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EVALUATION OF FACTORS OF MAINTENANCE WORK SCHEDULE IN OIL AND GAS INDUSTRY IN NIGER DELTA WETLAND (A CASE STUDY OF RIVERS STATE)

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Abstract

The study evaluated the factors affecting maintenance work schedule in oil and gas industry. It specifically aims to assess the effect of Preventive maintenance on productivity of the oil and gas industry and ascertain the relationship between Corrective maintenance and availability of maintenance materials in the oil and gas industry. The study adopted a survey research design. The study adopts a primary source of data. The data was collected using a questionnaire. The data was analyzed using Multiple Regression Analysis Method. Preventive maintenance has significant effect on the productivity of the oil and gas industry with a T-value calculated of 2.109 is greater than the tabulated t-value of 1.7056. While there is a significant relationship between Corrective maintenance and availability of maintenance materials in the oil and gas industry with T-value calculated of 8.378 is greater than the tabulated t-value of (3, 26) = 1.7056 from table. We conclude that Maintenance work schedule does significantly determine the successful development in oil & gas industry. The study recommended among others that Maintenance work scheduling techniques should be adopted fully.

1.1 Introduction

Maintenance is an important part of the life-cycle of embedded systems, and must be considered from the design stage through the end-of-life stage of the system. Maintenance covers two aspects of systems - operation and performance. Maintenance is generally performed in anticipation of, or in reaction to, a failure. Maintenance is performed to ensure or restore system performance to specified levels. Improperly performed or timed maintenance can exacerbate problems because of faulty parts, maintainer error, or decreased profits. A systematic and structured approach to system maintenance, starting during the design process, is necessary to ensure proper and cost-effective maintenance. Maintenance growth in Nigeria oil and gas industry will be the fastest of all markets, according to the latest 10-year forecast from Global Oil and Gas Perspectives and Oxford Economics.
Maintenance projects in Nigeria have adopted several scheduling and monitoring techniques to handle similar projects using manual or computer software operations. Maintenance project in the oil and gas industry are monitor and progress evaluations of work at site is been checked through representative, the project engineers or through nominated consultants. Generally, the site engineer and project supervisor will prepare scheduling reports

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to be evaluated and recommended by the client. The scheduling technique used will be the Precedence Diagram presented in the form of Microsoft Project or Primavera computer software. This method of scheduling is becoming more widely used in most of the oil and gas maintenance projects. Thus, with this new technique, the process of maintenance in future can be identified and understood by anybody who is involved and not involved in the project.

Therefore, research is done to identify factors affecting the preparation of a workable schedule of using Gantt chart, critical path method and other elements in the development projects in Nigeria. The usage of this method is predicted to reduce the problem of late possession of site and ensure that optimum cost, completion time and highest quality throughout the project. Work scheduling has come a long way in the last 25 years. Unfortunately, despite the widespread use of computerized scheduling in other projects today, there still exists a large disparity in the level of understanding in the proper use of this powerful tool. According to Frank (2004), some even say there is a crisis in the oil and gas industry because they believe scheduling software is being misused to assert delay claims and there is, in their view, a predominance of poor-quality schedules.

1.2 Statement of The Problem

Many projects schedule is created at the beginning of the project and never reviewed or revised until a problem develops. Since there are no clear guidelines for the application of project scheduling in project management the current practice is entirely depending on the experience of the project manager and engineers. This has resulted in a lot of time-wasting effort before parties involved in the project accept any work schedule. Nevertheless, there are still weaknesses in term of formal guidelines for the preparation and submission of work schedule. Several problems associated with project scheduling are the inability to fully utilize the schedule, lack of understanding of scheduling techniques, and unable to see the importance of work schedule as stated.

1.3 Objectives of the Study

The purpose of this study is to evaluate factors affecting maintenance work schedule in oil and gas industry. It specifically aims to:

i. To assess the effect of Preventive maintenance on productivity of the oil and gas industry.
ii. Ascertain the relationship between Corrective maintenance and availability of maintenance materials in the oil and gas industry.

