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Study The Initiation Steps Of Total Productivity Maintenance In An Organization And Its Effect In Improvement Of Overall Equipment Efficiency

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ABSTRACT

Frequent machine breakdowns, low plant availability, lower working time, idle laboureand increased overtime are a great threat to a plant as they increase operating costs of an industry. The main aim of this Project is to improve Overall Equipment Effectiveness (OEE) at a manufacturing company through the implementation of innovative maintenance strategies. The paper focuses on improving the maintenance in a manufacturing set up using an innovative maintenance regime mix to improve overall equipment effectiveness. I usually production is based on the total kilowatt of motors produced per day. Reduced demand and lack of raw materials particularly imported items are adversely affecting the manufacturing operations. The company has to suffer due to lower availability of machines as result of breakdowns and lack of raw materials. The price reductions and uncertainties as well as general machine breakdowns further lowered production. Some recommendations were given. For instance, employee empowerment in the company will enhance responsibility and authority to improve and totally eliminate the six big losses. If the maintenance department is to realize its proper function in a progressive, innovative industrial society, then its personnel must be continuously trained to meet current needs as well as future requirements. To make the maintenance planning system effective, it is essential to keep track of all the corrective maintenance jobs and preventive maintenance inspections. For large processing plants these cannot be handled manually. It was therefore recommended that the company implement (Computerized Maintenance Management System) CMMS.

Keywords:- Maintenance; Manufacturing; Overall Equipment Effectiveness

PROBLEM FORMULATION

Maintenance has been largely considered as a support function which is none productive since it does not generate cash directly. However for industry to produce goods of the right quality and quantity for the customers and be able to deliver them at the right time its plant or equipment must operate efficiently and accurately. For every manufacturing company the objective is to produce goods at a profit and this Is only achieved by using an effective maintenance system that helps maximize availability by minimizing machine downtime due to unwarranted stoppages. Without an effective and economically viable maintenance system, equipment reliability suffers, and the plant pays the price with poor availability and increased downtime. All these mentioned poor key performance indicators (KPIs) could be a result of poor machine condition and sometimes low employee morale. Low plant availability and overtime costs will negatively affect an industry's operational efficiency. Plant Engineers must therefore design an effective maintenance system for the plant and its equipment.
(Implementation of Total Productive maintenance, a case study)

Aim

The aim of this project is to improve Overall Equipment Effectiveness in the company through the Effective Maintenance implementation of Total Productive Maintenance.

RESEARCH OBJECTIVES

- To maximize overall equipment effectiveness
- To reduce equipment downtime while improving quality and capacity.
- To increase competitive advantage.

LITERATURE REVIEW

Many manufacturing systems operate at a lower capacity with a consequence of a higher cost of the Producing products. In the fabric Dyeing Process industry, the production process requires non-stop Operation of automatic production line equipment. A stoppage in a production line, due to a failure of the equipment, causes a drop in the production rate and quality problems on the products. Low productivity is the result of the worst function of the production lines. This is can be a result of imperfect maintenance of the machines. Maintenance is undertaken to preserve the proper function of the system so that it will continue to do what it was designed to do. A success of the product is generally measured by satisfaction of the customer who seeks good quality. So quality is the prime factor in the success of the product. Failure of the product is mainly due to poor quality of the product is mainly due to poor quality of product and the downtime loss in fabric dyeing processing industry leads to the loss in availability of

the equipment, in turn leads to the less Overall Equipment Effectiveness (OEE). The downtime loss results in shut down of the particular equipment which decreases the OEE. This is considered to be the one of the major losses to the company. So it becomes to reduce the downtime loss in order to increase the productivity of the particular equipment .There are various mathematical models for measuring OEE developed by various researchers. Felipe et al. (2002), Hernandez et al. (2006) EIMekkawy et al. (2006) and Charu et al. (2000) have defined OEE in combination with operation, maintenance and management of manufacturing equipment and resources. Muthiah et al. (2007) present some practical solutions highlighting the OEE teams at the Texas Instruments, USA which have been designed to minimize many of the semiconductor metric problems. Rathore et al. (2005) investigated OEE data with a productivity analysis framework called Capacity Utilization Bottleneck Efficiency System which identified and prioritized productivity inefficiencies with the decreasing in their accompanying tool capacity.

