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The Impact of Maintenance Management in Organizational Development

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Abstract- ***In recent years, maintenance management functions to improve organizational development has become increasingly important and has become the targeted focus of in the field of engineering management. Hence, this paper examines maintenance management processes within operational settings to gain a deeper understanding of their connection to organizational advancement in selected private enterprises located in Bayelsa State, Nigeria. The study involved the acquisition of empirical data, primarily through a structured Likert-scale questionnaire. The methodological approach adopted was a descriptive survey design, operating within a quantitative research paradigm. To examine the impact of the independent variables on the dependent variable, Multiple Regression Analysis (MRA) was employed. This statistical analysis was facilitated using the Statistical Package for the Social Sciences (SPSS), version 23.0.The findings from the data analysis reveal a substantial 75% correlation between the independent and dependent variables, accompanied by a coefficient of determination (R-squared) of 0.563, or 56.3%. Furthermore, the analysis yielded a highly statistically significant p-value (p < 0.001). These results collectively indicate that the predictive model, incorporating six independent variables such as planning and scheduling, condition-based maintenance, work execution, staff training, technical support and computerized maintenance, is highly significant in forecasting organizational development in private organizations.***

Index Terms- ***Organizational Development, Work Execution, Planning and Scheduling, Staff Training, SPSS.***

I. INTRODUCTION

In contemporary times, the efficient management of various maintenance aspects has become increasingly vital. This is primarily due to advancements in operational technologies and the evolving role maintenance plays within organizations. The market landscape is influenced by a wide array of customer expectations, requiring superior quality, expedited delivery, enhanced service standards, and competitive pricing. Concurrently, product lifespans are continually decreasing. Achieving success in any competitive environment necessitates possessing either a cost advantage, a value advantage, or ideally, both. Consequently, the endurance of any enterprise is contingent upon its capacity to compete proficiently (Ekanem et at, 2022). A management system comprises a collection of interconnected processes designed to enhance an organization's efficiency and effectiveness in attaining its defined objectives. A process is characterized as a series of activities that utilize resources and adhere to regulations to convert inputs into desired outputs. The process approach involves identifying, coordinating, and managing processes such that the output of one serves as the input for the subsequent process. This signifies a fundamental interrelationship among various processes (Popovic, 2010). A primary objective for any organization is the continuous enhancement of its overall development. (Ekanem et at, 2022), maintenance is defined as a process that encompasses managerial, administrative, and technical activities aimed at preserving or restoring equipment to its required operational condition. Similarly, (Ekanem et at, 2022), characterize maintenance as the combination of all technological and management actions, including administrative efforts, designed to enable an item to fulfil its intended function or to reinstate its ability to do so. The influence of maintenance on crucial business aspects such as productivity and profitability has become increasingly significant. Any production lost due to an unplanned operational halt is irrecoverable without incurring additional expenses. Consequently, the importance of the maintenance function has grown substantially, owing

to its vital role in sustaining and improving operational availability, efficiency, product quality, timely deliveries, compliance with environmental and safety regulations, and overall plant cost-effectiveness. This paper presents maintenance managers with considerable challenges and few clear answers regarding the adoption of practical maintenance metrics and evaluation procedures. Indeed, the assessment of maintenance management and the establishment of measurement processes continue to be a substantial practical hurdle for managers (Parida. 2007). Therefore, this study aims to investigate the relationship between the impact of maintenance management and organizational development. This research examines maintenance management processes within operational settings to gain a deeper understanding of their connection to organizational advancement in selected private enterprises located in Bayelsa State, Nigeria.

II. MATERIALS

The practical part of this study focused on gathering information, primarily through a structured survey. We chose this survey because it is adaptable, making it easier for participants to understand the questions and allowing us to verify the information they provide. The survey questions were carefully developed to align with the study's main goals, specific questions, and guiding ideas, ensuring we collected relevant and accurate data. To make responses clearer and more consistent, the survey included questions with fixed choices, designed to get short and definite answers. We used a four-point scale, from 4 (Strongly Agree) to 1 (Strongly Disagree), to measure responses. Participants were clearly instructed to indicate their level of agreement with each statement. Regarding how the study's main ideas were defined and measured, the independent factor, 'organizational development in private organizations,' was assessed by looking at its various components, as described earlier.

