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Research Paper

TOTAL PRODUCTIVITY MAINTENANCE AND PERFORMANCE OF SELECTED PLASTIC MANUFACTURING COMPANIES IN ANAMBRA STATE

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ABSTRACT

This study assessed Total Productivity Maintenance (TPM) and Performance of selected Plastic Manufacturing Companies in Anambra state. The specific objective of the study is to ascertain whether Maintenance Training of Operators is the only variable that affects the Machine Availability of the selected Plastic manufacturing firms in Anambra State. Correlation Survey Research Design was employed and data were analysed using Pearson's Product Moment Correlation Coefficient. The findings from the test of hypothesis revealed that Maintenance training has positive effect on Performance of selected Plastic Manufacturing Companies in Anambra state. This implies that Maintenance training enhances the performance of the organization. The study recommended organisations should embrace Maintenance training as it will impact on the machine life and reduce breakdown and that there is need to be a radical change in the maintenance culture of the firms from a routine maintenance approach by the engineering department to a daily maintenance approach by all trained operators.

KEYWORDS: Total Productivity Maintenance, performance, selected Plastic Manufacturing Companies in Anambra State, Hypothesis revealed

INTRODUCTION

Every organization appears to search for an edge over the other in a bid to capture more market share, remain competitiveness and relevant in the market, this is also being witnessed with the plastic manufacturing firms in Anambra State. They depend heavily on the overall equipment effectiveness of their organizations to remain in the market. Neely, Adams, and Kennerley (2002), captured it thus: achieving the profitability, cost competitiveness, and growth in the long-term would be generated through productivity efficiency and improvement. To keep these productive equipments in good shape, the plastic firms tend to adopt different maintenance approach. The maintenance processes and procedures can assume different dimensions, They could be such that are undertaken on a yearly basis, bi-annually, monthly or daily depending

on the philosophy of the organization and proclivity of the firm towards maintenance. According to Murthy, Atrens, and Eccleston (2002), up to 1940, maintenance was considered an unavoidable cost and corrective maintenance was the only approach. This is a situation where the productive equipments are allowed to breakdown before they are put in order. Therefore, maintenance job was observed as firefighting activity. However, in recent decades, the nature and style of maintenance has changed because of the complexity and sophisticated nature of equipment in use. Within the last few decades, there has been an evolution of perceptions on the concept of plant maintenance from a reactive perception of repairs to proactive perception of maintenance (Ahuja & Khamba, 2008). This was also aptly captured by Moubray (2003) who stated that as a



result of a huge increase in the number and variety of physical assets to be maintained, increasing automation and complexity, new maintenance techniques and changing views on maintenance organization and responsibilities, many organizations have changed their attitude and behaviour toward maintenance activity.

Garg and Deshmukh (2006) stated that the recent competitive trends and ever increasing business pressures have been putting maintenance function under the spotlight as never before. In Plastic Manufacturing firms maintenance activity is very critical in determining not just the quantity of products to be produced, but also the quality of products produced and quality of products plays important role in customer attraction and retention. Lazim, Ramayah and Ahmad (2008) stated that maintenance function has been more challenging in order to maintain and improve product quality. Just as there are maintenance approach that are schedule and done in stipulated time like monthly or bi-annually, there is also a maintenance approach that is undertaken on a daily basis and this approach is what is referred to as Total Productivity Maintenance (TPM). More and more organizations are embracing TPM as a way forward to being effective and efficient in productive activity. TPM is a maintenance approach that deals with the daily maintenance of equipment not only by the engineering personnel but by everybody in the organization especially the operatives. Bhadury (2013) defines it as an approach to maintenance that optimizes equipment effectiveness, eliminates breakdown and promotes autonomous maintenance by operators through day-to-day activities involving total workforce. TPM is designed to maximize the overall equipment effectiveness. It involves all departments that plan, use and maintain equipment, involves all employees from top management to front line workers (Tsang, & Chan, 2011).