1.4 Hypothesis of the Study

i. Preventive maintenance has no significant effect on the productivity of the oil and gas industry.
ii. There is no significant relationship between Corrective maintenance and availability of maintenance materials in the oil and gas industry

Review of Related Literature

2.1 Conceptual Review

History of Nigeria's Oil and Gas Industry

Nigeria joined the league of oil producing nations on 3 August 1956 when oil was discovered in commercial quantities in the Niger Delta in Oloibiri in present-day Bayelsa State. Today the country ranks as the fourth leading oil and gas producer in Africa, having lost its pre-eminent position to Angola in recent times, and the eighth largest oil exporter in the world. Nigeria is also Africa's most populous nation, with over 200 million people as recorded by the National Census in 2006.The Niger Delta consists of a total landmass of approximately 75,000 square km, with the third largest mangrove forest in the world of almost 20,000 square km, extensive freshwater swamp, coastal ridges, and fertile dryland forest and tropical rainforest characterized by great biological diversity. 26 Seasonal flooding and sediment deposits over thousands of years have made the land fertile.

The Delta sustains the largest wetland in Africa and one of the largest in the world. Its innumerable creeks and streams have in the past provided habitat for an abundance of fish and marine life. Petroleum is a naturally occurring liquid found in rock formations. It consists of a complex mixture of hydrocarbons of various molecular weights, plus other organic compounds. It is generally accepted that oil, formed mostly from the carbon rich remains of ancient plankton after exposure to heat and pressure in the Earth's crust over hundreds of millions of years. Over time, the decayed residue was covered by layers of mud and silt, sinking further down into the Earth's crust and preserved there between hot and pressured layers, gradually transforming into oil reservoirs. The

petroleum industry includes the global processes of exploration, extraction, refining, transporting (often by oil tankers and pipelines), and marketing petroleum products. The largest volume products of the industry are fuel oil and gasoline (petrol).

Petroleum is also the raw material for many chemical products, including pharmaceuticals, solvents, fertilizers, pesticides, and plastics. The industry is usually divided into three major components: upstream, midstream and downstream. Midstream operations are usually included in the downstream category. This is however ameliorated and set off against the PSC with the Federal Government of Nigeria under the aegis of the NNPC. NNPC upstream operations are in joint partnerships with the major oil companies. These multi-national E & P companies are operating predominantly in the on-shore Niger Delta, coastal offshore areas and lately in the deep water. As with many other developing countries, the multinationals in Nigeria had been operating under what is called a concession system, with NNPC being the concessionaire, while the companies are the operators. NNPC also is responsible for the management of the exploration bidding rounds for oil and gas. With a maximum crude oil production capacity of 2.5 million barrels per day, Nigeria ranks has Africa's largest producer of oil and the sixth largest oil producing country in the world. Nigeria appears to have a greater potential for gas than oil.

Importance of Maintenance Work Scheduling

The importance of planning and scheduling in oil and gas industry cannot be overestimated. Due to the current high global demand for energy, development projects of oil and gas resources are becoming more challenging than ever. Projects have increased in number, become more complex and are subject to more aggressive schedules. Changes to classic project execution practices have been undertaken by almost all oil companies in order to adapt to the new market environment. Innovative solutions to standardize engineering design, streamline procurement process and introduce new contracting strategies are the main themes of these changes. The maintenance schedule is one of the most powerful management tools at the service of the maintenance or project manager. A well-planned and realistic schedule that takes into account as many variables as possible will help keep a maintenance project moving along smoothly, alert the project and maintenance manager when the project is about to run into snags, and help make needed adjustments when unforeseen circumstances arise. In order to do all that, though, the plan must have the input and some degree of ownership from everyone who will have to live by it. Otherwise, there is risk of having workers and subcontractors who are working against the maintenance schedule rather than with it. Proper scheduling provides the best opportunity for a well- coordinated and well-sequenced project that is delivered on time and within all participants' budget, Jon et. al. (2002).

Types of Maintenance

Generally speaking, there are two types of maintenance in use:

1) **Preventive maintenance**: where equipment is maintained before break down occurs. This type of maintenance has many different variations and is subject of various researches to determine best and most efficient way to maintain equipment. Recent studies have shown that Preventive maintenance is effective in preventing age related failures of the equipment. For random failure patterns which amount to 80% of the failure patterns, condition monitoring proves to be effective.

