

Simulation of Maintenance Activity in Loco Shed

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Abstract - In recent years, performance measurement/ evaluation of maintenance operation in Loco Shed has been an area of intense research. Studies have shown that many maintenance operations do not present the overall performance of their work. Some activity have been developed had not regularly monitor them, leading to the limited success. Therefore, establishment of scientific, comprehensive maintenance system are faced with today's challenges.

There are many approaches to develop /upgraded industrial activity such as method study (motion study), work measurement (time study), productivity and work study etc. the approach to decide the validity would be substitute in the model known inputs for every observation and decide the difference in response by model and actually observed response. This will give us pattern of distribution of error and frequency of its occurrence.

Key Words: Maintenance, Evaluation, Simulation, Locoshed, Field Data

1. INTRODUCTION

Many researchers have given recommendations for ergonomics design and mechanization of maintenance activities. The problems of scheduling maintenance are also investigated by some researchers. There are many approaches to develop /upgraded industrial activity such as method study (motion study), work measurement (time study), productivity and work study etc. Studies have shown that many maintenance operations do not present the overall performance of their work. Some activity have been developed had not regularly monitor them, leading to the limited success. So in recent years, performance measurement/ evaluation of maintenance operation in Loco Shed has been an area of intense research. Therefore, establishment of scientific, comprehensive maintenance system are faced with today's challenges.

1.1 Identification of Process variables

Many researchers have given recommendations for ergonomics design and mechanization of maintenance activities. The problems of scheduling maintenance are also investigated by some researchers [1-3]. There are many approaches to develop /upgraded industrial activity such as method study (motion study), work measurement (time study), productivity and work study etc. Studies have shown that many maintenance operations do not present the overall performance of their work. Some activity have been developed had not regularly monitor them, leading to the

limited success [4-6]. So in recent years, performance measurement/ evaluation of maintenance operation in Loco Shed has been an area of intense research. Therefore, establishment of scientific, comprehensive maintenance system are faced with today's challenges.

1.2 Dependent and independent variables

Identification of dependent and independent variables of the phenomenon is to be done based on known qualitative physic of the phenomenon. If the system involves a large number of independent variables then the experimentation becomes tedious, time consuming and costly. So by deducing the dimensional equation for the phenomenon [7-8]. The number of independent variables is reduced and it gets confirmed that all variables are considered. The exact mathematical form of this equation could be obtained based on the experimental data. This mathematical form is the targeted model.

It is necessary to evolve design of an experimentation having provision of executing proposed experimentation plan [9-10]. Upon getting the experimental results, the erroneous data is identified and removed from the gathered data Based on this purified data as mentioned here, one has to formulate quantitative relationship between the dependent and independent pi terms of the dimensional equation.

1.3 Limitations of Man Machine System

A theoretical approach can be adopted in a case if a known logic can be applied correlating the various dependent and independent parameters of the system [11-13]. Though qualitatively, the relationships between the dependent and independent variables are known based on the available literature references but sometimes the generalized quantitative relationships are not known. The relevant quantitative data is not available for loco shed workers. Hence formulating the quantitative relationship based on the logic is not possible due to no possibility of formulation of theoretical model one is left with the only alternative method of formulating experimental data based method or to be very specific in this case field data based model.

2. FORMULATION OF PROBLEM

In order to form the mathematical model the most critical activities are identified and studied. For this present practice of maintenance schedule, past failure data and their

experiences can be taken into consideration. It can be seen that from identification of problem the effectiveness of activity depends on various factors such as human factors, workstation data tools used by workers, specification of crankshaft and liner piston, solvents used for maintenance activity, and extraneous variables such as temperature, humidity, light and noise [14]. Various studies has been carried out for maintenance but no researchers has applied the Theory of Experimentation. So it is decided to apply this approach systematically. This approach will give a new insight to optimization of parameters for maintenance activity. As soon as the model is formulated for such a phenomenon one gets clear idea about the variation of dependent variables in terms of interaction of various independent variables [15]. Hence in this research it has been decided to adopt this approach.

