International Journal of Business Quantitative Economics and Applied Management Research

ISSN: 2349-5677
Volume 2, Issue 8, January 2016

ANALYSIS OF OEE FOR TPM IMPLEMENTATION: CASE STUDY

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ABSTRACT

The primary goal of TPM (Total Productive Maintenance) programme is to change the culture of the company's maintenance policy by involvement of all employees toward the maintenance system of the company. Prior to implementation it is very necessary to check the present status of the company. With the help of OEE the present status is being checked. It aims to reduce unplanned stoppage, breakdown the accidents and losses obstructing equipment effectiveness. In most of Indian textile industries; maintenance is considered as evil activity. Prior to induce the TPM in the industry a review is being done by researcher and real time Overall equipment effectiveness is measured and shown to management of companies. The value of OEE is small and hence management is being suggested to implement TPM for the overall improvement in the company.

Key words: TPM, OEE, Utilization, Availability, Quality

1. INTRODUCTION

New approaches in modern service and manufacturing industries have been accepted around, developed and implemented so as to survive in the dynamic and fierce competitive system that are becoming ever more complex. The need for driving down costs, integrating every activities and available resources of a company, empowering the employee to make decision, eliminating waste generated by failure across the value adding process, shortening of production lead time and delivery of quality assured services and products have been given due attention [1]. As they are the necessity to secure a sound future within an ever changing market and to be open to all market and technology driven opportunities. To meet these needs, one of the new techniques in maintenance area that is developed in Japan to support TQC and JIT is Total Productive Maintenance [2]. Even though, many management personnel consider maintenance as expense

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Volume 2, Issue 8, January 2016

and evil activity, presently, there is a gradual shift in thinking as companies began to identify the role of maintenance and it is also well accepted that maintenance is one of the main potential area to use as a competitive advantage. Currently, the concept of TPM in Indian Manufacturing Industries is the critical missing concepts in successfully achieving not only world class equipment performance, but also it is a powerful new means in improving overall company performance [3].

2. AN INTRODUCTION TO TPM

Maintenance is a profession devoted to keep the factory running in the best possible shape, making equipment reliable, productive, and secure to operate. The maintenance function has historically been thought of as a necessary cost of doing business. However, new technologies and innovative practices have positioned the maintenance function to be an integral part of the overall profitability of many businesses. Modern maintenance techniques and practical approaches have the potential for significantly increasing competitive advantages in the global market. Just as the finely meshed gears of machinery must work together for the machine to perform its function, Production, Safety, Design Engineering, other team members, and Maintenance must work together to achieve true excellence.

The challenge for today's maintenance managers and reliability professionals, and all those involved in the maintenance profession, is to capture these opportunities. This requires establishing standards for maintenance and reliability practices, creating an appropriate information system to collect facts and build enthusiasm, and initiating enabling action plans. The responsibility of keeping our equipment and facility in optimal working conditions is not that of a small group of Engineers and Technicians, but every individual in the whole organization.

We all benefit of this optimal condition and therefore we all should be empowered to learn and intervene more in the vital process of preservation. TPM is exactly the discipline that will allow for us to achieve such optimal level of success [4].

2.1 GOALS OF TOTAL PRODUCTIVE MAINTENANCE

The goal of TPM focuses on improving corporate culture through improvement of human resources and plant equipment. The Japan Institutes of Plant Maintenance (JIPM) has put forward the five goals of TPM which are the minimum requirements for the TPM development [5].

1. Improving equipment effectiveness.
2. Improving maintenance efficiency and effectiveness.

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ISSN: 2349-5677
Volume 2, Issue 8, January 2016

3. Early equipment management and maintenance prevention.
4. Training to improve the skills of all people involved.
5. Involving operators in routine maintenance.

