Maintenance Engineering as a Basic Tool for Maximum Production.

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ABSTRACT

As a result of rapid advances in modernization schemes during the past four decades, industrial maintenance has become so sophisticated that trained personnel are necessary. Maintenance, an aspect of the engineering discipline, is rooted in engineering practice and is so important for the smooth running survival of any industrial set up. Discussion in this review covers a range of experience in maintenance systems for equipment or machines in industry. All over the world, industries have various ways of organizing maintenance activities to sustain the life span of equipment or machines and for greater efficiency and productivity. The failure of most industries today results from of lack of adequate maintenance practice, Experience has shown that many of our industrial machines break down when they still should be expected to be at the peak of their production performances. Outcome effects are that most industries start to run at a huge loss when they were expected to make profit. Consequently, a maintenance engineering culture should be properly in practice in all national industries.

(Keywords: maintenance, management, engineering, breakdown, equipment, lifespan, production, availability, efficiency, profit, routine, overhauls, schedule, preventive, repair, spare)

INTRODUCTION

The modern concept of maintenance systems is known as terotechnology, which is a total systems concept of maintenance [5]. The British standards, BS 3811 (1974), defines terotechnology as a combination of management, financial, engineering, and other practices applied to physical assets in pursuit of economic life cycle costs or simply as a combination of any actions carried out to retain an item in, or restore it to, an acceptable condition. All over the world, industries have various ways to organize maintenance activities, namely; planned, unplanned, preventive, corrective, or predictive maintenance. The primary objective is arrived at achieving maximum plant availability at minimum cost, that is:

- To prevent breakdown of equipment,
- To prolong the life span of equipment,
- To restore equipment to acceptable condition with minimum delay after an eventual breakdown.

In industry, there are only guidelines on how to organize maintenance but there are no single best ways.

OBJECTIVES OF MAINTENANCE

Many enterprises whether commercial or industrial, are set up with the main aim of making profit on investment. In order to achieve this corporate objective there is a need to pursue the following objective among others:

- Maximize production output
- Optimize the product quality

These maximum outputs and good quality products have to be achieved at the minimal cost index possible. All over the world, maintenance is scheduled to service production to achieve these goals. This involves ensuring the effort of the maintenance personnel in close collaboration with production staff and their service department [2]:

- that the availability and efficiency of facility for quality production at minimal cost index are maximized;

- that the means of evaluating equipment performance through record keeping and formulation of equipment Improvement action are achieved;
- the establishment of safe working environment;
- that the designed life span of equipment is realized; and
- the quick acquisition of manpower.

If these functions are not executed, production would be jeopardized. Figure 1 shows a typical maintenance flow chart. The most effective maintenance planning method is preventive maintenance planning and this can be achieved through routine inspections [3].

In decision support, it is important to ask if maintenance is to modify the existing design, or is it for plant improvement modification design? These questions need to be answered and then an institution can proceed on to the next step. The next steps now include repairs, either within the workshop capacity or beyond workshop capacity, spare parts procurement, and equipment weak point evaluation.

THEORETICAL CONSIDERATION

From past experiences, the maintenance system of plants and equipment involve the following methods [4]:

- Breakdown maintenance
- Routine maintenance and overhauls
- Scheduled maintenance and overhauls
- Preventive maintenance
- General overhauls

A. *Breakdown Maintenance*

This type of maintenance should be prevented or avoided to a barest minimum. Even with scheduled repairs and overhauls, the need to remedy disturbances will not be obviated. The so called unpredictability of events causing disturbances or breakdown is, however, not generally applicable. It is poor maintenance practice if the personnel in charge just wait for machines/equipment to breakdown before he acts.

B. *Routine Maintenance and Overhauls*

This refers to inspection and minor repairs carried out to exclude the coincidence of major disturbances.

C. *Scheduled Maintenance and Overhauls*

This schedule not only comprises the overhaul dates, but also the times required according to experience, thus allowing to accurately predicting the working times involved. For example, drive motors and similar equipment within complete plants may be maintained using this method.

