PRODUCTION FACILITIES MAINTENANCE PRACTICES AND SUSTAINABLE COMPETITIVE ADVANTAGE IN THE PAINT MANUFACTURING INDUSTRY, BENIN CITY, NIGERIA

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ABSTRACT: *The study examines the effects of production facilities maintenance practices on competitive advantage of some selected firms in the paint manufacturing industry, Benin City, Nigeria. The study adopted a survey research, through the administration of structured questionnaires to three hundred and ninety-five (395) staff of eight selected paint companies. The data were analysed using regression and Pearson matrix correlation techniques through Ordinary Least Squares (OLS) estimation technique. The result showed a weak positive significant relationship between reactive maintenance and the competitive advantage of the firms and a strong positive significant relationship between preventive maintenance and the competitive advantage of the firms. The study establishes that the integration of production facilities maintenance practices can strategically contribute towards realization of significant competitive advantage of the firms.*

KEY WORDS: *Competitive Advantage, Preventive, Maintenance, Production Facilities, Reactive Maintenance.*

JEL CLASSIFICATION: *C01, L11, L21, M11.*

1. INTRODUCTION

In modern industry, maintenance of equipment and machinery is a very vital part of the total productive effort. The downtime of equipment and machinery can be expensive to management. Maintenance of production facilities can lead to the

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production of high quality product. In turn, these high quality products create customer satisfaction that leads to an improved competitive position (Reed, Lemak & Mero, 2000).

Production facilities maintenance is the comprehensive management of machineries, equipment or tools used in a factory (Edward, 2007). Over the last decennia, maintenance function in manufacturing and production operations has evolved from non-issue into a strategic concern due to emergence of dynamic changes in the manufacturing industry across the globe (Alsyouf, 2007; Ahuja & Khamba, 2008). This is in line with the need to remain competitive and meet customers' expectations. The need to improve the availability, reliability and operations of a manufacturing plant in the production system has brought maintenance function into the limelight (Jackson, 2006).

Generally, competitive advantage refers to the ability gained through qualities and assets to perform at a higher level than other firms in the same industry or market. Competitive advantage suggest that each organization have one or more of the following capabilities when compared to its competitors, such as lower prices, higher quality, higher dependability, and shorter delivery time. These capabilities will enhance the organization's overall performance (Mentzer, Min & Zacharia, 2000). It is against this background that most firms embark on production facilities maintenance.

The stringent competition in the manufacturing industry underlines the need for improvement in manufacturing company's competitive advantages on the basis of cost, production quality, productivity target, on time delivery and profitability (Al-Najjar & Alsyouf, 2004). Also, manufacturing firms need to strive to improve and optimize their productivity through performance measurement systems that take into account different important elements of productivity in manufacturing processes (Al-Najjar & Alsyouf, 2004).

2. STATEMENT OF THE RESEARCH PROBLEM

The main problem being investigated in this study is the effect of production facilities maintenance on organizational competitive advantage. The increasing competitiveness in manufacturing sector across the globe means that organizations need to maximize productivity amongst others if they are to succeed. Some modern organizations have often been faced with situations where the production facilities maintenance does not measure up to expectation. It is considered that perhaps that manufacturing firms in Nigeria are challenged by poor maintenance culture over production facilities, which result in low competitive advantage (Alsyouf, 2007).

The need to carry out maintenance of production facilities as at when due, and how it may affect the competitive advantage of the firm cannot be overemphasized. The choice of maintenance technique (reactive or preventive) a firm adopts will determine if it will have a competitive advantage or not. There is a price for every choice that a firm makes at every point in time. That choice will either make or mar the competitive advantage of an organization. Some firms have neglected the role of plant maintenance, thereby finding it difficult to satisfy the timely needs of their products by customers. Against this background, Borris (2006) argued that emphases on production

facilities maintenance should be a factor in the design of the competitive advantage system if organizations are aimed at getting higher level of satisfaction from their customers. This in turn can enhance customer retention and thereby prevent customer defections. According to Pascal (2006) one of the greatest constraints militating against an organization is the inability of management to utilize an effective maintenance technique. This mostly result in loss of production arising from disruption in the production process as well as loss in quality production due to facilities and equipment malfunctioning. However, Obodoechi (2006) opined that the inability of most manufacturing plant in Nigeria to effectively maintain their facilities and equipment stem from the inability to employ the services of highly skill technicians and engineer that can effectively run maintenance program in an organization.