2.2 IMPROVING EQUIPMENT EFFECTIVENESS

Equipment effectiveness is a measure of the value added to production through equipment. This goal is to increase equipment effectiveness so each piece of equipment can be operated to its full potential and maintained at that level. Nakajima describes in his book that TPM maximizes equipment effectiveness though two types of activity to insure that the equipment performs to design specifications which is the true focus of TPM [6].

1. *Quantitative*: increasing the equipment's total availability & improving its productivity within a given period of operating time.
2. *Qualitative*: reducing the number of defective products, stabilizing & improving quality.

Although the equipment must operate at its design speed, produce at the design rate, and produce a quality product at these speeds and rates, there are factors which might obscure efficient utilization of the equipment. Examining, identifying and eliminating all losses which obscure the efficiency of the equipment will increase the efficiency of the equipment. The concept of zero breakdowns and zero defects are inevitable to maximize equipment effectiveness. These equipment losses include: equipment downtime loss, performance loss, and defect loss [7, 8].

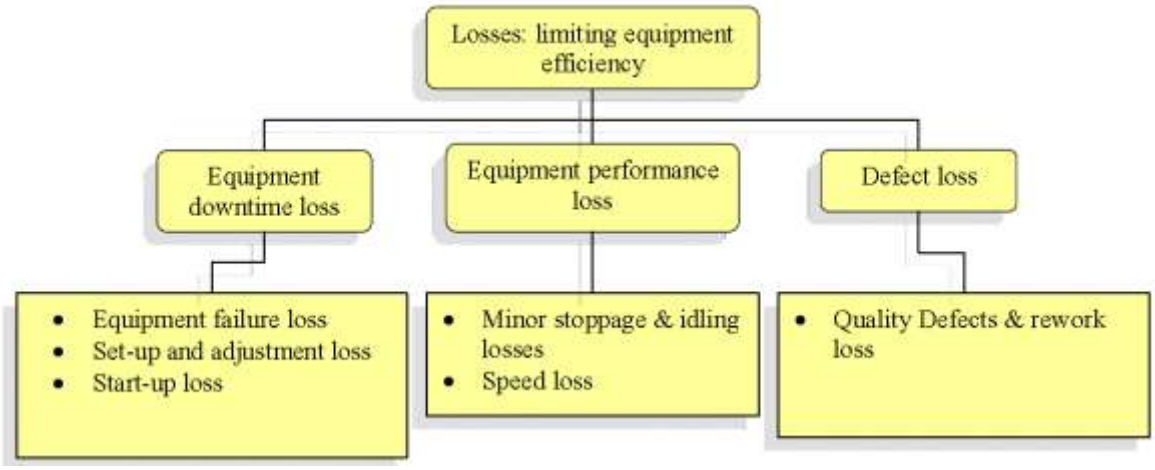

Figure: 2.1. *Major losses limiting equipment efficiency*

Various equipment losses can be quantitatively calculated through measuring equipment effectiveness that ties the '6 major losses' to three measurable:

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What is Overall Equipment Efficiency (OEE)?

OEE is a tool that combines multiple manufacturing issues and data points to provide information about the process. It is an all inclusive benchmarking tool that serves to gauge the various subcomponents of the manufacturing process (i.e., availability, performance and quality)—and used to measure actual improvements on 5S, Lean Manufacturing, TPM, Kaizen and Six Sigma. When using OEE with these management systems the benefits become tangible and noteworthy [6].

1. Defect loss
    a. Quality Defects & rework loss
    b. Equipment failure loss
    c. Setup and adjustment loss
    d. Startup loss
    e. Minor stoppage & idling losses
    f. Speed loss
2. Losses: limiting equipment efficiency
3. Equipment downtime loss
4. Equipment performance loss

After all factors are taken into account, the OEE result is converted (transmuted) in percentage. The results (in %), therefore, can be regarded as a preview of the existing production efficiency of a particular line, cell or machine.

As we all know, manufactured goods are a result of a complex production process—and without the proper measuring tools and formula, expect your business to run blindly even in the light of day. Having the right metrics, OEE provides you a window to analyze out of the ordinary issues and gives you an established framework for improving the whole manufacturing process.