Preventive maintenance is maintenance performed in an attempt to avoid failures, unnecessary production loss and safety violations. As equipment cannot be maintained at all times, some way is needed to decide when it is proper to perform maintenance. Normally, this is done by deciding some inspection/maintenance intervals, and sticking to this interval more or less affected by what you find during these activities. The result of this is that most of the maintenance performed is unnecessary; it even adds substantial wear to the equipment. Also, you have no guarantee that the equipment will continue to work even if you are maintaining it according to the maintenance plan. The effectiveness of a preventive maintenance schedule depends on the Reliability centered Maintenance analysis which it was based on, and the ground rules used for cost-affectivity.

2) **Corrective maintenance**: where equipment is maintained after break down

This maintenance is often most expensive because worn equipment can damage other parts and cause multiple damage.

Corrective maintenance is probably the most commonly used approach, but it is easy to see its limitations. When equipment fails, it often leads to downtime in production.

In most cases this is costly business. Also, if the equipment needs to be replaced, the cost of replacing it alone can be substantial. It is also important to consider health, safety and environment (HSE) issues related to malfunctioning equipment.

Corrective maintenance can be defined as the maintenance which is required when an item has failed or worn out, to bring it back to working order. Corrective maintenance is carried out on all items where the consequences of failure or wearing out are not significant and the cost of this maintenance is not greater than preventive maintenance.

Maintenance Work Scheduling Techniques

The advantages to using a complete maintenance scheduling package include: immediate field updates; realistic revisions; input from those actually completing the work; and a stronger investment in completing the work according to schedule and on time. Onsite internet access to the maintenance schedule and communication capabilities gives the project leadership the tools they need to provide onsite supervision that is responsive and decisive.

The nature of the project schedule will normally depend on the cost of the project. A bar chart is usually used on smaller projects. As the cost of the project increases project owner or client's start to demand a schedule that is based on a critical path method network.

Critical Path Method

It is important to understand the relationship between the commencement and completion of the various activities, which comprise in the oil and gas industry, especially in a maintenance project. Critical path method (CPM) network and Program Evaluation Review Technique (PERT) are the two scheduling devices, which indicate the dependencies and interrelationships between different activities. Those interrelationships between activities are indicated as a network. Over the years, the CPM has become the common network schedule in this industry. A CPM shows the sequence of each activity, the start of each activity, the dependence of that activity on the completion of a preceding activity, and how the completion of that activity will restrict the commencement of subsequent activities.

The CPM is graphical model of a project. The basic components of the network are individual arrows, which represent specific activities. The activity can be any aspect of the project that requires either time or resources. The schedule also has a time scale. Finally, the critical path is shown as darker or different colored line that runs through the critical activities.

Sources of Planning Work Schedule

When everyone is together, it is more possible to identify needs for additional manpower, added equipment, and potential time loss and gain. If a delay has caused the loss of time, the entire team can work on recovering the lost time. If there is a gain, the team can come up with the best way to use the gain.

There are many methods employed in project planning. Many project planners were used to table form which comprises from a date list, starting or completed information, which are provided by the management. Regardless of the methods employed, the decisions made will require the collection of data on materials, machineries, equipments, manpower, finance and time.

A. Maintenance Materials

The measurement of quantities by the engineering crew from facility plans and specifications can be summarized to determine the particular quality, quantity and types of materials to be used to perform a work. The availability and delivery period for these materials should be obtained and from suppliers, vendors or according to experience. Fletcher (1987) opined that cost of materials could be one of the largest single elements in the total cost of a maintenance project. Kontagora (1992) stated that materials and component constitutes between fifty and sixty percent of the total cost of its maintenance input. Onukwube (2000), the primary goal of the project team is to finish projects as specified, on schedule and within budget. The whole system of project management exists to ensure that we meet these goals.

B. Machineries and Equipment's

The machineries and equipment which are required to complete a maintenance project will definitely depend on

the suitable types and the method of which there are place or keep safely. After the selection on the particular machineries or equipments is made, the availability and delivery time must be determined.
Heavy machineries such as cranes, tools, steel bar cutter and steel bar bending machines for structural works are required during the execution of the work scheduling. These matters are important to prevent machineries from idling which induce will induce a high cost.

C. Labors and Manpower

Labors and manpower are important assets in maintenance projects. Without labors, a project can become abandoned and the contractor will need to terminate the contract. Thus, labors should be taken into account when scheduling work to ensure that the participation of the labors is at the maximum standard. The numbers of skilled workers should also be considered in the work performed. It should be adequately sufficient to meet expected workload and work tasks. A mistake in this planning will result in late submission of works.