D. *Preventive Maintenance*

This essentially comprises scheduled repairs which, on the basis of consistently updated checked reports, permit predetermined shut-down of the plant.

E. *General Overhauls*

General overhauls are carried out when the repairs required are expected to necessitate shut-down of the complete plant for a period longer than that required for normal repairs. Such overhauls should be carefully prepared by establishing a net work plan and predetermining critical paths, within all shop work. This type of maintenance system is very crucial to the generality of the consumers that is the end users. The aftermath of this is that there is total production breakdown and the commodity is completely off the market.

ENGINEERING MAINTENANCE PROBLEMS

It should be pointed out that maintenance, generally in this part of the world, has some constraints, which hinder the smooth and effective running of any industrial set up [3]. The most important of these constraints include:

- Non-availability of spare parts and consumables;
- Lack of understanding of the maintenance crew;
- Inadequate experience of engineering staff;
- Inadequate training of engineering personnel thereby resulting in lack of exposure;
- Manpower shortages;
- Difficulty in getting foreign exchange to update equipment and procure spare parts;

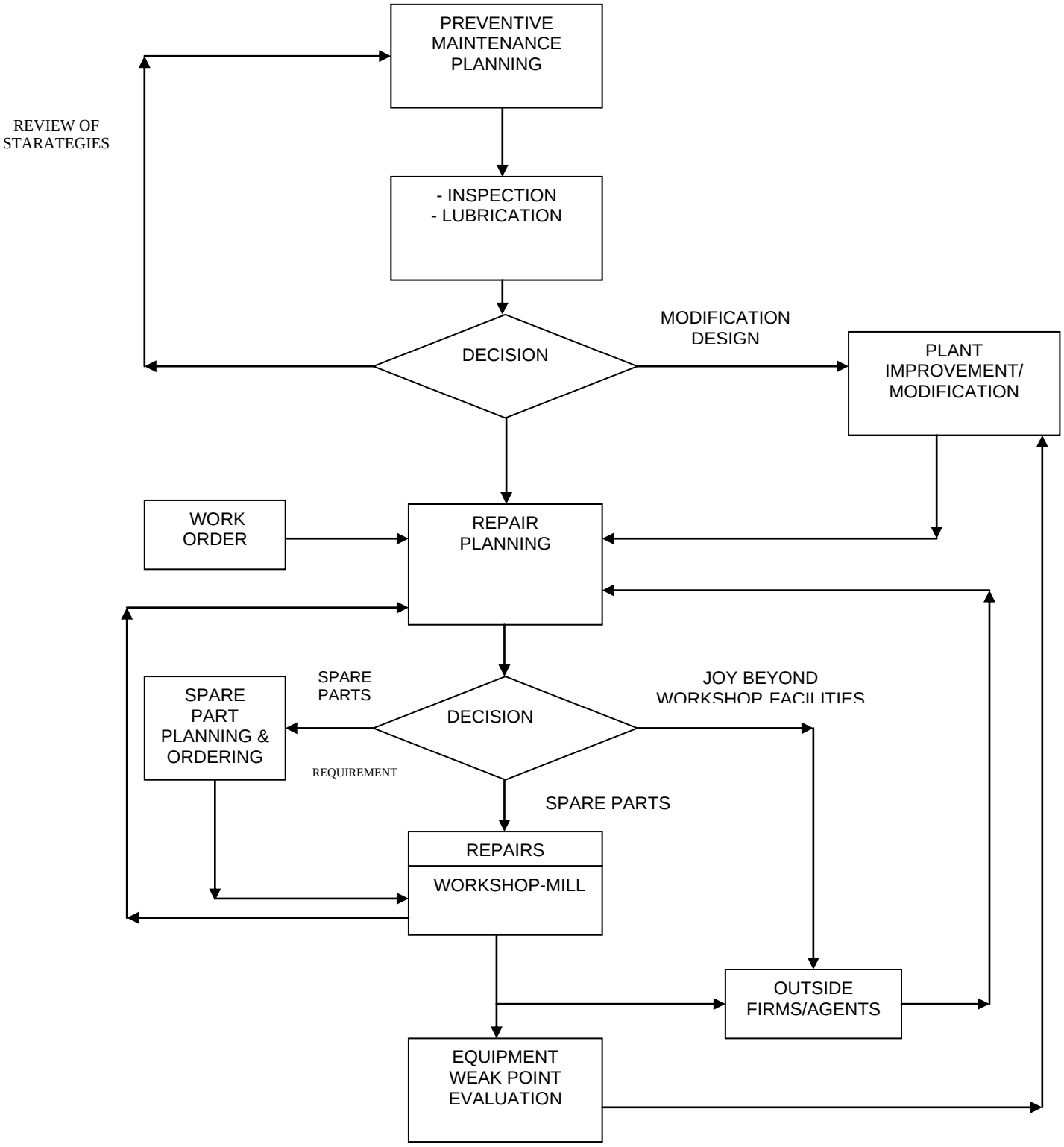

Figure 1: Typical Maintenance Flow Chart.

- Inadequate remuneration for engineering personnel which leads to their non-commitment and at times nonchalant attitudes to work;
- Lack of modern fault detecting equipment to monitor sensitive parts of machines like bearing and gears before resulting to failure leading to costly breakdowns.

METHODOLOGY

In this study a case study of maintenance practice of a salt produce company is examined. Optimum production, possibly to full plant capacity, is usually the ultimate goal of every manufacturing industry especially when the equipment are still very new and the products are the raw materials for other downstream industries.

The chairman of the company recruited personnel of various cadres and discipline to manage the various sections of the establishment. He was paying them very well and all members of staff were very happy and were ready to retain their appointments for as long as possible. The main concern of the chairman was only the production output which must be very high. He frowned at delay time of any nature.The maintenance manager knew this fully well and tried to satisfy the chairman to protect his job