The quantity of products produced by the plastic firms in Anambra State over a certain period depends on so many things, but the effectiveness and soundness of the productive equipments play a major role in this. This assertion was corroborated by Manu, Vishal, Anish and Dureja(2011) when they state that efficiency and effectiveness of equipment plays a dominant role in modern manufacturing industry to determine the performance of the organizational production function as well as the level of success achieved in the organization. That is, the soundness of equipment determines to a great extent the production capacity of organizations and plastic firms in Anambra

State also follows this line of thought. It was observed in the focused firms that they are usually faced with issues of regular machine breakdown leading to stoppage of activities in most cases. The maintenance culture adopted in the focused firms is based on reactive repair maintenance and this seems to be the reason for frequent machine breakdown in the firms. That is, equipments seemed to be allowed to breakdown before maintenance is embarked upon. This is probably because employees lack the requisite skills-set to take care of the equipment they man as a result of lack of training to do so. Furthermore, management seem to also not empower the employees with finance, autonomy and information to maintain equipment as only the engineering department of the organizations possess such resource power, autonomy and information needed for proper maintenance. All these seem to culminate in affecting the overall performance of the organization because the organizations spend more money which would have been invested in other profitable ventures; machineries also take longer time to repair. Furthermore, the customers of the focused firms are forced to look elsewhere for products because the productivity of the firms is not able to satisfy their demands. This may reduce the sales volume of the firm and invariable the profit performance of the organization.

STATEMENT OF THE PROBLEM

Whereas, the main thrust of TPM is the involvement of everybody in the maintenance activity of the machineries through training. Some Plastic manufacturing Companies seemed oblivious of TPM philosophy because the engineering department does all the maintenance in the organization. TPM is concerned about total involvement and commitment of everybody in the organization and the maintenance is on a daily basis (Ahuja & Khamba, 2008). The maintenance activities in these plastic manufacturing firms are seen as the exclusive function of the engineering department and personnel. The maintenance culture of the focused firms seem to be repair driven maintenance philosophy where machineries are allowed to break down first before maintenance is carried out or at best on scheduled dates which could be quarterly or bi-annually instead of a more preferred daily and regular maintenance by the operators at less cost. TPM is considered to be Japan's answer to United States (US) styled productive maintenance (Wal & Lynn, 2002). TPM has been widely recognized as a strategic weapon for improving manufacturing performance by enhancing the effectiveness of production facilities in USA (Dwyer,

1999; Dossenbach, 2006). It has been accepted as the most promising strategy for improving maintenance performance in order to succeed in a highly demanding market arena in Japan (Nakajima, 1988). We observed that the practise in the firms understudy is different and this scenario is what caught the attention of the researcher and the curiosity to carry out this research to examine the relationship existing between training a TPM principle and performance to establish whether this will improve the performance of the focused firms if they adopt this maintenance approach.

OBJECTIVES OF THE STUDY

The broad objective of this study is to determine the nature of relationship that exists between Total Productivity Maintenance and Performance of selected Plastic Manufacturing Companies in Anambra state. Specifically, the objectives of the study intends to ascertain the nature of relationship that exists between Maintenance Training of Employees and Machine Availability of the selected Plastic manufacturing firms in Anambra State.

HYPOTHESES

Specifically the hypothesis is stated as:

- Ho: There is no effect of Training on the Machine Availability of the selected Plastic manufacturing firms in Anambra State.
- Hi: There is effect of Training on the Machine Availability of the selected Plastic manufacturing firms in Anambra State.

REVIEW OF RELATED LITERATURE

Conceptual Review:-

TPM does not require a rocket science for effective implementation, what is required is appropriate training as can be seen in the words of Mora (2002) who stated that implementing TPM is not a difficult task; however, it would require some customized training in order to succeed. Training is aimed to have multi-skilled revitalized employees whose morale is high and who are eager to come to work and perform all the required functions effectively and independently (Juric, Sanchez, &Goti, 2006; Blanchard, 1997). In Manufacturing Companies which include Plastic Manufacturing firms especially those that have embraced TPM, training is given to operators to upgrade their skill. It is not sufficient to know only “know-how” but they should also learn “know-why”. By experience they gain, “know-how” on how to overcome a problem and what is to be done. The objective of TPM training is not only to explain TPM elements and pillars, but also to raise morale

and soften resistance to change. The most important requirement for operators is to have ability to detect abnormalities in the working of the equipment with respect to operation and quality of output, based on a sense that there is something wrong, and to have this abilities, the employees need to be empowered with training, skills and resources needed (Sharma, Kumar & Kumar, 2012).

