Planning: An Effective Tool for Industrial Maintenance.

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ABSTRACT

Technology development is a key to industrialization, however this effect is usually lost because soon after the adoption of new technologies, advancement often collapses owing to lack of effective planning for maintenance. Thus, there is a need to reverse this trend in order to keep the benefits of industrial advancement. Effective plant maintenance calls for the proactive planning of maintenance for materials, manpower, and facilities. It also requires an employee motivation program as well as an objective budget. In this paper, these essential functions of maintenance administrative planning are discussed. If put in practice, these endeavors will support the industrial advancement of a developing country.

(Keywords: planning, planning horizon, employee motivation, labor efficiency, job planning)

INTRODUCTION

Though maintenance is a familiar word to most people, its meaning and interpretation may differ. In the service and manufacturing industries, maintenance is generally seen as shop floor activities, such as tightening nuts and bolts, lubricating bearings, or repairing parts when broken.

There are many reasons for careful planning of all types of maintenance activities in an industrial set-up, most especially in a developing country like Nigeria. Certainly, no company will want to over or under maintain his facilities because either case will unnecessarily increase the unit cost of production/service. For instance, hiring too many maintenance personnel can increase maintenance costs, while too few skilled personnel can increase company downtime and damage to equipment. Hence, there is need to plan for the right number of maintenance personnel for a production period.

The present situation in developing countries like Nigeria calls for a thoughtful-planning. We are today witnessing the slow-down of many companies due to improper administrative planning and material shortages for production and maintenance. Only those companies with good plans may survive.

PLANNING HORIZON

A planning horizon is the time span set for attaining a goal. This time span may be an hour, a day, a week, a month, or some years from today. A maintenance planning horizon depends on the degree of the company planning problem and may be classified into short, intermediate, or long range time spans. In general, a period covering from an hour to one year is regarded as short range; two to three years is intermediate; and long range may be four or more years.

The choice of a maintenance planning horizon today is important since the paperwork for obtaining spare parts, can sometimes take more than a year. It needs to be mentioned here that the choice of a planning horizon for maintenance may not be done in isolation from development of a production planning horizon. Since maintenance is only a supporting activity to production, it is only proper to choose the same planning horizon as production, unless operating circumstances demand otherwise.

In production, long-range planning is usually involves such things as plant expansion, intermediate planning involves product changes, and short-range is for production control. The maintenance administrator needs to know when plant expansion or product changes will take

place in order to plan for appropriate increases in maintenance activities or changes in strategy.

PLANNING FOR MAINTENANCE MATERIALS

Planning for all maintenance materials for a large company can be an expensive venture. For economic planning, it is necessary to identify the "vital few" materials for careful planning and control; the "trivial many" for" loose planning; and forecast the quantity for each item required. Final decisions to determine when and how much to purchase for each item can then be supported.

The Vital Few Items

To determine the items for careful planning, a method called Pareto Analysis is used. The essential steps involved in the analysis are:

1) Identification of all maintenance materials used in a period of time, say one year.

2) Determine capital cost of each material for the period.

3) Arrange items by descending order of cost starting with the most costly.

4) Plot cost against items starting with the most costly.

The "vital few" will be obvious on the chart, it is common to observe that the "vital few" will be about 80% of total material costs and 20% maintenance administration. To label all so classified items for these "vital few" may save more money than loose planning for all items. For the "trivial many", bulk purchases for the planned period may be done.

FORECASTING MATERIAL NEEDS

In a small organization, an experience planner can reasonably guess the quantity of maintenance materials needed in a large organization with a centralized maintenance planning. The task of estimating may require statistical forecasting techniques. One way to do this is:

1) Identify all times/facilities that use the planned materials.

2) Using past records, sum up machine hours of all the equipment which use each item.

3) Record the quantities of items for the corresponding year.

4) Plot quantity of items against number of hours.