As such, most equipment easily breakdown due to improper maintenance. This is evident in the way most manufacturing firm use expatriate to do minor repair and installations. This problem stems from technical education failure in Nigeria (Obodoechi, 2006). To this end, Amaeshi, Okorocha and Akujor (2015) observe that the relationship between production facilities maintenance and organizational competitive advantage has not been explicitly and fully explored. Therefore, there is an existing gap in production facilities maintenance and competitive advantage literature that requires to be researched to determine whether each of the aspects of production facilities maintenance has any effect on competitive advantage.

3. OBJECTIVES OF THE STUDY

The main objective of the study is to ascertain the influence of production facilities maintenance on organizational competitive advantage. The specific objectives are to: 1. ascertain the extent to which reactive maintenance of production facilities influences competitive advantage of firms in the Nigerian paint industry; and 2. determine the extent to which preventive maintenance of production facilities influences competitive advantage of firms in the Nigerian paint industry.

4. RESEARCH HYPOTHESES

To guide this study, the hypotheses put in the null forms are as follows:

Ho_1: There is no significant relationship between reactive maintenance of production facilities and competitive advantage of firms in the Nigerian paint industry; and

Ho_2: There is no significant relationship between preventive maintenance of production facilities and competitive advantage of firms in the Nigerian paint industry.

5. RESEARCH FRAMEWORK

Production facilities maintenance is conceptualized as a two dimensional constructs. The two dimensions are reactive maintenance of production facilities and preventive maintenance of production facilities. Using literature support, the expected relationships among production facilities maintenance practices and firms' competitive advantage are discussed.

5.1. Production facilities maintenance

Maintenance of production facilities is an essential organizational function that supports production related processes. Huang, Dismukes, Mousalans, Razzak and Robinson (2003) view production facilities maintenance as the combination of all technical and associated administrative actions intended to retain an item in, or restore it to a state in which it can perform its require function. This means that maintenance is an action necessary to put an equipment item in an efficient operational state. Borris (2006) stated that the maintenance of production facilities guarantees minimum breakdown and keeps the plant in good condition at the lowest possible cost. Thomas (2005) also affirms that production facilities maintenance keep the machines and other facilities in such a condition that permits them to be used at their optimal capacity without interruption. Also, in the views of Mascitelli (2011), production facilities maintenance ensures the availability of the machines, buildings and services required by other sections of the factory for the performance of the functions at optimal return on investment. Reactive and preventive maintenance strategies have evolved over time to keep manufacturing system operating at peak efficiency.

5.1.1. Reactive maintenance of production facilities

The reactive maintenance technique is the traditional method of maintenance from time immemorial (Waeyenbergh & Pintelon, 2002; Donald, 2003). This technique ensures that when a machine breaks down it should be repaired but if it is working and has no fault, then it shouldn't be touched (Gits, 2010; Godwin & Nsobunda, 2013). It waits for machine failure before any maintenance action is taken (Donald, 2003; Paula, 2006). In essence, firms using this management technique do not spend money on maintenance until a machine system fails to operate. To Garp and Deshmukh (2006), reactive maintenance technique is a policy that focuses on performing repair/maintenance work after a system or component failure has occurred. This type of maintenance policy is not concerned with scheduling inspections or service routines on deteriorating components. It implies that repairs are made after the equipment failed and cannot perform its normal function anymore, thus it is reactive maintenance strategy (Wacyenbergh & Pintelon, 2002).

There is a misconception to the views on the cost associated with the use of reactive maintenance. According to Edward (2007), the reactive maintenance to production facilities is an inexpensive method of maintenance. He stated that the major expenses associated with this type of maintenance management are high over time labour cost, high machine downtime and low production availability. However, in the views of Waeyenbergh and Pintelon (2002), it is more costly to carry out maintenance on a failed system than to prevent the system from failing. Reactive maintenance to production facilities can as well give rise to poor and hurried maintenance, delay in production, plant deterioration, increased chances of accidents and less safety for both workers and machines, spoil of materials, loss of customers to competitors and direct loss of profit (Ogbodoechi, 2006; Michaud, 2015).