III. RESEARCH METHODS

The study utilized a descriptive survey approach as part of its quantitative research methodology. This method was considered appropriate for examining how to improve quality results, as it facilitates the organized collection of consistent data through structured questionnaires. Such a methodology allows for obtaining measurable information from a significant number of participants, thereby enabling the application of the findings to the larger population. To ensure a suitable representation of maintenance management practices across the defined area, a purposive sampling method was used to select the study sites. This non-random selection technique was deemed fitting given the research goals, which required the inclusion of private organizations located in Bayelsa, Nigeria. The selection process was guided by several criteria, including an even distribution of locations, variety in organizational types and their specific areas of expertise, evidence of past involvement in relevant academic and practical discussions, ease of access and operation, strong data systems, and existing relationships that would simplify data gathering. These guidelines ensured that the selected organizations not only represented a broad geographical area but also possessed operational features directly pertinent to the research question. As a result, ten private organizations in Bayelsa State, Nigeria, were chosen. These organizations form the core geographical and organizational focus of the study, deliberately selected to improve the significance, depth, and practical relevance of the research findings. Therefore, the combination of a descriptive survey approach and targeted site selection created a thorough methodological framework for examining the factors that support better organizational development in maintenance management programs.

IV. STUDY POPULATION

The participants for this study comprised all employees working within ten specifically chosen private organizations and departments located throughout Bayelsa State, Nigeria. These establishments were intentionally selected to ensure both wide regional coverage and direct relevance to the research objectives. The entire group totalled 284 individuals. This number represented the complete workforce within each designated organization and served as the foundation for establishing the study's sample. The comprehensive involvement of staff from all identified organizations and departments

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ensures that the investigation captures a varied and representative range of entities engaged in maintenance management practices.

V. SAMPLE SIZE DETERMINATION

The suitable sample size for the present study was determined using Taro Yamane's equation, a widely accepted formula (Adam, 2020) recognized for its applicability in calculating sample sizes from a finite population.

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

Where:
n = Sample size
N = Population size (284)
e = Level of precision or allowable error (0.05)
1 = Constant
Given that;
N = 240, e = 0.05
Substituting the corresponding values into (1) gives:
Assuming a 5% or 0.05 level of significance, the sample size can be calculated thus:

$$n = \frac{284}{1 + 284(0.05)^2}$$

$$n = \frac{284}{1 + 284(0.0025)}$$

$$n = \frac{284}{1.71}$$

$$n = 166.08$$

$$n \cong 166$$

Hence, the sample size is 166 respondents.
The percentage of the structured questionnaires sampled and received was determined using the equation presented below:

$$\% \text{ Retrieval} = \frac{\text{Structured questionnaire retrieved}}{\text{Structured questionaires administred}} \times 100\% \quad (2)$$

$$\% \text{ Retrieval} = \frac{123}{166} \times 100\%$$

$$\% \text{ Retrieval} = 74.1\%$$

The percentage retrieval depict that the number of structured questionnaires are reasonable enough to carry on with the analysis.

VI. RELIABILITY OF THE INSTRUMENT

The internal reliability of the measurement tool was evaluated using Cronbach's Alpha coefficient, calculated with the Statistical Package for the Social Sciences (SPSS). This particular measure was chosen for its known effectiveness in accurately assessing how well the individual items within the survey relate to one another. A minimum score of 0.70 was set to define an acceptable level of reliability. Therefore, any parts of the survey with a Cronbach's Alpha score under 0.70 were judged to have inadequate internal consistency, while those meeting or surpassing this standard were deemed acceptably reliable. The outcomes regarding the instrument's internal consistency are shown in Table 1.

Table 1: Cronbach's Alpha Reliability Test Results

Variables	Items	Cronbach's Alpha
Planning and Scheduling	3	0.815
Condition Based Maintenance	3	0.798
Work Execution	2	0,811
Staff Training	3	0.791
Technical Support	3	0.824
Computerized Maintenance	2	0.810
Organizational Development	4	0.776

Source: SPSS output, 2025,

The research instrument is reliable because the Cronbach's Alpha is 82.7%.

VII. DATA ANALYSIS APPROACH

This study employed Multiple Regression Analysis (MRA) to determine the impact of the independent variables on the dependent variable. All statistical calculations were conducted using version 23.0 of the Statistical Package for the Social Sciences (SPSS). Subsequently, comprehensive diagnostic tests were performed to confirm the validity and consistency of the results. The linear model central to MRA measures the degree of association between the

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outcome variable and the explanatory variables, and is formally depicted by the equation provided below:

$$y = f(x_1, x_2, \dots, x_n) \quad (3)$$

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \cdots + \epsilon \quad (4)$$

Where:

y = the response variable

$x_1, x_2, \dots, x_n$ = the predictor variables

β_0 = the intercept or constant term

$\beta_1, \beta_2, \dots, \beta_n$ = the regression coefficients for each predictor variable

ϵ = the error term

VIII. RESULTS AND DISCUSSION

Multiple Regression Analysis (MRA) was conducted to investigate the hypothesized relationships between the independent and dependent variables.