History of TPM

From where did TPM evolve? What spurred its development? TPM originated in Japan and was an equipment management strategy designed to support the Total Quality Management strategy. The Japanese realized that companies cannot produce a consistent quality product with poorly-maintained equipment. TPM thus began in the 1950s and focused primarily on the pre-ventive maintenance. As new equipment was installed, the focus was on implementing the preventive maintenance recommendations by the equipment manufacturer. A high value was placed on equipment that operated at designed specifications with no breakdowns. During these same years, a research group was formed which later became the Japanese Institute of Plant Management (JIPM).

During the 1960s, TPM focused on productive maintenance, rec-ognizing the importance of reliability, maintenance, and economic efficiency in plant design. This focus took much of the data collected about equipment during the 1950s and fed it back into the design, procurement, and construction phases of equipment management. By the end of the 1960s, JIPM had established and awarded a PM prize to companies that excelled in maintenance activities.
Then in the 1970s, TPM evolved to a strategy focused on achieving PM efficiency through a comprehensive system based on respect for individuals and total employee participation. It was at this time that "Total" was added to productive maintenance. By the mid-1970s, the Japanese began to teach TPM strategies internationally and were recognized for their results.

This process was an evolutionary one that took time, not be-cause it was technically difficult to produce the results, but because of the efforts to change the organizational culture so that it valued the "Total" concept.

Today the international focus on TPM is intensifying. This in-terest is expressed to support a company's full utilization of its assets. For example, one of the prevalent strategies today is the concept of Lean Manufacturing. It is based on the Toyota production system and is designed to drive out waste from an organization. Lean Manufacturing strategies have yet to produce the true benefits possible because they assume full asset utilization. Furthermore, the full utilization of assets will never occur without an effective TPM strategy. Therefore, are Lean Manufacturing strategies effective today? The answer is no. A quick review of the current state of maintenance in the United States indicates that changes are required if companies want to achieve the benefits of Lean Manufacturing.
(httphttp://www.reliabilityweb.com)

METHODOLOGIY

The methodology is based on study the steps of implementation of TPM in an organisation. Method is divided into various steps, whose aims are bring forth improved maintenance policies of the mechanical equipment. Also, the continuous and through inspection of the production process is achieved through measurements of the overall equipment effectiveness (OEE). The goal of the development methodology is to bring the competitive advantages, such as increasing
the productivity, improving the quality of the products and Project gives an idea about outcomes of industry such as productivity, quality, profit etc., by introducing a new framework.

THEORTICAL FRAME WORK

WHAT IS TPM

What is Total Productive Maintenance (TPM)?

It can be considered as the medical science of machines. Total Productive Maintenance (TPM) is a maintenance program, which involves a newly defined concept for maintaining plants and equipment. The goal of the TPM program is to markedly increase production while, at the same time, increasing employee morale and job satisfaction.

TPM brings maintenance into focus as a necessary and vitally important part of the business. It is no longer regarded as a non-profit activity. Down time for maintenance is scheduled as a part of the manufacturing day and, in some cases, as an integral part of the manufacturing process. The goal is to hold emergency and unscheduled maintenance to a minimum.

Why TPM?

TPM was introduced to achieve the following objectives. The important ones are listed below.

- Avoid wastage in a quickly changing economic environment.
- Producing goods without reducing product quality.
- Reduce cost.
- Produce a low batch quantity at the earliest possible time.
- Goods send to the customers must be non-defective.

Similarities and differences between TQM and TPM:

The TPM program closely resembles the popular Total Quality Management (TQM) program. Many of the tools such as employee empowerment, benchmarking, documentation, etc. used in TQM are used to implement and optimize TPM. Following are the similarities between the two.

1. Total commitment to the program by upper level management is required in both programmes
2. Employees must be empowered to initiate corrective action, and
3. A long-range outlook must be accepted as TPM may take a year or more to implement and is an on-going process. Changes in employee mind-set toward their job responsibilities must take place as well.

Types of maintenance:

1. Breakdown maintenance:

In this type of maintenance, no care is taken for the machine, until equipment fails. Repair is then undertaken. This type of maintenance could be used when the equipment failure does not significantly affect the operation or production or generate any significant loss other than repair cost. However, an important aspect is that the failure of a component from a big machine may be injurious to the operator. Hence breakdown maintenance should be avoided.

2. Preventive maintenance (1951):

It is a daily maintenance (cleaning, inspection, oiling and re-tightening), design to retain the healthy condition of equipment and prevent failure through the prevention of deterioration, periodic inspection or equipment condition diagnosis, to measure deterioration. It is further divided into periodic maintenance and predictive maintenance. Just like human life is extended by preventive medicine, the equipment service life can be prolonged by doing preventive maintenance.