by avoiding delays from any section to the extent that he avoided demands for preventive maintenance periods. In fact, he avoided any delays except for unforeseen circumstances which may eventually lead to minor repairs. Things went on smoothly for a while because the plant was still very new when this maintenance manager assumed the leadership of the company. The production of salt (in bags) in the factory record for 1987 is collected and tabulated as shown in Table 1.

After a short period of time the honeymoon was over and the machines started to breakdown one after the other. They were still expected to be at the peak of their production performances. Time utilization records showed that over 75% of the planned production time was being spent on breakdown repairs. Production cost hikes due to very low production output resulting from very low plant utilization. The production of salt (in bags) in the factory record for 1988 was collected and tabulated as shown in Table 2.

The aftermath effect was that the company started to run at a huge loss and was at the verge of bankruptcy. To salvage this situation, the chairman had to negotiate for a loan from his banker to import spare parts. This time around, instead of employing a local maintenance manager, he employed an expatriate expert to manage the company. In his own opinion, he introduced comprehensive knowledge of a maintenance culture which enabled him to improve technical effects on both the performance and service life of the equipment which greatly enhanced the production capacity and sustenance. The production record in this consequence is shown in Table 3.

Table 1: Salt Production Record (1987).

Month	No. of Bags (million)
January	2.0
February	2.1
March	2.2
April	2.2
May	2.3
June	2.3
July	2.2
August	2.3
September	2.2
October	2.1
November	2.0
December	2.0

Table 2: Salt Production Record (1988).

Month	No. of Bags (million)
January	2.0
February	1.86
March	1.85
April	1.84
May	1.8
June	1.64
July	1.6
August	1.6
September	1.53
October	1.2
November	1.0
December	0.1

Table 3: Salt Production Record (1989).

Month	No. of Bags (million)
January	2.4
February	2.45
March	2.6
April	2.67
May	2.6
June	2.62
July	2.62
August	2.63
September	2.6
October	2.7
November	2.65
December	2.65

RESULTS AND DISCUSSION

In 1987 when production was just started with machine parts in good condition, the chairman was able to achieve his goal for maximum productivity despite the fact the manager avoided introduction of maintenance engineering culture. This is clearly shown in Figure 2.

