investigated maintenance engineering and productivity in a salt production firm in Osun State Nigeria. Descriptive survey research design was used for the study, questionnaire was the data collection tool employed while regression analysis was used to analyse the collected data. Findings revealed that machine with good working condition impacts the productivity of the firm in focus.

Chiekezie, Nzewi and Odekina (2017) examined the extent to which maintenance culture influences performance of selected manufacturing firms in Benue State, Nigeria. The study adopted survey research 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 coefficient. Result of the study

Shows that preventive maintenance significantly influences product delivery of the selected firms.

### **Gap in Knowledge**

None of the empirically reviewed has examined total productive maintenance as it relates to the performance of selected bottling company plants in Edo state, Nigeria and none of the empirically reviewed has specifically identified planned maintenance as it relates to the competitive advantage of selected bottling company plants in Edo state, Nigeria. This is the gap in knowledge that this study intends to fill.

### **Methods**

#### **Research Design**

The research design adopted for this study was the survey research design. It was used because of the nature of the study. Survey research design enables the researcher to observe what happens to the sample subjects without manipulating them.

## Population of Study

**Table 1:** Population of Employees in the Organizations of Study

Company	Marketing Department	Production Department	Human Resource Department	Finance Department	Total
Nigerian Bottling Company (NBC) Benin Plant	118	162	127	135	542
Seven Up Bottling Company, Benin Plant	75	107	81	93	356
<b>Total</b>	<b>193</b>	<b>269</b>	<b>208</b>	<b>228</b>	<b>897</b>

**Source:** Personnel Department of the Organizations of Study (April, 2019).

**Table 2:** Study Population

Company	Production Department
Nigerian Bottling Company (NBC) Benin Plant	162
Seven Up Bottling Company, Benin Plant	107
<b>Total</b>	<b>269</b>

**Source:** Personnel Department of the Organizations of Study (April, 2019).

The study population was restricted to the production department of the companies in focus because planned maintenance of equipment is peculiar to the production department was the chosen variable for this study.

### Sample Size and Sampling Technique

Census sampling was used for this study. It was chosen because the study population of 269 is a manageable size. Based on this, 269 copies of the questionnaire were randomly distributed to the respondents of the production department in the companies of study.

### Instrument of Data Collection

The data collection tool employed by the researcher was the questionnaire. It was designed on a five point Likert Scale. Strongly Agree (SD), Agree (A), Strongly Disagree (SD), Disagree (D) and Undecided (U).

### Validity of the Instrument

Validity is the extent to which an instrument measures what it intends to measure. The content and face validity test was used by the researcher.

### Reliability of the Instrument

This is a measure of the consistency of a particular instrument employed by a researcher. The Cronbach's Alpha reliability test was used for the study. Suwannoppharat and Kaewsu, (2015) assert that a reliability coefficient of 0.696 and above is acceptable. Therefore, a benchmark of 0.696 was used for the study.

**Table 3: Scale: Reliability Statistics for Total Productive Maintenance**

### Reliability Statistics

Cronbach's Alpha	N of Items
.842	5

Since the Cronbach's Alpha score of the reliability statistics for total productive maintenance 0.84 is greater than 0.696, it shows that the instrument is reliable.

**Table 4: Scale: Reliability Statistics for Organizational Performance**

### Reliability Statistics

Cronbach's Alpha	N of Items
.736	5

Since the Cronbach's Alpha score of the reliability statistics for organizational performance 0.74 is greater than 0.696, it shows that the instrument is reliable. The results of the reliability test were indications of the internal consistency of the instrument.

### Method of Data Analysis

Regression analysis was used to analyse the collected data. This was done with the aid of Statistical Package for Social Sciences (SPSS) version 20.

### Data Presentation and Analysis

Table 5: Table of Returned and Unreturned Questionnaire

ANALYSIS OF RETURNED AND UNRETURNED QUESTIONNAIRE		
	Frequency	Percentage %
Returned Questionnaire (Valid)	189	70.26
Returned Questionnaire (Invalid)	42	15.61
Unreturned Questionnaire	38	14.13
Total Questionnaire Administered	269	100

Source: Field Survey, April (2019)

The table above shows that out of the 269 copies of the questionnaire administered, 189 valid questionnaires were retrieved. Based on that, 189 copies of the questionnaire were used for the analysis.

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**Table 6:** Descriptive Statistics of the Analysed Data (planned maintenance)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q1	189	1.00	5.00	3.5000	1.20924
Q2	189	1.00	5.00	3.2407	1.32663
Q3	189	1.00	5.00	3.5285	1.31380
Q4	189	1.00	5.00	3.4672	1.10312
Q5	189	1.00	5.00	3.2148	1.14635
Valid N (listwise)	189				

Source: Field survey, 2019.

A bench-mark of 3.0 was used for the study. Since the mean values of all the questions for planned maintenance are above 3.0, it shows that all the questions were acceptable for the study. Hence, they were all used for the study.