5.1.2. Preventive maintenance of production facilities

Geoff, Janice and Charles (2010) opine that preventive maintenance is a maintenance policy that observes and collects information concerning the condition and health of equipment to avert unexpected failure and to determine optimum maintenance schedule. Prabhuswamy, Nagesh and Ravikumar (2013) affirm that preventive maintenance relies on the estimated probability that the equipment will breakdown or experience deterioration in performance at a specified interval. This is to give room for critical parts to be replaced before they fail and consumable items are changed regularly.

Pomorski (2002) describes preventive maintenance as a maintenance strategy that reduces the frequency and sporadic failure by performing planned repairs, replacement, overhauling, lubricating, cleaning and inspection of machines and equipment at specific time interval. Hansson, Backlund and Lycke (2003) emphasize that the regular inspection can take the form of lubrication, cleaning, and replacement of sub-components, tightening and adjustment of the machines. This maintenance strategy ensures physical check-up of machines to avert breakdown and to prolong machine service life. Hence, preventive maintenance technique is regarded as a proactive maintenance strategy (Fore & Zuze, 2010; Melesse & Ajit, 2012).

According to Kahn (2006), preventive maintenance makes use of human sense and sensitive instruments, such as audio groups, vibration analyzer, amplitude meter, pressure, and temperature and resistance strain gauges. However, an unusual noise, vibration, change in temperature, linkage or shortage of oil and excessive hotness of equipment predict trouble (Kahn, 2006; Melesse & Ajit, 2012).

5.2. Sustainable competitive advantage

Tracey, Vonderembse and Lim (1999) posit that competitive advantage comprises capabilities that allow an organization to differentiate itself from its competitors. According to Reed, Lemak and Mero (2000), competitive advantage is the outcome of a strategy that generates increased value for a firm, relative to its competition. The definitions signify competitive advantage as the ability to stay ahead of potential competition. It is the leverage that a business has over its competitors. This can be done by offering clients better and greater value.

Porter (1985) identifies cost advantage, innovation strategy and differentiation advantage as basic types of competitive advantage that can help an organization achieve competitive advantage over its rivals. Koufteros, Vonderembse and Doll (1997) used competitive pricing, premium pricing, value-to-customer quality, dependable delivery, and production innovation as a research framework for competitive capabilities. The study of Tracey *et al* (1999) identified price/cost, quality, delivery, and flexibility as important competitive capabilities. The study of Zhang (2001) identified time-based competitive advantage as an important competitive priority.

Amaeshi *et al* (2015) categorized competitive advantage into cost of manufacturing operations, product quality, productivity target, on-time delivery and

profitability. Rijamampianina (2003) opine that these various types of competitive advantage provide the understanding that resources held by a firm and the business strategy by a firm will have a profound impact on generating competitive advantage. According to Lau (2002), the successful implementation of these strategies will lift a firm to superior performance by facilitating the firm with competitive advantage to outperform current or potential players. Hence, viable business strategy may not be adequate unless it possesses control over unique resources that have the ability to create such a unique advantage.

Reed *et al* (2000) stated that sustainability of advantage relies upon acquisition of resources that competitors cannot easily able to imitate. Barney (1991) posits that firm's resources include assets, capabilities, organizational processes, firm attributes, information, and knowledge. According to Barney (1991), these resources can be classified in terms of physical, human, or organizational capital. According to Reed *et al* (2000), human and organizational capital are viewed as being the main drivers of competitive advantage because, unlike physical capital, they are not as easily acquired in factor markets.

Powell (1992) argues that the management skills used to align the organization with its environment is resources that can be sources of advantage. In the views of Barney (1991), sustainability of competitive advantage is present if the increased value remains when competitors stop trying to imitate the advantage. Hall (1993) and Pfeffer (1995) identifies people, their skills, employee know-how, and the way they are managed, ability to manage change as being important sources of sustainable advantage. In the same vein, Castanias and Helfat (1991) include cultural resources, organizational skills, and effective top management as sources of sustainable advantage. Mahoney (1995) argues that such resources are path dependent and are developed over time. In the views of Barney (1991), resources must be both rare and valuable. He stated that if an advantage is to be sustained beyond the short term, the resources should not be easily obtained on the open market by competitors.