D. Finance

Financing a maintenance project in the oil and gas industry is expensive and it runs into millions of dollars. The allocation of finance must be scrutinized to reimburse for the cost of the supply of maintenance materials, labors and machineries. Any financial difficulties must be solved to ensure that the maintenance project can be carried out smoothly.

E. Time

The most crucial element which must be carefully monitored is time. The client will normally check for starting dates, completed dates and other relevant yet important dates in contract submissions by the contractors. Besides, there are also time limits which must be obeyed by organizations during planning stage. In this industry time is very important, because each passing minute billons of dollars is been lost due to this maintenance. The time require for the maintenance materials to be delivered to site should follow a specified schedule. This is to fulfill worker's demand and reduce wastage. A proper understanding of the project requirements will enable a more effective and efficient materials handling at site.

Factors Affecting a Better Maintenance Work Schedule

According to Mohamad Ibrahim et. al. (2006), they believed that four areas should be properly investigated prior to the development of the project scheduling procedures. The critical areas that have been identified are process of acceptance, responsibilities of contracting parties, application of work schedule, and implications of work schedule. According to Jon et. al. (2002), clear and concise schedule specifications outlining the responsibilities for scheduling and the requirements for preparation, approval, participation, use, maintenance, and reporting are essential for timely and successful completion of most projects. Unfortunately, poor scheduling especially in terms of its specifications, have contributed to the downfall of many projects. Some of the common problems associated with the poor maintenance work schedule include:

i. Project Specific Factors

Project Specific factors which were affecting better maintenance work schedule was the type of project which is undertaken, the nature of the project, complexity of the project and size of the project.

ii. Project Management

According to Chua et. al. (1999), project management action is a key for project success. By using management tools, the project managers would be able to plan and execute their maintenance projects to maximize the project's chances of success. Thus, the variable in the project management include inadequate communication, control mechanism, feedback capabilities, troubleshooting, coordination effectiveness, decision making effectiveness, monitoring, project organization structure, planning of schedule, and related previous management experience.
A number of attributes which will affect a better maintenance work schedule includes, communication system, planning effort, safety and quality assurance program and overall managerial actions

2.2 Theoretical Framework:

Theory of Choice of a Work Schedule

Tang and Chang (2020), propounded the theory of choice of a work schedule in a work environment. According to him, each worker has a separate work schedule, and so, no one work schedule is universally acceptable. Each worker has to consider his own peculiar times and needs before agreeing to a particular work schedule. Schedules

of Work can be used for a variety of different construction types, but there are commonly two themes: new work and maintenance work, which can also include alterations. The Schedule of Work does not have to be overly descriptive if the work required is covered in detail on the contract drawings or adequately described in the specification, but time should be taken to ensure adequate cross referencing is in place.

2.3 Empirical Studies

Yi, Eul-Bum and Junyong (2019) conducted a study on onshore oil and gas design schedule management process through time-impact simulations analyses in Korea. Monte Carlo simulation technique was used. The results revealed that the engineering phase is up to 10 times as impactful as the procurement and construction phases on the overall schedule duration. In assessing the engineering activities.

Banjo (2021), carried out a primary research design on the extent project planning affects work schedule performance in the construction industry in Nigeria, by interviewing 100 workers of Julius Beggar Construction Company, Abuja. 87 (87%) agreed that a well-planned project makes for effective work delivery in any construction firm, while the rest have no assessment. So, we conclude that for effective delivery of a project, work schedule has to be planned well. It is recommended that work schedule should work hand in hand with a well-planned work structure.

Moha (2021) carried out a primary study on the way quality control affects work schedule performance in the construction industry in Nigeria by interviewing 100 employees of Arab Contractors, Lagos. 98 (98%) opined that there is no good work schedule without sound quality control, while the rest declined comment. So, we conclude that quality control has great influence on work schedule. It is recommended that quality control should form the basis of work schedule in any construction work.

Nwankwo (2021) carried out secondary research on how resource planning affects work schedule performance in the construction industry in Nigeria, using data from Nigerian ministry of works Abuja, 1980-2020. Regression was conducted using Special package for social sciences software. After the run, it was discovered that resource planning is central to work schedule in a construction industry. It was recommended that every work schedule should be accompanied by resource planning.