2a. Periodic maintenance (Time based maintenance - TBM):

Time based maintenance consists of periodically inspecting, servicing and cleaning equipment and replacing parts to prevent sudden failure and process problems. *E.g. Replacement of coolant or oil every 15 days.*

2b. Predictive maintenance:

This is a method in which the service life of important part is predicted based on inspection or diagnosis, in order to use the parts to the limit of their service life. Compared to periodic maintenance, predictive maintenance is condition-based maintenance. It manages trend values, by measuring and analyzing data about deterioration and employs a surveillance system, designed to monitor conditions through an on-line system. *E.g. Replacement of coolant or oil, if there is a change in colour. Change in colour indicates the deteriorating condition of the oil. As this is a condition-based maintenance, the oil or coolant is replaced.*

3. Corrective maintenance (1957):

It improves equipment and its components so that preventive maintenance can be carried out reliably. Equipment with design weakness must be redesigned to improve reliability or improving maintainability. This happens at the equipment user level. E.g. Installing a guard, to prevent the burrs falling in the coolant tank.

4. Maintenance prevention (1960):

This program indicates the design of new equipment. Weakness of current machines is sufficiently studied (on site information leading to failure prevention, easier maintenance and prevents of defects, safety and ease of manufacturing). The observations and the study made are shared with the equipment manufacturer and necessary changes are made in the design of new machine. (Butterworth-Heinemann, 1997, Oxford)

OEE (Overall Equipment Efficiency):

The basic measure associated with Total Productive Maintenance (TPM) is the OEE. This OEE highlights the actual "Hidden capacity" in an organization. OEE is *not* an exclusive measure of how well the maintenance department works. The design and installation of equipment as well as how it is operated and maintained affect the OEE. It measures both efficiency (doing things right) and effectiveness (doing the right things) with the equipment. It incorporates three basic indicators of equipment performance and reliability. Thus OEE is a function of the three factors mentioned below. (www.epa.gov/lean/thinking/tpm.htm)

1. Availability or uptime (downtime: planned and unplanned, tool change, tool service, job change etc.)
2. Performance efficiency (actual vs. design capacity)
3. Rate of quality output (Defects and rework)

OEE = A x PE x Q

A - Availability of the machine. Availability is proportion of time machine is actually available out of time it should be available.

Availability = (Planned production time – unscheduled downtime) Planned production time

Production time = Planned production time – Downtime

Gross available hours for production include 365 days per year, 24 hours per day, 7 days per week. However this is an ideal condition. Planned downtime includes vacation, holidays, and not enough loads. Availability losses include equipment failures and changeovers indicating situations when the line is not running although it is expected to run.

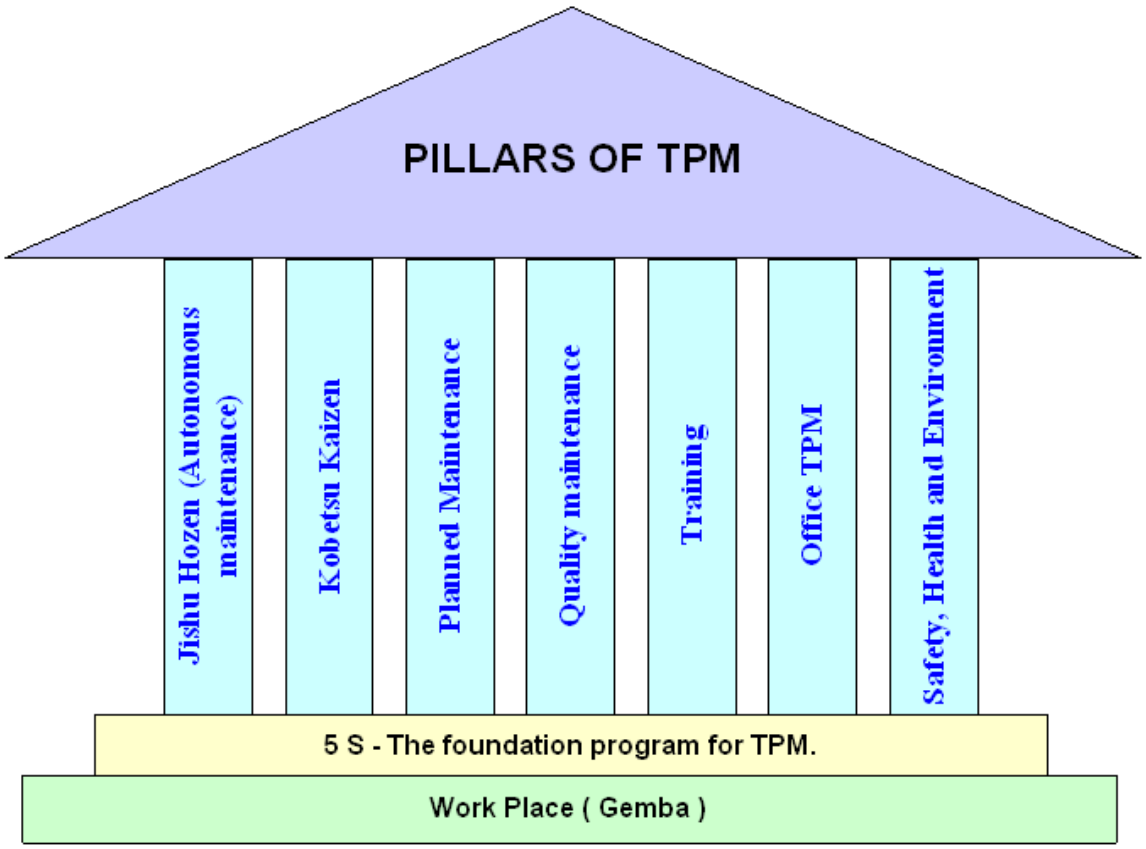
PE - Performance Efficiency. The second category of OEE is performance. The formula can be expressed in this way:

Performance (Speed) = (Cycle time x Number of products processed) Production time

Net production time is the time during which the products are actually produced. Speed losses, small stops, idling, and empty positions in the line indicate that the line is running, but it is not providing the quantity it should.

Q - Refers to quality rate. Which is percentage of good parts out of total produced. Sometimes called "yield". Quality losses refer to the situation when the line is producing, but there are quality losses due to in-progress production and warm up rejects. We can express a formula for quality like this:

Quality (Yield) = (Number of products processed – Number of products rejected)/ (Number of products processed)



J. Venkatesh

Steps of Implementation of TPM

Step 0 – Initial preparation

- prepare a Cleaning & Lubrication map
- Arrange Red & White Tags
- History of Failures
- Training on 7 steps of Jishu Hozen
- Gantry Chart
- Training on 7 types of abnormalities

Step 1 – Initial cleaning

Make the list of

- Hard to clean,
- hard to lubricate,
- hard to tighten,
- hard to inspect,
- hard to adjust
- Record cleaning time
- Carry out audit on 1st step
- Meeting after the daily activities
- Refer to the old history records

Step 2 – Measures against sources

- Countermeasures against sources of contamination
- Make approach easy for CLRI
- Make easy to do CLRI
- Shorten cleaning , lubricating time
- Adopt concepts of localized guards
- Ranking the priority places for daily cleaning

Step 3 – formulation of cleanup and lubrication standards

- Standards for cleaning, lubricating and tightening
- Standards are made by operators themselves with guidance by pm
- Standards are made by using 5w 1h
- Standards should be easily understood by every one
- Introduce extensive visual controls

Benefits of TPM

The main benefits of TPM are as follows:

- Increased productivity and OEE (Overall Equipment Efficiency).
- Rectify customer complaints.
- Reduce the manufacturing cost by up to a great extent.
- Satisfy the customer's needs by almost 100 % (Delivering the right quantity at the right time, in the required quality).
- Reduce accidents.
- Follow pollution control measures.
- Higher confidence level among the employees.
- Keep the work place clean, neat and attractive.
- Favorable change in the attitude of the operators.
- Achieve goals by working as team.
- Horizontal deployment of a new concept in all areas of the organization.
- Share knowledge and experience.
- The workers get a feeling of owning the machine.

Conclusion:

Today, with competition in industry at an all time high, TPM may be the only thing that stands between success and total failure for some companies. It has been proven to be a program that works. It can be adapted to work not only in industrial plants, but also in construction, building maintenance, transportation, and in a variety of other situations. Employees must be educated and convinced that TPM is not just another "*Program of the month*" and that management is totally committed to the program and the extended time frame necessary for full implementation. If everyone involved in a TPM program does his or her part, an unusually high rate of return compared to resources invested may be expected. TPM is capable of bringing a machine back to original condition and even better. The cost of postponing a decision of implementing TPM, that have to make sooner or later, can be excessive. It is convincing that the losses for each day of delay are out of imagination.

Apparently, successful TPM implementation can achieve better and lasting result as compared to other isolated program because there is an ultimate change in people (knowledge, skills, and behavior) during the progress.

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