6. METHODOLOGY

The study made use of the survey research design. The population of the study consists of employees of the Nigerian paint manufacturing sector, which was purposively selected. The sample size consists of three hundred and ninety-five (395) properly filled and retrieved structured questionnaires out of the four hundred (400) questionnaires administered to the selected respondents. This gave a response rate of 98.5%. The respondents comprise of management and non-management staff of Kings paint, Carmelite/Favour paint, Meyers paint, Sonic paint, Santex paint, Glover paint, Deluxe paint, and Premier paint all in Benin City, Nigeria, from which empirical findings and conclusion was drawn.

The structured questionnaire employed a five points modified form of Likert type scales with 1 = strongly disagree (SD), 2 = disagree (D), 3 = neutral (N), 4 = agree (A), 5 = strongly agree (SA) to measure all the items. The constructs, which were used to measure competitive advantage, were adopted with modification from Li, Ragu-Nathan, Ragu-Nathan and Rao (2006).

The data were sourced between May and October, 2017. Table 4 presents the multiple items representing each of the constructs. Collected data was analyzed through descriptive and inferential statistics. All data were coded and the test analyses were done at 5% level of significance using the Statistical Package for the Social Sciences (SPSS) version 22.0.

6.1. Validity and reliability of the research instrument

To ensure validity of the questionnaire prepared, copies of the questionnaire were given to colleagues in research area to critically examine application of the questions. Pilot study was conducted by testing and pre-testing the questionnaire with 20 randomly selected employees of the selected aluminium firms. Feedbacks were incorporated and questions were then revised.

The final version of the questionnaire consisted of 28 closed-ended questions as presented in Table 4. To test reliability of the research instrument, the researchers used Cronbach's alpha as a diagnostic measure. It assesses the consistency of the entire scale. The results of the reliability analysis are summarized in Table 1.

Table 1. Cronbach Alpha

Variables	Cronbach Alpha	Number of Items
Reactive Maintenance of Production Facilities	0.774	6
Preventive Maintenance of Production Facilities	0.736	6
Organizational Competitive Advantage	0.720	16

Source: Researchers' computation based on the field survey 2017 using SPSS 22.0

6.2. Model specification

The model in its econometric form is specified as follows:

$$SCA = \beta_0 + \beta_1 RMPF + \beta_2 PMPF + U_t \qquad (1)$$

Where:
SCA = Organizational competitive advantage;
RMPF = Reactive maintenance of production facilities;
PMPF = Preventive maintenance of production facilities;
U_t = Stochastic error term;
β_0 = Intercept;
β_1 and β_2 = Parameters to be estimated.

Apriori expectation
$\beta_1>0$ and $\beta_2>0$
Equation 1 was estimated using Ordinary Least Squares (OLS)

7. DISCUSSION OF FINDINGS

Table 2. Pearson's Correlation Coefficient for All Variables

	Mean	SCA	RMPF	PMPF
SCA	3.417	1.000		
RMPF	3.368	0.655	1.000	
PMPF	3.658	0.443	0.573	1.000

Source: Researchers' computation based on the field survey 2017 using SPSS 22.0

In Table 2, all the correlation statistics values are positive, indicating that these variables move in the same direction as competitive advantage of the firm. It shows that competitive advantage is significantly positively correlated with the independent variables at 5% level of significance. It was also observed that the independent variables in relation to competitive advantage did not exhibit multicollinearity since none of the variables have correlations in excess of 0.90 as suggested by Dwivedi (2008).