3. Methodology

The method of research design adopted for this study is survey. Three Oil and gas companies operating in Rivers State represents the population of this study. A total of fifty (50) questionnaires were distributed to three different oil & gas companies and thirty (30) responded. Two sampling technique were be adopted. They are simple random sampling for questionnaires administration and judgmental sampling for selecting oil & gas companies.

Data Analysis

Multiple Regression Analysis Method were used for data analysis. Multiple regression presented in its operational form use in this research thus: -

$$Y = a_0 + \beta_1 X_1 + \beta_2 X_2 \ldots\ldots\ldots + \beta_n X_n + eo$$

Where

Y = Oil and gas industries

a_o = The Constant term

$\beta_1 - B_n$ = The relationship coefficients

\+ = a sign whi ch indicates the nature of the relationship

x_1 = Factors affecting a better maintenance works schedule

x_2 = Maintenance work schedule technique

x_3 = Importance of maintenance work schedule

e_0 = The error term in estimation.

The calculation is done by the window version of statistical package for social science (SPSS 10.0) - a computer software designed based on the multiple regression technique.

The regression parameters (β_1) is estimated using the formula:

$$\beta_1 = \frac{N\sum X_i Y_i - (\sum X_i)(\sum Y_i)}{N\sum X_i^2 - (\sum X_i)^2}$$

On the other hand

$$a_0 = \frac{\sum Y_i - \beta_1 \sum X_i}{N}$$

The correlation coefficient (R) which measures the magnitude of the relationship between the variable (Y) and the group of independent variables (X_1, X_2, X_3, &X_4) is determined using

$$R = \frac{N\sum X_i Y_i - (\sum X_i)(\sum Y_i)}{N\sum X_i^2 - (\sum X_i)^2][N\sum Y_i^2 - (\sum X_i)^2}$$

Also the coefficient of determination (R^2) which measures the extent of the variation in the dependent variable (Y) that is being explain by the variations in the independent variables ($X_1 \ldots\ldots X_n$) is given by the formula:

$$R^2 = \frac{SSR}{SST}$$

Where SSR (Sum of Squares due to regression) is given by:

$$SSR = \beta_1 = \left(\sum X_i Y_i - \frac{\sum X_i \sum Y_i}{N} \right)$$

And

SST (Total sum of Squares) is given as:

$$SST = \sum Y_i^2 - \frac{(\sum Y_i)^2}{N}$$

However, the sum of squares due to error is given by

$$SSE = SST - SSR$$

In testing the stated hypotheses, the F-test and t-test will be used.

The F-test statistics is calculated using the formula:

$$F^*_{cal} = \frac{MRS}{MSE}$$

Where MSR (Mean Squares due to regression) is given as:

$$\frac{SSR}{k}$$

Where k is the number of independent variables.

On the other hand MSE (Mean Square due to error) is given by

$$\frac{SSE}{n-k-1}$$

Where "n" equals the number of observation of the sample size.

All the above parameters will be summarized using an integrated computer tool in a table of Analysis of Variance (ANOVA) as follows:

ANOVA TABLE

Source of variation	**Sum of Squares (SS)∑**	**Degree of freedom (df)**	**Mean square (MS)**	**Variance Ratio (F-ratio)**
Regression	$SSR = R^2 \sum Y^2$	K	$MSR = \frac{SSR}{K}$	$F^* = \frac{MSR}{MSE}$
Error	$SSE = \sum Y^2 - R^2 \sum Y^2$	n-k-1	$MSE = \frac{SSE}{n-k-1}$	

Total	$SST = \sum Y^2$	n-1		

Decision Rule for Accepting Hypothesis

The stated hypotheses will be accepted or rejected based on the following decision rules:

F-test:

Accept the null hypothesis (H_0) if $F^* < F_1\text{-}\alpha$; k, n-k-1 degree of freedom, where α = the chosen significance level which for the purpose of this study will be 5% or 0.05 otherwise the null hypothesis (H_0) is rejected. Where $F^* < F_1\text{-}\alpha$; k, n-k-1 is the critical value obtainable from the standard F-distribution table.

t-test:

The null hypothesis (H_0) i.e $b_i = 0$ is accepted at $\alpha/2$ level of significance and n-k-1 degree of freedom if

$t^*_{cal} < t_1 - \alpha/2$, n – k - 1 d.f

Otherwise, the null hypothesis (H_0) is rejected in favour of the alternative hypothesis (H_A), i.e., $b_0 \neq 0$. Where $t_1 - \alpha/2$, n-k-1 d.f n-k-1 is the critical value obtained from the t-distribution table.

