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## Implementation of TPM for Reducing Losses and Increasing Overall Equipment Effectiveness

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**ABSTRACT** Overall equipment effectiveness is the most common methods and popular in the industries. Implementation of total productive maintenance is common plan is used. In this work we are going to calculate the OEE by implementation of TPM and solving the problems for selected industry. We collect data of machine shop from the industries and then calculate maximum OEE. It should be approximately 95% for maximum OEE.

**KEYWORDS:** Total productive maintenance, Implementation, OEE

### I. INTRODUCTION

The implementation of total productive maintenance to enhance OEE. For this purpose a medium scale industry in Shivane, Pune is selected known as REL-METH Pvt Ltd. It is leading manufacturer of pin, roller and pulley components used in packaging machines. Management should take all correct data for immediate action on response for supervisors concerning problem such as lack of maintenance of machines, poor machines tools and inherit defects. Management plays an important role in training and education for all the workers which are not trained. So, they provide training programs for unskilled workers and then appoint in desired position. Statistically methods must be used to discover when training is complete. Some important points explained below:

- i. **EFFICIENCY:** It is the actual input over the reference input.
- ii. **EFFECTIVENESS:** It is the actual output over the reference output.
- iii. **PRODUCTIVITY:** It is the actual output over the actual input. (Number of final product per employee)
- iv. **TOTAL QUALITY MANAGEMENT:** In manufacturing industry five principle is basically used:

- Produce quality work
- Concentrate on customer
- Improvement by strategic approach.
- Improving continuously
- Encourage mutual respect
- Team work

### II. PROPOSED METHODOLOGY

Measurements data is collected according to shown below points:

1. Number of item
2. Defective item
3. Planned production time
4. Unscheduled downtime

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5. Planned downtime
6. Ideal cycle time
7. Available time

## EXPRESSIONS USED TO CALCULATE OEE:

Overall equipment effectiveness is an important method used in industries. It is a product of availability, performance rate and quality rate. It is expressed as

$$OEE = A \times PR \times QR$$

Where,

A= Availability

PR= Performance rate

QR= Quality rate

Procedure to calculate the Overall Equipment Effectiveness:

- i. Track OEE (including Availability, Performance, and Quality) for the target equipment for one month. Make sure to compile the results by shift.
- ii. Review every shift result, keeping track of the best individual result for Availability, Performance, and Quality across all shifts (i.e. the highest Availability score across all shifts, the highest Performance score across all shifts, etc.).
- iii. Multiply the best individual results together to calculate a “Best of the Best” OEE score.

“Best of the Best” OEE score represents the stretch goal derived from the best results actually achieved across the month for Availability, Performance, and Quality.

Expression used for calculation:

- $Availability = \frac{Planned\ production\ time - Unscheduled\ downtime}{Planned\ downtime}$
- $Performance = \frac{Ideal\ cycle\ time \times parts\ produced}{Available\ time}$
- $Quality = \frac{Total\ units\ started - Defective\ units}{Total\ units\ started}$
- **OEE = Availability x Performance x Quality**

Where, OEE= Overall Equipment Effectiveness (in %)

OEE is a measure of machine capability it is used where increase of effectiveness needed in an industry. Implementation of TQM tools are used in finding the maximum OEE. The collection of data is important for the manufacturing process result into useful information for productivity improvement. When higher productivity is expected machine tool which are converted into a finished product with the help of raw material to increase the OEE. The reliability includes availability of machines with least down time which requires failure data analysis and root cause analysis. A TQM tool is a method which is used to measure quality along with price rate improvement of quality product in automatically into productivity.

## III. CALCULATION

Roller In A Machine Overall Equipment Effectiveness Calculation Of Pin In A Machine

$$Availability\ of\ Roller = \frac{43200 - 3600}{43200} \times 100 = 91.67\%$$

Where,

Planned production time= shift Length- Breaks= 43200-3600= 39600 min

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$$\text{Performance of Roller} = \frac{7.2 \times 90}{720} \times 100 = 90\%$$

Where,

$$\text{Ideal cycle time} = (6 \times 60 \times 12) \text{ min} / (600) \text{ piece} = 4320 \text{ min} / 600 \text{ piece} = 7.2 \text{ min/piece}$$

$$\text{Parts produced} = 90 \text{ piece}$$

$$\text{Available time} = 12 \times 60 = 720 \text{ min}$$

$$\text{Quality of Roller} = \frac{540}{600} \times 100 = 90\%$$

Where,

$$\text{Total number of pieces} = 600$$

$$\text{Non defective Pieces} = \text{Total units started} - \text{Defective units} = 600 - 60 = 540 \text{ pieces}$$

$$\text{OEE} = 0.9167 \times 0.90 \times 0.90$$

$$\text{OEE} = 74.25\%$$

### OEE AFTER TPM IMPLEMENTATION CALCULATION OF ROLLER IN A MACHINE:

$$\text{Availability of Roller} = \frac{43200 - 3600}{43200} \times 100 = 91.67\%$$