These plots will help identity those "vital few" items which vary with machine usage and those that may not. For the variable items, curve fitting techniques can be used to find the best linear curve for the purpose of estimation. To show how one can develop such a forecasting model, the following are defined:

Y_1 quantity of maintenance material for period I

X_1 total machine hours of equipments which used material

a : gradient of linear curve

b : gradient of linear curve

n : number of periods in which data is collected

Y_1: $a_1 + bx_1$ is the linear model

To calculate "a" and "b", the following formulae are used:

B $n\sum xiyi - (\sum xi)(\sum yi)$

N $\sum xi \quad (\sum xi)$

n

$\sum yi \quad {}_b\sum xi$

With "a" and "b" and the machine hours x_1 for any period known, the quantity of material for the period can be estimated. From past records, a and b can be calculated. However, x_1 is derived from forecast production volume. From this, the operating capacity of each equipment can be determined.

An example for the quantity of lubricating oil requirement is shown below.

Table 1: Example for the Quantity of Lubricating Oil Requirement.

Period	X_i (Gallons of lubricant x 10^8)	Yi (Total m/c Hour x 10^6)	X_i^2	X_i Yi
1	5	2	4	10
2	11	4	16	44
3	16	6	36	96
4	23	10	100	230
TOTAL	55	22	156	380

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$n\sum x_i y = 4\sum x_i y_i = 380$

$(\sum x_i)\ (\sum y_i) = (22)(55) = 1210$

$(\sum x_i)\ 22^2 = 484$

$\sum x^2_i = 156$

$$b \frac{(4)(380) - 1210}{(4)(156) - 484} = \frac{1520 - 1210}{624 - 484} = 2.2$$

$Yi \quad 55.X_i = 22$

$$a = \frac{55 - (2.2)(22) = 1.65}{4}$$

The linear model is therefore:

$Y = 1.65 + 2.2x$

Suppose, in a particular planning period, the total machine hours of all equipment that use lubricating oil is $7x\ 10^6$. Then, estimated lubricating oil requirement is as follows:

Quantity of lubricating oil
$= 1.66 + 2.2\ (7) \times 10^8$

$= 17.05 \times 10^8$ gallons

For the no variation items, the same amount may be purchase in each planned period.

MANPOWER PLANNING

Manpower planning is best accomplished when a company has established a standard procedure for most of its maintenance tasks including trouble shooting. For each documented procedure, a standard performance time is assigned using appropriate work measurement techniques and giving all necessary allowances.

Experience has shown that most maintenance administrators are reluctant to accept the standard procedure approach. For a small organization, they may be correct since manpower changes may be minimal from period to period. For large companies, it should be mandatory that not only are standard procedures used for planning but also for labor control. It is good company policy for foreman to have their craftsman follow standard procedures and have their performance rated accordingly.

Where standard procedure has been established manpower planning is carried out as follows:

1) Identify all skills required in the maintenance department.

2) For each skill type, group all craftsmen and sum up all man-hours of these craftsmen for each production period using information from time cards.

3) Record the company production volume of the same period.

4) Plot maintenance man-hours of each skill type against production volume for those maintenance hours which correlate with volume of production. A liner forecasting model can be developed in the same manner as in the case with maintenance materials.

The number of maintenance craftsmen for any skill is calculated as follows:

1) Obtain company forecast of production volume for the planned period. If this volume is higher than plant capacity, maximum production volume of the plant is taken.

2) Calculate maintenance hours for the skills using a liner model. That is, Maintenance Hours (a) + (b) (Prod. Vol.).

3) Determine available working hours in the plan period. For a one year plan period of 250 working days and 8-hour day, total available working hours are 2000 less any planned overtime hours.

4) From past records, determine craftsmen use or proportion of time, they were actually doing their maintenance job.

5) Number of skill craftsmen for planned period = Total Maintenance Hours/Available Hours use factor.

If the number of craftsmen obtained in (5) are less than current number in the company, the administration may decided to lay off the surplus if the situation is a trend, otherwise, they may be retained for a better year.

If the number of craftsmen shows a large increase from previous years our techniques for developing maintenance, the organization should decide whether to increase the number of foremen supervisors.