Table 2 also shows the means of the two dimensions of production facilities maintenance practices: reactive maintenance of production facilities and preventive maintenance of production facilities. The Table reveals that Nigerian paint manufacturing industry emphasized more on preventive maintenance of production facilities (mean = 3.658). The average score for the two dimensions was equal to 3.513. Given that the scale used a 5-point scale (1=strongly disagree, 5=strongly agree), it can be concluded that Nigerian paint industry is highly committed to production facilities maintenance practices above the average mean. Table 2 also shows the mean of the organizational competitive advantage of Nigerian paint manufacturing industry. The Table reveals that Nigerian paint manufacturing industry has a high competitive advantage with a mean of =3.417. Given that the scale used a 5-point scale it can be concluded that Nigerian paint manufacturing industry has a high competitive advantage above the average mean of 3.

The results of the estimated multiple regression model using OLS are presented in Table 3 below. The coefficient of determination (R-squared) of 0.81 indicates that for the period under study based on the available data, reactive maintenance of production facilities and preventive maintenance of production facilities, jointly explain 81% of the systematic variations in competitive advantage of firms in the Nigerian paint manufacturing industry with only 19 percent being explained by other variables which were not included in the study. This result was further supported by the R-Bar squared value of 78 percent which is reasonably high. This indicates a goodness of fit for the model.

The F- Statistics of 25.726 with probability value of 0.000 indicates that there was a simultaneous linear relationship between the dependent variable and the explanatory variables combined. Thus, we therefore reject the hypothesis of a non-linear simultaneous relationship between competitive advantage and the explanatory variables combined. This suggests that the joint effects of the included variables in the

model are significant in explaining competitive advantage of firms in the Nigerian paint manufacturing industry. The Durbin Watson (D-W) statistic values for the equation of 1.9875 is sufficiently close to 2. It is generally acceptable in terms of absence of autocorrelation in the estimates. Thus, there is the absence of a first order position autocorrelation in the model.

Table 3 revealed that the variables included in the model have significant impact on organizational competitive advantage at the 5% level. Considering the calculated t-value of -2.694 at 5 percent level, it indicates that a unit increase in reactive maintenance of production facilities, will lead to a fall in SCA by 0.143 units of competitive advantage of firms in the Nigerian paint industry. Nevertheless, Paula (2003) opined that most firms' production facilities maintenance is greatly affected by an organization's effort to reduce cost of maintenance. These make the firms to resort to maintenance when there is malfunctioning of facilities and equipment and even sometimes, complete breakdown. This leads to lost arising from production storage and waste of raw material in production line at that time. As manufacturers are faced with stiff pressure to control and improve productivity, production facilities maintenance should emerge as an essential capability.

Table 3 also revealed that the calculated t-value of 13.306 at 5 percent level indicates that a unit increase in preventive maintenance of production facilities will lead to an increase in SCA by 0.770 units of firms in the Nigerian paint manufacturing industry. This means that sound preventive maintenance strategy influences the competitive advantage of firms in the Nigerian paint manufacturing industry. This is in line with Oseghale (2014) that preventive maintenance strategy can influence the performance of industrial facilities. Borris (2006) posits that preventive maintenance improves equipment life span, its availability, decreased maintenance cost, and reliability for optimum operational performance.

Considering the strength to which the independent variables affect the dependent variable, the coefficient results showed that preventive maintenance of production facilities has the most significant effect on sustainable competitive advantage (β_2=0.770, $p<0.05$), and reactive maintenance of production facilities (β_1=0.143, $p<0.05$). This indicates that reactive maintenance of production facilities is not be a strong indicator of sustainable competitive advantage compared to preventive maintenance of production facilities. Hence, preventive maintenance of production facilities is the strongest significant predictor of sustainable competitive advantage.

Table 3: Regression Analysis Using Ordinary Least Square

Variable	Coefficient	Std. Error	t- Statistics	P-value	Hypotheses
(CONSTANT)	5.638	0.271	20.834	0.000	Significant
RMPF	-0.143	0.0538	-2.694	0.008	Significant
PMPF	0.770	0.058	13.306	0.000	Significant
R^2 = 0.81 **Adjusted R^2 =** 0.78 **F- Stat (Prob.) =** 25.726 (0.000) **Durbin-Watson Statistic** = 1.9875					

Source: Researchers' computation based on the field survey 2017 using SPSS 22.0

8. CONCLUSION

This paper empirically examines the influence of two key dimensions of production facilities maintenance practices on sustainable competitive advantage within the context of firms in the paint manufacturing industry, Benin City, Nigeria. According to Reed *et al* (2000), sustainability of advantage relies upon inculcating means into the strategic decisions and policies of the firms that competitors cannot easily imitate. In this study, sustainable competitive advantage of the firms was looked at from the perspective of cost of manufacturing operations, product quality, delivery dependability, on-time delivery and product innovation. The achievements of Nigerian paint firms through proactive implementation of production facilities maintenance practices have been evaluated. Critical production facilities maintenance success factors identified in form of policy recommendations for enhancing the sustainability of competitive advantage of Nigerian paint firms.