Where,

$$\text{Planned production time} = \text{shift Length} - \text{Breaks} = 43200 - 3600 = 39600 \text{ min}$$

$$\text{Performance of Roller} = \frac{6.8 \times 100}{720} \times 100 = 95.23\%$$

Where,

$$\text{Ideal cycle time} = (6 \times 60 \times 12) \text{ min} / (630) \text{ piece} = 4320 \text{ min} / 630 \text{ piece} = 6.8 \text{ min/piece}$$

$$\text{Parts produced} = 100 \text{ piece}$$

$$\text{Available time} = 12 \times 60 = 720 \text{ min}$$

$$\text{Quality of Roller} = \frac{600}{630} \times 100 = 95.23\%$$

Where,

$$\text{Total number of pieces} = 630$$

$$\text{Non defective Pieces} = \text{Total units started} - \text{Defective units} = 630 - 30 = 600 \text{ pieces}$$

$$\text{OEE} = 0.9167 \times 0.9523 \times 0.9523$$

$$\text{OEE} = 83.13\%$$

After analyzing the calculation it is clear that machine is CNC and product is roller whose OEE is least i.e. 74.25%. This machine is named as TPM model machine whose OEE is to be improved by implementation of TPM. At the end OEE is recalculated for the Model machine after TPM implementation which shows increase in OEE from 74.25 % to 83.13 %.

### IV. RESULTS AND DISCUSSION

Based on the methodology implemented in the previous chapter the results obtained by implementation of TPM model machine. Also, OEE for the model machine is recalculated after implementation of TPM. The OEE of roller is obtained before and after TPM implementation is now compared with the one before and after implementation and graphical results are plotted

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Table1. Comparison of OEE before and after TPM implementation

S.no.	OEE Factor	Before TPM	After TPM
1	Availability	91.67	91.67
2	Performance	90.00	95.23
3	Quality	90.00	95.23
4	Overall OEE	74.25	83.13

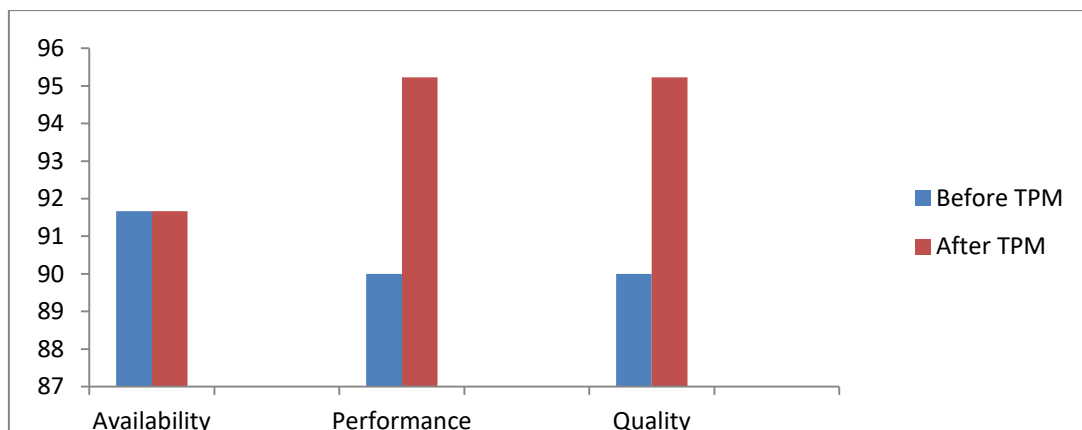


Figure .1. Comparisons of Availability, Performance and Quality

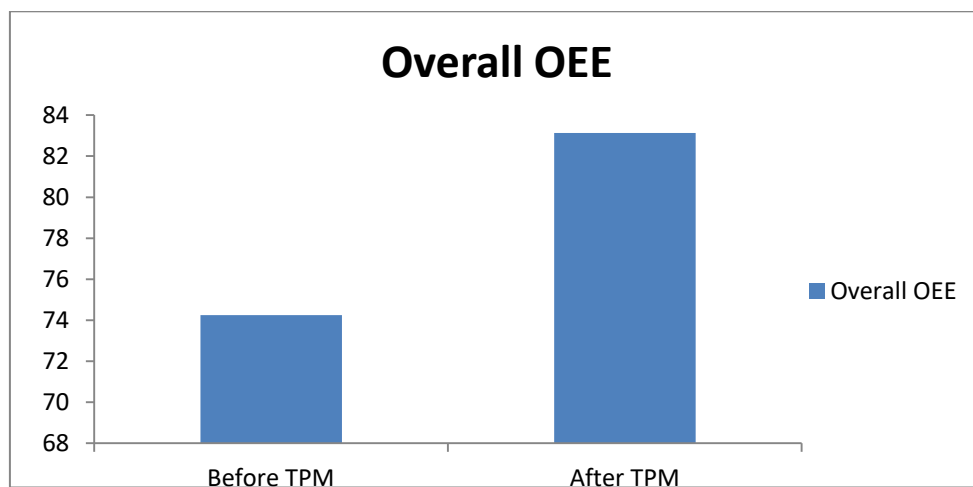


Figure 2. Comparison of overall OEE

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From the above result it is clear that OEE is recalculated. The model machine after TPM implementation which shows increases in OEE of Roller product decreasing rejected pieces and increases manufactured product quantities at same planned production time.