TPM consolidates the preventive and predictive maintenance approaches with the emphasis on employee participation. However, in order to enable employee participation, training and should be provided sufficiently (Ireland & Dale, 2006). Training plays an important role in minimizing the negative effect of system complexity on manufacturing system performance (Guimaraes et al. 1999). The element of training is very important in any organization, regardless whether they are manufacturing or services oriented. However, in TPM implementation, various authors stressed the contribution of training towards performance such as Teresko (1992).Ireland and Dale (2006), Sharma et al (2006) and Ahamd,Masjuki and Taha(2005). The most important requirement for operators is to have ability to detect abnormalities in the working of the equipment with respect to operation and quality of output, based on a sense that there is something wrong (Sharma, Shudhanshu & Awadhesh 2012). Operators and maintenance workers need to have a greater understanding of each other’s function and often have to acquire some new skills. For example, operators need to learn to anticipate problems and should be able to carry out minor adjustments and basic preventive maintenance, such as routine checking, cleaning and lubrication, an enhanced role in which multi-skilling is seen as providing essential support. In practicing TPM, the maintainers are released from the tasks of lower skill levels and are able to move onto jobs which require higher level of skills such as “equipment improvement, more complex preventive maintenance and overhauls” (Gautam, Kumar, Singh & Sukhchain 2012).

The kind of maintenance giving to productive equipment in the plastic firms will go a long way in determining the life span of equipment, the length of the machine availability and the productivity of the equipment. TPM offers huge improvement in maintenance activities of various organizations and has significantly shown a positive impact towards their operational availability and organizational performances (Sharma, Kumar, & Kumar, 2006).For global market survival in the changing and increasing competitive

industrial arena, uninterrupted equipment will play a major role in increasing the productivity of production equipment and invariably the overall performance of organizations (Mosh, 2013).

One of TPM's main goals is enhancing equipment and plant availability and productivity with moderate investment in maintenance (Wal & Lynn, 2002). Al-Hassan, Chan, and Metcalfe (2000) proposed that optimizing facilities and equipment is the leading way to reduce life-cycle cost. TPM is a philosophy to enhance an organization's productivity and produce high quality goods by minimizing waste thereby reducing costs (Prasanth, Poduval, Pramod, & Jagathy, 2013). TPM is an innovative approach to maintenance that optimizes equipment effectiveness and availability, eliminates breakdowns and promotes autonomous maintenance by operators through day-to-day activities involving total workforce (Bhadury, 2000). Ahuja (2009) refers to TPM as greatly known and acting as a weapon of strategy for enhancing manufacturing performance by improving production facilities effectiveness and availability. A key objective of TPM is to eliminate or minimize of all losses related to manufacturing system to improve overall production effectiveness. In the initial stages, TPM initiatives focus upon addressing six major losses, which are considered significant in lowering the efficiency of the production system (Gupta, Sonwalkar & Chitale, 2001). The six major losses include equipment failure/breakdown losses, setup and adjustment losses, idling and minor stoppage losses, defect and rework losses, and start-up losses. Strategic investments in the maintenance function can lead to improved performance of manufacturing system and enhance the competitive market position of the organization (Coetzee, 1999; Jonsson & Lesshammar, 1999).

When implemented fully, TPM could dramatically improve productivity by increasing machine availability, quality of products and reduce costs of production. TPM is an approach to eliminate/reduce losses in the plant (time & cost) and equipment management that involves all employees (officers, supervisors & operators) from production, maintenance and administration departments (Sawhney, Soundararajan, & Xueping, 2009). TPM implementation in an organization can ensure higher productivity, better quality, fewer breakdowns, increase machine availability, lower costs, and reliable deliveries, motivating working environments, enhanced safety and improved morale of the employees (Tripathi, 2005).