From this research study, it has been established that production facilities maintenance practices play vital role in giving a firm competitive edge over other firms in the industry. Production facilities maintenance practices assist in offering quality products that meet the needs of customers, at the right time.

We also established that an organization must continually adapt to its competitive environment. To remain successful, an organization should use production facilities maintenance as a business strategy. This variable positively influences competitive advantage of paint manufacturing firms when aggressively implemented.

9. POLICY RECOMMENDATIONS

Based on the study's data analysis and empirical findings, we recommend that:

1. firms should be committed to producing quality products that are safe and friendly to the health of painters, employees and the generality of the society in order to sustain their competitive drive;
2. firms should be committed to producing quality products that can stand the test of time;
3. manufacturing firms should provide and advice painters with the use of materials that can protect the eyes, nose and general body;
4. manufacturing firms should see production facilities maintenance as a business level strategy where competitive advantage occurs;
5. every manufacturing firm should integrate appropriate maintenance culture into their organizational objectives to minimize production losses and wastes;
6. every manufacturing firm should have functional maintenance unit in their organization;
7. managers and employees are not omniscient. They have to be given adequate education about quality concepts, and be trained in the use of quality tools and techniques on preventive maintenance of production facilities;
8. production facilities maintenance will not work without the demonstrated long-term commitment of top management, hence preventive maintenance actions should be

monitored by the head of maintenance department to reduce the chances of machine breakdown; and

9. firms should view organizational skills and effective top management as the main drivers of sustainable competitive advantage.

REFERENCES:

[1]. Ahuja, I.P.S.; Khamba, J. S. (2008) *Strategies and success factors for overcoming challenges in TPM implementation in Indian manufacturing industry*, Journal of Quality in Maintenance Engineering, 2, 123-147

[2]. Al-Najjar, B.; Alsyouf, I. (2004) *Enhancing a company's profitability and competitiveness using integrated vibration-based maintenance: A case study*, European Journal of Operational Research, 157(3), 643-657

[3]. Alsyouf, I. (2007) *The role of maintenance in improving companies' productivity and profitability*, International Journal of Production Economics, 105(1), 70-78

[4]. Amaeshi, B.; Okorocha, V.; Akujor, H. (2015) *Effects of production facilities maintenance on competitive advantage of selected firms in* Nigeria, International Journal of Research in Management, Science & Technology, 3(4), 176-190

[5]. Barney, J.B. (1991) *Firm resources and sustained competitive advantage*, Journal of Management, 17, 99-120

[6]. Borris, S. (2006) *Total productive maintenance: Proven strategies and techniques to keep equipment running at peak efficiency*, London: McGraw-Hill

[7]. Castanias, R.P.; Helfat, C.E. (1991) *Managerial resources and rents*, Journal of Management, 17, 155-171

[8]. Donald, A. (2003) *Plant and equipment maintenance*, Journal of Engineering, 7(3), 113-121

[9]. Dwivedi, D.N. (2008) *Managerial economics*, 7th edition, Delhi: Vikas Publishing House PVT Limited

[10]. Edward, B. (2007) *Production management*, Accra: Ashanti Publishers, 20-22

[11]. Fore, S.; Zuze, L. (2010) *Improvement of overall equipment effectiveness through total productive maintenance*, World Academy of Science, Engineering and Technology, 37, 402-410

[12]. Garp, A.; Deshmukh, S.G. (2006) *Maintenance management: Literature review and directions*, Journal of Quality in Maintenance Engineering, 12(3), 205-238

[13]. Geoff, M.; Janice P.; Charles, S. (2010) *A case study of lean, sustainable manufacturing*, Journal of Industrial Engineering and Management, 3(1), 11-32