2.1 Solution for formulation of mathematical model for maintenance activity

Normally the approach adopted for formulating generalized experimental data based model suggested by H. Schenck Jr, for such a complex physical phenomenon involves the following steps [16].

1. Identification of Identifying system, causes, effect and extraneous variable affecting the phenomenon [17]

(a)System- it is a specific spot in a workshop with available environment

(b)Causes- These are independent variables which are actuating the system

(c)Extraneous variables- The extraneous variables influences the performance of an activity but cannot be measured.

(d)Effect –these are dependent variables are responses after execution of an activity

2. Reduction of variables through dimensional analysis
3. Test planning
4. Design and Conduction of experimentation
5. Purification of experimental data
6. Approach of the formulation of model by multi plane regression analysis

2.2 Determination of appropriate sample size

An appropriate size of sample is based on a number of accuracy factors. Together they comprise four steps process in field data based activity

Here the number of observations considered as 30 based on probability concept of Degree of uncertainty. The formula for calculating number of reading is

$$N = \left[\left(\frac{x}{Z_c} \right) - \mu \right] \sigma$$

Where, x =mean

μ = median

σ = standard deviation

Z_c = tail value

N = number of readings

For $N \geq 30$, $Z_c = 2.58$ for certainty (confidence level 99%)

$Z_c = 1.96$ for certainty (confidence level 95%)

$Z_c = 1.645$ for certainty (confidence level 90%)

Hence selecting $Z_c = 2.58$ for certainty with the confidence level 99% satisfied the no. of readings

$$N = \left[\left(\frac{x}{Z_c} \right) - \mu \right] \sigma$$

For $N \leq 30$, $Z_c = 2.48$ for certainty (confidence level 99%)

$Z_c = 1.71$ for certainty (confidence level 95%)

$Z_c = 1.32$ for certainty (confidence level 90%)

Hence selecting $Z_c = 2.48$ for certainty with the confidence level 99% satisfied the no. of readings

2.3 Sensitivity Analysis of Maintenance Activity

The influences of various independent π terms for maintenance activity have been studied by analyzing the indices of the various π terms in the models. Through the technique of sensitivity analysis the change in the value of a dependent π terms caused due to an introduced change in the value of individual independent π terms is evaluated.

In this case, the change of $\pm 10\%$ is introduced in the individual π terms independently (only at a time). Thus the total limit of the introduced change is 20%. The effect of this introduced change on % change values in the dependent π terms and effect of introduced change for dependent variables indicate the most sensitive element of the maintenance activity

2.4 Reliability of Maintenance Activity:

In general reliability is a term associated with the chance of failure. Hence reliability also finds value, which is used to show the performance of the model. The reliability of model is evaluated as.

For available mathematical model, the known value of independent variables has substituted in the mathematical model. So that, one will obtain, the required values of dependent variable, which is known as calculated value of

dependent variable. Now, one can find error in the calculated value of dependent variable and observed value of dependent variable. For this, it is necessary to subtract calculated value from the observed value of dependent variable. Once the error is calculated, then one can calculate the reliability of model by calculating the mean error.

This can be done by using following formula,

Reliability= 1- Mean error

Where, Mean error= $\Sigma XIFI / \Sigma FI$

Where, $\Sigma XIFI$ = Summation of the product for percentage of error and frequency of error occurrence and ΣFI = Summation of frequency of error occurrence.

3. CONCLUSIONS

For complex man machine systems such as maintenance activities, it is only partially possible to plan experimentation. However in many of such systems, Test planning part of experimentation approach is not feasible to be adopted. One has to allow the activity (i.e. Phenomenon) to take place either the way it take place or else allow it to take place as planned by others. So it is feasible to adopt experimental data based modeling for such a complex maintenance activity.

Loco shed follows traditional and conservative maintenance policy for maintaining locomotive. So the loco shed worker performs this complex machine maintenance work under physical and mental stress, poor environmental conditions etc. they are not aware as to what extent ergonomics intervention can alleviate their exhausting work.

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