DAY-TO-DAY MAINTENANCE JOB PLANNING

It is a common experience for maintenance technicians to report for assigned duties only to discover that they have insufficient materials or the wrong tools to perform their duties. A reason for this may include inadequate information concerning the job. In a day, several episodes of this can result in lots of manpower waste. Such waste can contribute to the high cost of production or service.

Maintenance administration can avoid such unproductive labor by making it a policy that all foreman or supervisors carry out for-the-day planning of maintenance activities. The following steps are useful for day-to-day maintenance planning:

1) Have all requests for emergency maintenance fill out appropriate requisition forms.

2) Whenever request are not, understand the requirements for carrying out maintenance job requirements (materials and tools needed).

3) For a centralized maintenance system, a technician is assigned jobs in the same location in order to minimize travel time. It is also a good practice that technicians know their assignments, at least a day ahead of time.

PLANNING FOR MAINTENANCE FACILITIES

Maintenance facilities are those which provide such utilities as electricity, compressed air, heat, refrigeration, purified water, and chemicals. They may also include the machinery in a workshop. Once established, the plan to change facilities is not done on regular basis except when plant expansion is anticipated. In plant expansion, maintenance administration should work with production management to determine the maintenance implications.

MOTIVATION OF THE MAINTENANCE EMPLOYEE

Administration of employees is not as easy as that of maintenance materials and facilities. It is easier for the administrator to predict the behavior of materials and facilities. Human beings are capable of independent thinking and having the free will to choose from alternatives, therefore, people are not easily administered. As a result, planning is geared towards those actions that motivate the employee to stay on the job and perform efficiently.

Some of the motivational plans that the administrator can do to achieve good maintenance results are:

1) Training programs
2) Performance ratings
3) Objective promotions
4) Special rewards for outstanding performance.

Training Programs

The mere existence of a training program to which the maintenance employee can look towards may motivate him to do better. The selection of those to benefit from such a scheme is based on a performance measures that are well understood by all in the company. In addition to worker motivation, the level of sophistication of modern maintenance equipment today calls for equally sophisticated maintenance personnel. It is no longer feasible for an old-time craftsmen to maintain most parts or equipment. The repair and service of micro-processor for the control of a milling machine or boiler, for instance, needs special skills. For effective maintenance of modern equipment, a good training program is the answer.

Performance Rating

When standard procedures and maintenance hours are established for each activity, a performance rating index can be calculated. Knowledge of performance indices can and does motivate an employee. It is a good practice to have the performance of maintenance employees measured and published weekly or bi-weekly. Work measures and method analyses are valuable tools for performance measurement.

To compute performance ratings, it should be a company policy for all labor, individuals, or groups to record time taken to complete assigned activities. Such records are cross-checked and signed by the foreman. For all activities with standard procedures, a performance index or labor efficiency for an individual group or department is the Sum of standard Hours of completed tasks/Actual Man-Hours spent on the tasks.

Complete tasks are those approved by the foreman and actual man-hours spent, and do not include such delays for material shortage, tool damage, etc. For weekends, the labor efficiency of employees and departments is computed and displayed on the notice board. Experiences have shown that companies who control employees by labor efficiency use about a 90% minimum score. Those who score below are advised to improve. Persistent poor performance may lead to layoff.

Objective Promotion Scheme

At the end of the year, a plan for promotions is based on labor efficiency. For example, if five are to be promoted. the five with highest annual labor efficiencies are chosen. When this is well administered, productivity of maintenance workers will considerably improve.

Reward For Outstanding Performance

Using the labor efficiency as a criterion; company trophies or special Christmas presents are awarded for the best performance. Conversely, if inevitable layoffs are to be made, it starts with those having the worst performance.

CONCLUSION

For a developing company to remain competitive and profitable, it must continue to improve its maintenance culture (i.e., the use of proper maintenance planning, motivation of the maintenance employees, and reasonable maintenance budgets). This will no doubt result in reductions in running cost, higher yields, and greater utilization of resources (less scrap), as well as higher job satisfaction and improved production quantity with higher quality. The bottom line to all benefits is improved productivity.

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