[14]. Gits, C.W. (2010) *Structuring maintenance control systems*, International Journal of Operations and Production Management, 14, 5-17

[15]. Godwin, H.C.; Nsobunda, M.C. (2013) *Impact of maintenance performance in cable manufacturing industry: Cutix cable hub example*, Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS), 4(1), 94-99

[16]. Hall, R. (1993) *A framework linking intangible resources and capabilities to sustainable competitive advantage*, Strategic Management Journal, 14, 607-618

[17]. Hansen, R.C. (2005) *Overall equipment effectiveness. A powerful production and maintenance tool for increased profits*, United States: Industrial Press Inc.

[18]. Hansson, J.; Backlund, F.; Lycke, L. (2003) *Managing commitment: Increasing the odds for successful implementation of TQM, TPM and RCM*, International Journal of Quality and Reliability Management, 20(9), 993-1008

[19]. Huang, S.H.; Dismukes, J.P.; Mousalam, A.; Razzak, R.B.; Robinson, D.E. (2003) *Manufacturing productivity improvement using effectiveness metrics and simulation analysis*, International Journal of Production Research, 41, 513-527

[20]. Jackson, M. (2006) *An analysis of flexible and reconfigurable production systems*, Sweden: Linkopings Universitet

[21]. Kahn, J. (2006) *Applying six sigma to plant maintenance improvement programs*, Georgia: JK Consulting Fayetteville

[22]. Koufteros, X.A.; Vonderembse, M.A.; Doll, W.J. (1997) *Competitive capabilities: Measurement and relationships*, Proceedings Decision Science Institute, 1067-1068

[23]. Lau, R. (2002) *Competitive factors and their relative importance in the US electronics and computer industries*, International Journal of Operations and Production Management, 22(1), 125-135

[24]. Leflar, J.A. (2001) *Practical TPM: Successful equipment management at Agilent Technologies*, Portland: Productivity Press

[25]. Li, S.; Ragu-Nathan, B.; Ragu-Nathan, T.S.; Rao, S.S. (2006) *The impact of supply chain management practices on competitive advantage and organizational performance*, OMEGA, 34 (2), 107-124

[26]. Mahoney, J.T. (1995) *The management of resources and the resource of management*, Journal of Business Research, 33, 91-101

[27]. Mascitelli, R. (2011) *Mastering lean product development: A practical, event-driven process for maximizing speed, profits and quality*, Northridge, CA: Technology Perspectives

[28]. Melesse, W.W.; Ajit, P.S. (2012) *Total productive maintenance: A case study in manufacturing industry*, Global Journal of Researches in Industrial Engineering, 12(1), 42-50

[29]. Mentzer, J.T.; Min, S.; Zacharia, Z.G. (2000) *The nature of inter-firm partnering in supply chain management*, Journal of Retail, 76, 549-568

[30]. Michaud, D. (2015) *A real-time predictive maintenance system for machine systems*, International Journal of Machine Tools and Manufacture, 44, 759-766

[31]. Ogbodoechi, A. (2006) *The impact of maintenance on effective production*, Journal of Management, 4(1), 18-30

[32]. Oseghale, C. (2014) *Impact of maintenance strategies on the performance of industrial facilities in selected industrial estates in Lagos State, Nigeria*, American Journal of Engineering Research, 3(8), 171-179

[33]. Pascal, A. (2006) *Plant maintenance*, England: McGraw Hill

[34]. Paula, B. (2003) *Effectiveness of preventive maintenance*, Journal of Engineering, 3(1), 56-69

[35]. Paula, B. (2006) *An enhanced approach for implementing total productive maintenance in the manufacturing environment*, Journal of Quality in Maintenance Engineering, 3(2), 69-80

[36]. Pfeffer, J. (1995) Producing sustainable competitive advantage through the effective management of people. Academy of Management Executive, 9 (1), 55-69

[37]. Pomorski, T. (2002) *Lean manufacturing: Concepts, history and literature review*, Cincinnati, OH: Union Institute and University

[38]. Porter, M.E. (1985) *Competitive advantage: Creating and sustaining superior performance*, New York: The Free Press, First Edition