In February 1988, sudden reduction in production was identified due to weakness of the machine parts. Instead of the maintenance manager complying with the introduction of appropriate maintenance practices, he refused to do so until total breakdown of the system came to reality in December of the same year when the chairman of the company employed foreign expert to replace the position of the former one.

With his own regime starting from January, 1989, he introduced the practice of maintenance culture, hence a sudden increase in productivity emerged. The chart for the output production is shown in Figure 2.

RECOMMENDATION

Experience has shown that the practice of maintenance engineering culture plays a vital role in high production. This implies that management should enforce the practice of a maintenance engineering culture in their company in order for the company to achieve their objectives. In addition, they should take the following basic elements into consideration:

- Spare parts listed from suppliers
- Replacement and handy stocks
- Checking of wearing parts within the plants
- Various methods of maintenance
- Operating and maintenance instructions provide by the suppliers.

CONCLUSION

It can be inferred from this write up that lack of a well organized preventive maintenance system was solely responsible for the setback of this company. The chairman and maintenance manager did not stress the importance of preventive maintenance which has lead to the breakdown of plants and equipment.
Also, it can be pointed out that in any industrial set up, maintenance is very important to keep the industry running and to protect the interest of the workers.

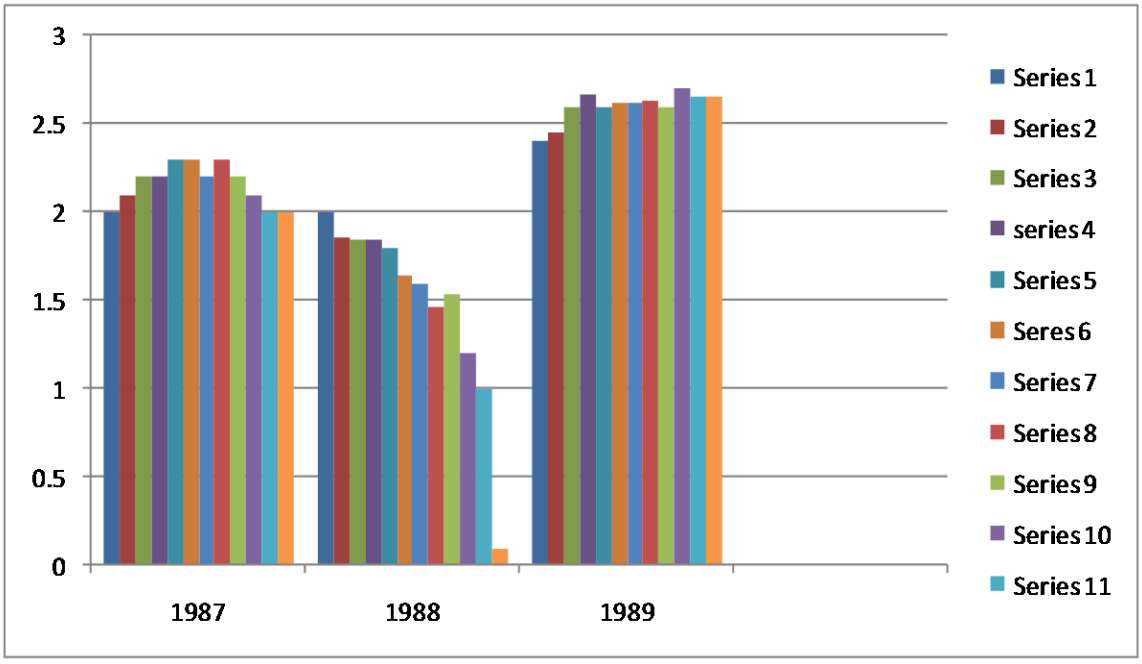

Figure 2: Bar Chart to Illustrate Salt Production (in Bags) for 1987 to 1989.

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