THEORETICAL FRAMEWORK

This study is anchored on the Theory of Structural Empowerment credited to the work of Kanter (1977). Empowerment in the workplace is a popular idea that has permeated both the popular and scientific literature (Laschinger, Finegan, Shamian, & Wilk, 2001, 2004). Conger and Kanungo (1988) posit that empowerment is a principle component of managerial and organizational effectiveness. According to this theory, empowerment means the level of opportunity given to the employees for growth and mobility, the amount of power possessed by employees to access resources and information to carry out their duties and the leeway to make decisions concerning their duties in the organization. Power to Kanter (1993: 210) is defined as the "ability to mobilize resources to get things done". Power is 'on' when employees have access to lines of information, support, resources, and opportunities to learn and grow. When these 'lines' or sources are unavailable, power is 'off' and effective work is impossible. These lines of power are sources of 'structural' empowerment within the organization (Greco, Laschinger, & Wong, 2006; Laschinger et al., 2001, 2004). According to Kanter, these lines of power emanate from formal and informal systems within organizations. Jobs that are highly visible permit discretion or flexibility in how work is accomplished, and are central to the overall purpose of the organization; describe positions that are high in formal power. The tenets of this theory relates to this study in that an opportunity to grow in the organization, opportunity to acquire knowledge and skills could come through training which could pay off in increased machine availability. Furthermore, when employees are given the resources and information needed to do so effectively, then such employees would want to get involved in the maintenance process.

Empirical Review

Badli (2012) studied Automotive Small and Medium Enterprises in Malaysia to explore the TPM implementation level and Critical Success Factor (CSF). The surveys covered 550 companies with 94 responses considered valid. Questionnaire was used in data collection and analysis was done using a combination of ANOVA test statistics and paired comparison test. The study found out that TPM as part of overall maintenance management evolution plays an important role for keeping the assets in good condition to further enhance the manufacturing performance and therefore is a CSF.

Affan and Zulfiqar (2013) investigated the impact of employee empowerment and employee branding on employee turnover behaviours in Pakistan. They used a closed end questionnaire as a research instrument for the collection of primary data from a sample of 100 employees working in various organizations. The data obtained from different employees was analyzed through different statistical techniques such as descriptive statistics, correlation and regression analysis. The results showed a significant positive relationship of employee empowerment and employee branding with employee turnover behaviours.

Lazim, Salleh, Subramaniam, and Othman (2013) in Malaysia studied the relationship between TPM practices and manufacturing performance. They investigated the moderating effect of the level of technical complexity in the production process in the TPM practices and manufacturing performance relationships as well. Significant Relationships were found between TPM practice and costs. They found the moderating effect of technical complexity in the production process on the relationship between TPM practices and manufacturing performance.

Gautam, Ravinder, Amandeep and Dhillon (2012) investigated the contribution of total productive maintenance initiatives to manufacturing industries in India. After testing the two hypotheses formulated using regression analysis, they found that the success of TPM implementation depends on the commitment and awareness level of all employees in the organization.

Mfowabo (2006) studied the impact of TPM on the manufacturing performance at the Colt Section of DaimlerChrysler in the Eastern Cape, South Africa. The total population of the study was 228 and the sample size was 74. Data was elicited using questionnaire. He found out that Top management support for TPM and training of personnel is essential for successful implementation of TPM and therefore recommends a great deal of commitment from everybody for TPM to see the light of the day.

Mwanaongoro and Imbambi (2014) carried out a study on the assessment of the relationship between plant and equipment maintenance strategies and the factory performance of the Kenya sugar firms. The researchers used survey research design. A sample of sixty respondents composed of ten respondents from Mumias, Chemelil, Muhoroni, Nzoia, South Nyanza and West Kenya Sugar Companies was used to provide

information for analysis. The study established that robust plant and equipment maintenance strategies play a key role in the factory performance.