[39]. Powell, T.C. (1992) Organizational alignment as competitive advantage. Strategic Management Journal, 13, 119-134

[40]. Powell, T.C. (2001) *Competitive advantage: Logical and philosophical considerations*, Strategic Management Journal, 22(9), 875-888

[41]. Prabhuswamy, M.; Nagesh, P.; Ravikumar, K. (2013) *Statistical analysis and reliability estimation of total productive maintenance*, Journal of Operations Management, 12(1), 7-20

[42]. Reed, R.; Lemak, D.J.; Mero, N.P. (2000) *Total quality management and sustainable competitive advantage*, Journal of Quality Management, 5, 5-26

[43]. Rijamampianina, R. (2003) *A framework for concentric diversification through sustainable competitive advantage*, Management Decision, 41(4), 362

[44]. Thomas, S.J. (2005) *Improving maintenance and reliability through cultural change*, New York: Industrial Press Inc.

[45]. Tracey, M.; Vonderembse, M.A.; Lim, J.S. (1999) *Manufacturing technology and strategy formulation: Keys to enhancing competitiveness and improving performance*, Journal of Operations Management, 17(4), 411-28

[46]. Waeyenbergh, G.; Pintelon, L. (2002) *A framework for maintenance concept development*, International Journal of Production Economics, 77(3), 299-313

Table 4. Instrument for Production Facilities Maintenance Practices and Sustainable Competitive Advantage in the Paint Manufacturing Industry, Benin City, Nigeria

No	Variables	SD	D	N	A	SA
	Production Facilities Maintenance Practices					
	Reactive Maintenance of Production Facilities*: maintenance policy that focuses on performing repair/maintenance work after a system failure has occurred.*					
1.	The firm considers time spent testing and getting equipment ready to resume operation as treat to competitiveness.					
2.	The firm considers time spent doing repairs of breakdown equipment as constituting challenge to organizational productivity.					
3.	The firm considers replacing faulty parts and components of production facilities as a major cost.					
4.	Investment in reactive maintenance offers organization opportunity to increase profit margins.					
5.	The repair of production facilities are done after the equipment failure.					
6.	Reactive maintenance provides organization enabling environment to achieve a higher level of performance.					
	Preventive Maintenance of Production Facilities*: maintenance policy that focuses on the collection of information concerning the condition of equipment to avert unexpected failure.*					
7.	The firm involves in computerized maintenance management systems.					
8.	The firm carries out regular diagnostic information on the condition of the plant/machines/equipment.					
9.	The firm frequently invests in the technical skills and competence of maintenance staff on how to carry out maintenance on the equipment.					
10.	The firm periodically performs planned replacement of machine parts.					
11.	Reactivation of production facilities enhances plant availability.					
12.	Preventive maintenance influences organizational competitive advantage.					
	Organizational Competitive Advantage					
	Price/cost: *the ability of an organization to compete against major competitors based on low price.*					
13.	Effective production facilities maintenance makes the company to offer competitive prices.					
14.	Effective production facilities maintenance makes the company to offer prices as low or lower than its competitors.					
	Quality: *the ability of an organization to offer quality product that creates higher value for customers.*					

15.	The company is able to compete based on quality products that are safe and friendly to the environment.					
16.	The company offers products that can stand the test of time.					
17.	The company offers products that are very durable.					
	Delivery dependability: *the ability of an organization to provide on time the type and volume of product required by customers.*					
18.	The company delivers the kind of products needed by customers.					
19.	The company delivers customer order on time.					
20.	The company provides dependable delivery.					
	Product innovation: *the ability of a firm to introduce new products and features in the marketplace.*					
21.	The company provides customized products.					
22.	The firm provides painters with materials that can protect the eyes, nose, and the general body.					
23.	The firm advices painters with materials that can protect the eyes, nose, and the general body.					
24.	The company alters its product offerings to meet client needs.					
25.	The company responds well to customer demand for “new” features.					
	Time to market: *the ability of a firm to introduce new products faster than major competitors.*					
26.	The company delivers products to market quickly.					
27.	The company is first in the market in introducing new products.					
28.	The company has fast product development.					