There are dozens of formulas, systems and metrics being used to improve the whole manufacturing process, but only OEE correctly reduces complex production problems into simple, easy to follow steps in handling data and information. The OEE tool helps to methodically improve the process using basic measurements. The good thing about using OEE is that this particular measuring tool cannot be manipulated. OEE is a very simple metric that immediately indicates the current status of a manufacturing process. Somehow it also becomes a multifaceted tool allowing you to understand the effect of the various issues in the manufacturing process and how they affect the entire process. The biggest advantage of OEE is that it allows companies to have separate business functions by applying/using a single, easy to understand formula [5].

OEE is by far the most effective benchmarking tool in making sound management decisions.

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Useful Formulas:
OEE = Actual output / Theoretical maximum output
OEE = Availability Ratio x Performance Ratio x Quality Ratio
• **Availability Ratio** — the share of the actual production time and the planned production time. All planned stops and breakdowns will reduce the availability ratio, including setup times, preventive maintenance, breakdowns and lack of operators. The only time that you may choose to deduct from the availability ratio is lack of orders.
• **Performance Ratio** — Loss of production due to under utilization of the machinery. In other words, losses are incurred when the equipment is not run with full speed. Short, unregistered, stops may affect the performance ratio as well.
• **Quality Ratio** — the amount of the production that has to be discharged or scrapped. It is a significant performance indicator in TPM which enables one to know how much the equipment is utilized to the fullest. A high level of equipment effectiveness can be achieved only when all three rates are high.

3. OBJECTIVES

Based on observed problems in the industry, the study focuses on dealing with the way that the selected Textile industry enables to improve the existing maintenance system of the company to have better capacity utilization and to enhance the effectiveness of its equipments.

4. RESEARCH METHODOLOGY

The focus of study is to utilize the OEE to evaluate the performance of company. For the calculation of OEE the relevant data is being collected and the formulae derived in the previous section are used to analysis purpose. The collected data mainly aims at assessing the existing maintenance system and the future business plan of the industry. Besides, the data is synthesized with literature for investigating the potential area of improvement. Data analysis in the research has been conducted using appropriate tools in order to identify core problems in the specified company. Finally, Total Productive Maintenance system is developed along with its implementation and master plan for the selected textile industry.

5. BRIEF ABOUT THE COMPANY

The selected textile industry (STI) has understood the finer nuances of technology-led transformation by constantly seeking new technologies and product solutions to cater to the changing needs of customers. The STI is on the cutting edge of technology in Spinning which has propelled the Group to be the largest producer of compact, gassed, mercerized and fibre dyed

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yarns in India. The state-of-the-art manufacturing facilities producing 90 mn meters per annum processed fabric are located in North and Central India, which cater to the highly customized fabric needs of the buyers. An integrated fabric supply chain extending from raw materials to yarns and from weaving to processing provides the winning edge to the customers. Yarn is the largest strategic business unit of the STI with 8, 00,000 spindles and 65 MT per day yarn and fiber dying capacity.

6. CALCULATING OVERALL EQUIPMENT EFFECTIVENESS

Some of the data pertinent to the above loss are difficult to obtain, since the company doesn't apply the overall equipment efficiency concepts in evaluating the performance of the machines at the individual level. It has been attempted to gather some relevant data to estimate the OEE of the typical machinery.

Availability

The availability is the ratio of time needed for operating the equipment to the time actually consumed for operation and it is expressed as:

$$Availability = \frac{Actual\ Run\ Time}{Scheduled\ Run\ Time}$$

$$Availability = \frac{Scheduled\ Running\ Time - Unplanned\ stoppages}{Scheduled\ Running\ Time} \quad ---(1)$$

From the observations and few recorded data to calculate the availability of the machine, the researcher has treated the weaving machines as a whole as one machine and considered the available machines in that departments. Therefore accordingly the available machines on the days are collected and recorded in the following table.