Irefin and Mohammed (2014) conducted a research in Coca Cola Nigeria Limited to examine the effect of employee commitment in TPM practice on organizational performance with special interest in. They made use descriptive and explanatory research methodologies in the study. Questionnaire was used in collecting data and tested using the Pearson Correlation Coefficient. The result showed that: the level of employee commitment of the Staff of Coca Cola Company Plc is very high; there is a fairly high relationship between employee commitment and organizational performance; there is also a very high inverse relationship between employee commitment and employees' turnover and therefore recommended that the management should hire employees who are likely to become linked to the organization.

Adekola (2012) examined the impact of organizational commitment on job satisfaction of employees in public and private universities in Nigeria. Data were collected from 150 employees consisting of academic and Administrative and technical staff from both the public Universities and the Private Universities. The results from the data analysis showed that employees in Public Universities have greater degree of organizational commitment in comparison to Private Universities. Furthermore, job satisfaction increases or decreases based on increase or decrease in organizational commitment. He concluded by saying that organizational commitment is being proven as the catalyst for enhancing job satisfaction level of employees.

Ongori (2008) in Botswana researched on what should be done in organizations to enhance employee empowerment and reduce employee turnover. The methodology adopted in the paper was to review critically the existing literature on employee empowerment both online and print. The study contributed greatly to existing literature specifically in inspiring managers to develop various strategies on how to empower their employee in organization and reduce employee turnover. The outcome from the review indicates that employee empowerment is essential in this era of globalization to enable the organization to respond quickly to any changes in the environment and reduce employee turnover.

Seng and Jantan (2012) studied Malaysian manufacturing companies to examine the implementation of TPM in selected organizations. A structured survey approach was used in the study and data was collected using questionnaire. Three hypotheses were formulated and tested with the use of multiple regression analysis. Their findings showed that there is a positive relationship between human-oriented strategy and the extent of TPM implementation.

METHODOLOGY

Research Design

The research design employed in this study is a correlation research design under survey research design. This is because the study determined the nature of relationship existing between the various paired wise dependent and independent variables and so correlation design is best suited to the study. The population of the study is 489 consisting of the employees of 10 selected plastic manufacturing firms in Anambra State

Method of Data Collection

Secondary data on the total productivity maintenance of particular activities (training of operators, manufacturing equipment maintenance and performance) were obtained from the official Standard Operating Procedures of the selected 10 manufacturing companies' supplementary annual reports with the Anambra State Ministry of Commerce and industry.

Data Requirement

For the purpose of this study, the required data were:

Total number of operators/ employees training activities from 2002-2016.

Total man hour of manufacturing Machine Availability from 2002-2016

Method of Data Analysis

The Pearson's correlation coefficient was employed in analyzing the statistical data. The Pearson Product- Moment Correlation is a measure of the

strength and direction of association that exists between two continuous variables measured on at least an interval scale. Correlation, which is closely related to but conceptually very much different from regression analysis, is aimed at measuring the strength or degree of linear association between the dependent and independent variables (Gujarati, 2003). Such relationship exists in three forms; a strong positive relationship, a weak positive relationship and no relationship. The Pearson's r ranges from -1.0 to 1.0, where a negative coefficient indicates inverse relations between the variables.

The formula is given as:

$$r = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{n}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{n})(\sum Y^2 - \frac{(\sum Y)^2}{n})}}$$

A value of r is interpreted as follows:

A coefficient of 0 indicates that the variables are not related.

A negative coefficient indicates that as one variable increases, the other decreases.

A positive coefficient indicates that as one variable increases the other also increases.

Identification of Variables

X = This is the total number of operators/ employees training activities from 2002-2016.

Y = This is the total hours of manufacturing Machine Availability from 2002-2016

N = This is the total number of years considered.

DATA PRESENTATION AND ANALYSIS

This section provides the data presentation, analysis and test of the relevant hypothesis of the study. The analyses were conducted in order of priority.