Hypothesis

Ho: There is no statistically significant relationship between the independent variables and the dependent variable.

Table 2: Shows the Variables Entered/Removed

Model	Variables Entered	Removed	Method
	Planning and Scheduling, Condition Based Maintenance, Work Execution, Staff Training, Technical Support, Computerized Maintenance		Enter

Dependent variable Organizational Development
Source: SPSS output 2025

Table 2 indicates that the independent variables included in the analysis are the use of planning and scheduling, condition-based maintenance, work execution, staff training, technical support, and computerized maintenance. Conversely, the single dependent variable examined is the achievement of organizational development within private organizations, a structure that supports the application of Multiple Regression Analysis.

Table 3: Shows the Model Summary

Model	R	R Squared	Adjusted R Squared	Sts Error of the Estimate	Durbin Watson
1	0.750	0.563	0.540	0.34129	1.847

Source: SPSS output 2025

The correlation coefficient (R) of 0.750 shows a strong, direct connection between the predictor variables and the outcome variable. This value suggests a significant relationship between the factors being studied. Additionally, the coefficient of determination (R-squared) reveals that 56.3% of the changes in the outcome variable can be explained or accounted for by the chosen predictor variables.

Table 4: Shows the ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig
Multiple Regression	17.403	6	2.901	24.902	0.000
Residual	13.511	116	0.116		
Total	30.915	122			

Source: SPSS output 2025

The ANOVA table is utilized to assess the model's overall effectiveness by determining its statistical significance. More precisely, it evaluates whether the model, containing six independent variables, offers a superior explanation compared to a basic model based solely on the overall average. The calculated p-value of 0.000 is substantially lower than the predetermined significance level of 0.005. This outcome indicates that the model, incorporating the six predictor variables, serves as a statistically meaningful influence on the dependent variable, "organizational development in private organizations." Consequently, a clear statistical connection is evident between the independent variables and the outcome variable. As a result, the null hypothesis (H_0), which proposes no significant relationship between these variables, is emphatically

disproven. This finding confirms the general usefulness and soundness of the developed model.

Table 5: Shows the Coefficients

Model	Unstandardized Coefficient β	95% confidence Interval Min Bound Max Bound
	-.122	-.745
(Constant)	.165	.502
Planning _ and	.080	.032
_Scheduling	.224	.297
Condition_ Based	.141	-.102
_ Maintenance	.156	.263
Work _ Execution	.227	.117
Staff _ Training		.370
Technical _		-.077
Support		.358
Computerized _		.029
Maintenance		.283
		.108
		.347

Source: SPSS Output 2025

This table shows us how the model works. Recall that our model is

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \cdots + \epsilon \quad (4)$$

This implies that

$$y = -.122 + .165x_1 + .080x_2 + .244x_3 + .141x_4 + .156x_5 + .227x_6$$

The analytical model indicates that several factors significantly impact organizational development. Specifically:

- Each unit increment in "planning and scheduling" is associated with a statistically significant enhancement of 0.165 in organizational development.
- A one-unit increase in "condition-based maintenance" correlates with a notable improvement of 0.080 in the calibre of organizational development outcomes.
- Furthermore, an additional unit in "work execution" practices leads to a substantial augmentation of 0.244 in organizational development.
- Similarly, a one-unit advancement in "staff training" corresponds to a significant gain of 0.141 in organizational development.
- Heightened "technical support, measured by a one-unit rise, significantly elevates organizational development by 0.156.
- Lastly, each unit increase in the application of "computerized maintenance" contributes significantly to a 0.227 improvement in the overall organizational development outputs.

IX. CONCLUSION

The data analysis clearly shows a significant connection between various aspects of maintenance management in private organizations and the overall development of those organizations. The multiple regression analysis further confirmed that each individual maintenance management factor plays an important role in organizational development. Specifically, the study found that a one-unit increase in planning and scheduling resulted in a 0.165 unit increase in organizational development. Similarly, condition-based maintenance added 0.080, work execution contributed 0.244, staff training 0.141, technical support 0.156, and computerized maintenance 0.227. All these elements showed a clear positive influence on the organization's progress.

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