Unplanned stoppage means the period during which the line is stopped due to equipment failure, setup, adjustment, and change over and so forth. To find the availability of the machines, equipment failure loss of ten days is collected and shown in table: 1.

Table: 1. *Sample data of weaving machines available in the department*

S. No.	Total No. of Weaving Machine	No. of Machine in operation per day	Planned Production in (minutes)	Maximum Production	Availability in %
1	15	6	1515	575	40

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ISSN: 2349-5677

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2	15	6	1515	575	40
3	15	7	1515	530	46
4	15	7	1515	554	49
5	15	6	1515	607	40
6	15	6	1515	418	40
7	15	6	1515	648	40
8	15	6	1515	637	40
9	15	6	1515	482	40
10	15	6	1515	275	40

PERFORMANCE RATE

The performance rate is the product of the speed operating rate and the net operating rate. This factor indicates the ratio of the actual output and the targeted output. Actual output is the actual performance of the operation and is less than the targeted output due to rough running of the equipment, jams and equipment wear. Hence, it is expressed as:

$$Performance\ Rate = Speed\ operating\ rate - Net\ operating\ rate \text{ ----------}2$$

To find the Performance Rate for the machines, the collected data indicates that the scheduled speed of the machineries is 280RPM. The quality section performed calculations to find the performance of the machines. The following table shows the performance of weaving machine.

Table 2 Shows the performance of the weaving machine

S.No.	Average RPM	Average Picks/cm	Average Time	Average Weft breakage	Average warp breakage	Calculate production in meter	Average actual production	Average actual effect in %
1	280	8.1	30 min	4.4	2	10.37	8.2	76.8
2	280	8.1	30 min	4.8	2.2	10.37	8.2	73.6
3	280	8.1	30 min	4.5	2	11.75	8.3	91.07

From the observations, interview and available data for the calculation of OEE; The researcher calculated the performance of the machines. According to the records the average performance rate of the pantor loom (weaving machine) is 80%.

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Quality is fitness to use or exceeding customer satisfaction and so on. In the case of selected textile industry the quality parameters are defined in two factories that is Blanket and Acrylic yarn factory.

The quality problems in the blanket factories arise from different reasons. But recorded data shows that the main reason for poor quality product is negligence of operators.

$$Quality\ rate = \frac{Output}{Input}$$

From the table above the quality rate of the machine is 85%. Therefore, the Overall Equipment Efficiency of the weaving machine is obtained by multiplying the above three factors and the result is

0.85*0.8 *0.4=0.272

The calculated Overall Equipment Efficiency of the machines shows that the poor OEE attributes to poor availability of the machines. The company can easily identify the causes of the loss which inhibit the overall equipment efficiency using this method.

7. OVERALL TPM DEVELOPMENT PROGRAM FOR THE INDUSTRY

Implementation of TPM is required for the industry to avoid essentially unplanned downtime in the course of linking the operators in daily inspection and routine maintenance. By implementing TPM, the maintenance personnel can begin to make use of the skills of the operators to perform the expected maintenance activities which allows the maintenance personnel to ponder and expand more on proactive maintenance and elimination of recurrence failure. Since TPM has a companywide concept, the implementation is also required to integrate every activities of the industry toward providing better service through enhancing the equipment efficiency.

8. CONCLUSION

The selected company's maintenance activities are studied and yarn sections has been identified for the study purpose. All the three factors of OEE is described in detail and relevant data is collected. The factors of OEE calculated separately and indicates that the values very lesser than the standard value. The successful company measures 95% availability, 90% performance rate and more than 99% quality rate. The overall values of OEE are expected to have more than 80% [9]. In the present research it is only 27% and this indicates that the company has no any strategies that have the very much resource utilization. The overall analysis suggests the TPM implementation for the overall result utilization of the company. Further the research can be extended to other sectors.

ISSN: 2349-5677
Volume 2, Issue 8, January 2016

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