**Table 7: Descriptive Statistics of the Analysed Data (Competitive Advantage)**

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q1	189	1.00	5.00	3.4630	1.22417
Q2	189	1.00	5.00	3.1667	1.43737
Q3	189	1.00	5.00	3.1630	1.51342
Q4	189	1.00	5.00	3.4573	1.48929
Q5	189	1.00	5.00	3.2963	1.24314
Valid N (listwise)	189				

Source: Field survey, 2019.

A bench-mark of 3.0 was used for the study. Since the mean values of all the questions for competitive advantage are above 3.0, it shows that all the questions were acceptable for the study. Hence, they were all used for the study.

### Test of Hypothesis

Ho: The relationship between planned maintenance and competitive advantage of selected bottling company plants in Edo State is not significant and positive.

**Table 8: Model Summary of Regression Output**

#### a) Model Summary<sup>b</sup>

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.818 <sup>a</sup>	.832	.814	.63123	.852	233.041	1	52	.000	1.659

a. Predictors: (Constant), Planned Maintenance

b. Dependent Variable: Competitive Advantage

**Table 9: ANOVA Result from Regression Output**

#### b) ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	88.933	1	88.933	223.041	.000 <sup>a</sup>
	Residual	20.065	54	.386		
	Total	110.000	55			

a. Dependent Variable: Competitive Advantage

b. Predictors: (Constant), Planned Maintenance

**Table 10: Coefficients from Regression Output**

#### c) Coefficients<sup>a</sup>

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.292	.197		1.484	.144	-.103	.686
	Planned Maintenance	.904	.060	.906	15.254	.000	.789	1.028

a. Dependent Variable: Competitive Advantage

The result obtained from the regression analysis shows that planned maintenance has significant effect on competitive advantage ( $\beta = 0.904$ ,  $t = 15.254$ ,  $P < .05$ ). Also, planned maintenance is a predictor of competitive advantage ( $F = 223.041$ ;  $R^2 = 0.832$ ;  $P < .05$ ). The predictor variable single handedly explained 83.2% of the variance in competitive advantage, while the remaining 16.8% could be due to the effect of

extraneous variables. The durbin-watson value of 1.7 shows that there is no first order serial correlation. This makes the result respectable.

### **Discussion of Findings**

Findings from the test of the formulated hypothesis shows that planned maintenance has significant and positive effect on competitive advantage of selected bottling company plants in Edo State. This corroborates the work of Bakri (2015). He examined the impact of total productive maintenance on performance of selected automotive companies in Malaysia. Findings of the study revealed that total productive maintenance impacts the performance of the automotive companies in focus. The work of Nzewi, Chiekezie and Arachie (2016) on the relationship between total productivity maintenance and the performance of selected aluminium firms in Anambra State is also in line with the result obtained from the test of the hypothesis. Findings of the study revealed that maintenance autonomy has a significant positive relationship with employee commitment. The work of Renganathan (2014) also corroborates the result obtained from the test of the formulated hypothesis. The study which examined the impact of total productive maintenance practices on the performance of selected manufacturing companies in Malaysia revealed that total maintenance practices impacts the performance of the focused companies.

### **Summary of Findings**

Findings from the test of the formulated hypothesis shows that planned maintenance impacts competitive position of selected bottling company plants in Edo State since ( $F = 223.041$ ;  $R^2 = 0.832$ ;  $P < .05$ ).

### **Conclusion**

Based on the findings, the researchers concluded that total productive maintenance impacts the performance of selected bottling company plants in Edo State. The findings of the study show that the planned maintenance of equipment used by managers of the companies in focus could impact the competitive advantage of these companies.

### **Recommendations**

The researchers made the following recommendations based on the findings of the study:

1. Heads of the production department of the companies in focus should ensure the enactment of a schedule geared towards regularly maintaining their production equipments.
2. An orientation of new employees on the importance of equipment maintenance should be done by heads of the production department of the companies in focus.

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### Appendix

#### Questionnaire Items on Total Productive Maintenance and Performance

**Options: Strongly Agree = SA, Agree = A, Undecided = UD, Strongly Disagree = SD, Disagree = D.**

**Please tick (  ) as it represents your view**

	<b>Questionnaire Item for Independent Variable (Total Productive Maintenance)</b>					
<b>No</b>	<b>Planned Maintenance</b>	<b>SA 5</b>	<b>A 4</b>	<b>U D 3</b>	<b>SD 2</b>	<b>D 1</b>
1	There is a schedule of equipment maintenance in your organization.					
2	Your head of department wait for a machine to break down before it is maintained/repaired.					
3	There are a lot of faulty production equipments lying fallow in your organization.					
4	There are capable production engineers in your organization.					
5	You are satisfied with the working condition of production equipments/machines in your organization.					
	<b>Dependent Variable (Performance)</b>					
	<b>Competitive Position</b>					
1	You like the position your organization occupies in the industry it belongs.					
2	In the last five years, the market share of your organization has been threatened.					
3	There is an annual increase in the sales of your organization.					
4	There is an annual increase in the profit of your organization.					
5	Your organization has a stiff competitor in the industry it belongs.					