4. Data Presentation and Analysis

4.1 Criterion Group Returns & Analysis

This study recognized TCO marine Ltd, West African Oil & Gas group and Addax oil in the design of this thesis. The questionnaire spread by Researcher is as shown in table below.

Table 4.1: Questionnaire Distribution and Collection

Companies	Number Distributed	Number Returned	Number not Returned	% of No Returned	% of no not Returned
TCO Marine Ltd	20	12	8		
West African Oil & gas	17	10	7		
Addax Oil	13	8	5		
Total	50	30	20	60%	40%

From the 50 questionnaires were distributed to three Oil & gas industries operating in Rivers State. A total of 30 respondents returned their questionnaire giving a return rate of 60%. The questionnaire reveals that 24% of the respondents belong to the TCO Marine Ltd, 20% from West African Oil & Gas group and 16% of the respondents came from Addax Oil Company. The analysis of respondent by designation shows that the respondents who participated in the study are involved in contract/procurement management. It is believed that this management cadre and experts have better and practical knowledge of the variables under study. About 70% of the respondents have been involved for less than one year. About 10%, 20%, 30%, 40%, of the respondents are rated as 0'level, OND, BSc and Postgraduate holders respectively.

The result of the questionnaire administered to target respondents involved in the project understudy are shown as table 3.2, 3.3, 3.4, and 3.5 respectively, see Appendix III. When the data shown in the table below were subjected to a stepwise regression analysis using the SPSS software the following results were obtained from the questionnaire which attempted to evaluate factors affecting maintenance work schedule in the oil and gas Industry.

4.2 Data Presentation and Analysis

Secondary Data

Some data based on published statistics from oil &gas company and related literature are presented in order to empirically evaluate factors affecting maintenance work schedule in oil and gas industry. According to Mohamed Ibrahim et al (2006), they believed that four areas should be properly investigated prior to the development of the project scheduling procedures. The critical areas that have been identified are process of acceptance, responsibilities of contracting parties, application of work schedule and implications of work schedule.
According to Jon et al (2002), clear and concise schedule specifications outlining the responsibilities for scheduling and the requirements for preparation, approval, participation, use, maintenance and reporting are essential for timely and successful completion of most projects. Unfortunately, poor scheduling especially in terms of its specifications, have contributed to the downfall of many projects.

Model Summary

The regression results as shown below are the bases for the model designed to predict the effect of preventive maintenance on productivity of the oil & gas industry, maintenance work schedule technique and progress expected in executing a maintenance work scheduled.

Table 3.6: Model Summary

Model	Correlation Coefficient R	Coefficient Determination R Square	Adjusted R Square	Std. Error of the Estimate
1	.827[a]	.684	.673	5.1159
2	.955[b]	.911	.905	2.7646
3	.961[c]	.924	.915	2.6034

Table 3.7: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	25.768	8.048		3.202	.003	9.283	42.253
X_3	1.960	.252	.827	7.790	.000	1.445	2.476
2 (Constant)	10.351	4.729		2.189	.037	.648	20.054
X_3	1.511	.146	.638	10.325	.000	1.211	1.811
X_2	.923	.111	.513	8.300	.000	.695	1.151
3 (Constant)	9.117	4.492		2.030	.053	-.116	18.350
X_3	1.394	.149	.588	9.378	.000	1.088	1.699
X_2	.885	.106	.491	8.378	.000	.666	1.103
X_1	.918	.435	.129	2.109	.045	.023	1.813

The regression results as shown above are the bases for the model one, two and three designed to predict the success factors for maintenance work schedule in oil & gas industry, maintenance work scheduled technique and progress expected in executing a maintenance work scheduled. Y = Dependent variable while x = Independent variable.