Table 1: Yearly Operators/ employees Training Activities and Total Machine Availability

No. of Years	Total number of operators/ employees Training Activity	Total man hour of manufacturing equipment
2002	20	334
2003	22	361
2004	27	375
2005	25	475
2006	29	490
2007	35	511
2008	38	532
2009	47	551
2010	55	565
2011	61	598
2012	64	654
2013	72	714
2014	75	760
2015	80	891
2016	87	945

Anambra State Ministry of Commerce and Industry

Correlation Analysis

A summary and interpretation of Pearson correlation result came first which was closely followed by the test of hypothesis.

Table 2: Summary of correction coefficient Output for Operators/ Employees Training Activities and Total Machine Availability

	Operators/ Employees Training Activities	Total Machine Availability
Operators Training Activities Pearson correlation ® Sig. (2-tailed)(p) N	1.000 - 15	.985+ .002 15
Total Machine Availability Pearson correlation ® Sig. (2-tailed)(p) N	.985+ .002 15	1.000 - 15

** Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

The result from the analysis of the study are presented in a matrix as can be found in table 2 above. Nevertheless, the table above presents the Pearson Correlation, the significance value and the sample size that the calculation is based. The r-value indicates the strength and direction(+)of the correlation. The ‘**’ means we can reject the null hypothesis (Ho). The p-value is the probability that can see an r-value of this size just by chance.

Test of Hypothesis One:

- Ho: There is no effect of Training on the Machine Availability of the selected Plastic manufacturing firms in Anambra State.
- Hi: There is effect of Training on the Machine Availability of the selected Plastic manufacturing firms in Anambra State.

The basis for the acceptance or rejection of the hypothesis is based on the following assumptions:

Ho: $r=0$ (There is No NATURE OF EFFECT)

Hi: $r\neq 0$ (There is NATURE OF EFFECT)

Table 3: Summary of Pearson Product-Moment Correlation Coefficient Showing the Nature of the Effect of Training on the Machine Availability of the selected Plastic manufacturing firms in Anambra State.

Variables	Mean Score	SD	VIF	TOL	t-cal	t-tab	df
Training Activities (n=15)	8.62	4.41	1.00	1.00	0.985	0.19	15
Total Machine Availability of selected Plastic manufacturing firms in Anambra State.	13.08	6.52					

Source: Correlation Output

(t(15)=0.985, p<0.5)

Source: Field Survey (August, 2016)

Computation: E-Views Ver. 7

DISCUSSION OF FINDINGS

From the Pearson correlation coefficient in table 2, r is 0.985, and is statistically significant at ($p < 0.0005$).

Arising from the above, it implies that training activities has a strong, positive effect on the **Machine Availability**, which was statistically significant ($r = .985, n = 15, p < .0005$).

The result as summarized in table 3 above showed that the calculated Pearson Product Correlation value of 0.985 is greater than the table value of 0.19. Therefore, the tested null hypothesis is rejected and the alternative hypothesis which states that there is nature of training on the machine availability selected plastic manufacturing firms in Anambra State is accepted. This is in line with the study by Mfowabo (2006) He found out that training of personnel is essential for successful implementation of TPM and has a positive and significant effect on machine availability.

FINDINGS AND POLICY IMPLICATIONS

The finding which revealed that training has a positive effect on the machine availability of selected plastic manufacturing firms in Anambra State is accepted. The selected plastic manufacturing firms in Anambra State is imbued with policy implications. Most probably, the Management of the firms spent money in training its employees, but the positive result indicated that such decision was fundamental to robust machine availability. However, the Management may consider the option of constant monitoring of the company's operators to ensure compliance with its core values.

There is the implication of some review and adjustment in long-term goals and structure of the focused organisations if machine performance is to be sustained.

CONCLUSIONS AND RECOMMENDATIONS

Following the results from the test of hypothesis and data analyses, we conclude that Training of Operators of selected plastic manufacturing firms in Anambra State has a positive effect on the organizational machine availability. Therefore, the effective and efficient use of operators training in a firm enhances the manufacturing machine effectiveness of the organization.

The following recommendations are therefore made:

Successful implementation of operators training strategy has been credited with helping to improve machine performance, increase profitability and productivity, therefore organizations should embrace the training of operators strategies to enhance overall performance.

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