Derived Models and Equation Model Equation & Interpretation

$Y = 9.117 + 1.393x_3 + 0.885x_2 + 0.918x_1$

Variable x_1 enters model to meet with x_2 and x_3 to form a complete model. This model implies that oil and gas industry increase by 96.1% of correlation coefficient (R). The R square increased to 92.4% and adjusted R square to 91.5%. The standard error of the estimate decreased to 2.6034. An F-test was performed on model 3 to test for significance of the model after the inclusion of all the independent variable. The result of F-value calculated using SPSS 10.0 for window is shown below.

Table 3.8: ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression Residual Total	1588.125 732.841 2320.967	1 28 29	1588.125 26.173	60.678	.000[a]
2	Regression Residual Total	2114.603 206.364 2320.967	2 27 29	1057.301 7.643	138.334	.000[b]
3	Regression Residual Total	2144.742 176.224 2320.967	3 26 29	714.914 6.778	105.478	.000[c]

a. Predictors: (Constant), X_3
b. Predictors: (Constant), X_3, X_2
c. Predictors: (Constant), X_3, X_2, X_1
d. Dependent Variable: Y

The sum of squares from the ANOVA table above is 2320.697 while the mean square is 714.914. Since the calculated F-test value is 105.478 and at 5% level of significance is F-tabulated (3, 26) is 2.98. We observed that F (3, 26) = 2.98 < 105.478 which signifies that the inclusion of factors affecting a better maintenance work schedule, maintenance work schedule technique and progress expected in executing a maintenance work schedule in the model as independent variable is significant to predict the success of oil and gas which is the dependent variable.

Hypothesis Testing

The t-test statistics was performed on the coefficient of x as stated in model 3 in other to estimate the extent to which each independent variable contributes to the success of oil & gas.

(a) **Hypothesis One**

Preventive maintenance has no significant effect on the productivity of the oil and gas industry.

Since the T-value calculated of 2.109 is greater than the tabulated t-value of 1.7056 from table, the research accepts the Alternative hypothesis and reject Null Hypothesis. It is therefore concluded that there are better factors affecting maintenance work schedule in oil & gas industry in Rivers State.

(B) **Hypothesis Two**

There is no significant relationship between Corrective maintenance and availability of maintenance materials in the oil and gas industry

Since the T-value calculated of 8.378 is greater than the tabulated t-value of (3, 26) = 1.7056 from table, the researcher accepts the Alternative Hypothesis which state there are maintenance work schedule technique in oil & gas industry in Rivers State and reject Null Hypothesis.

5.1 Summary of Findings

Maintenance schedule specifications are all over the map. According to the committees of the Association for the Advancement of cost Engineering (AACEI) and the Project Management Institute College of Scheduling (PMICOS) (2005), there is no consistency in arrangement, focus or language. Some specifications start right off with the software to be used along with the requirements for reports and updates. Others start with scheduler qualifications while still others introduce the purpose of the schedule and the scope of work. Other findings in course of carrying this research are shown as follows:

5.2 Conclusion

Sequel to the above findings, the following conclusion were made or this research work. Choosing the right scheduling method guarantees effective work delivery. It is very difficult to establish standard schedule specification for use by the oil & gas industry today. There are factors affecting maintenance work schedule in oil & gas industry. There is maintenance work schedule technique used by the oil & gas industry. Maintenance work schedule is significantly important to oil & gas industry.

Maintenance work schedule does significantly determine the successful development in oil & gas industry. One of the key decisions to be made before a project begins is which method is best suited to the project. There are requirements of successful maintenance work schedule. Factors affecting maintenance work schedule, maintenance work schedule technique and importance of maintenance work schedule as independent variable is significant to predict the success of oil & gas industry. T-test of the hypothesis confirmed that the independent variable are effective factors for dependent variable.

5.3 Recommendation

The following recommendation are made based on the findings made and conclusion arrived at, as a way of mapping out the progress expected in executing a maintenance project in a timeline that is the most efficient and cost effective possible in oil and gas in Rivers State.

i. Maintenance work scheduling techniques should be adopted fully. Scheduling consultant should strive to develop a trusting relationship with the different participants to develop a workable plan & project schedule. Labors should be taken into account when scheduling work to ensure that the participation of the labors is at the maximum standard.

ii. One method for coordinating the schedule input of large groups of contractors is a meeting called the schedule card trick. Project managers must be equipped with the relevant maintenance work schedule in oil & gas skills to enable them effectively handle some factors affecting maintenance work schedule. Projects schedule should be reviewed before problem develops.

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