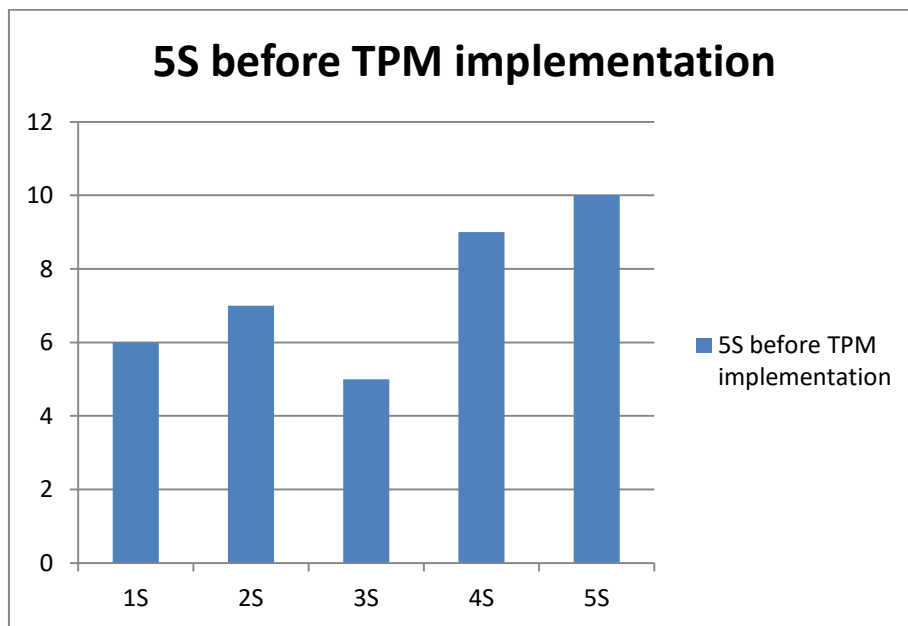


Figure 4 5S audit after TPM implementation

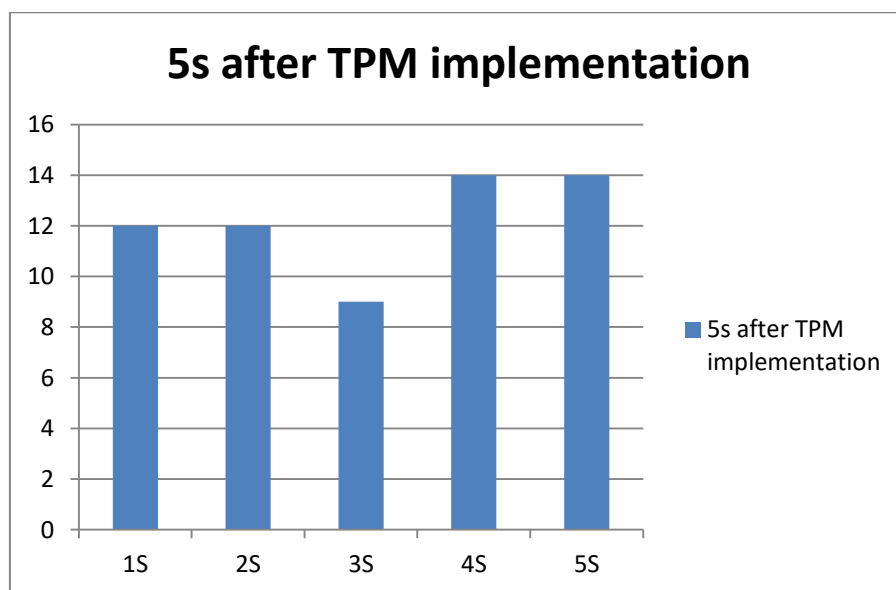


Figure 5. 5S audit after TPM implementation

From the above results it clearly indicated 5S audit sheet and graphical representation of scores reduces losses and increases OEE before and after TPM implementation.

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## V. CONCLUSION

It is concluded that implementation of TPM and reduces losses increases the OEE. In the industry OEE plays important role of increasing productivity. In the industry OEE plays important role of increasing productivity. Through this research work a medium scale manufacturing industry is studied and analyzed to assess maintenance and overall equipment effectiveness of machines. The various problems like production delay, setup loss, machine loss, machine idleness, machine breakdowns, performance losses associated with these machines are analyzed and stepwise implementation of TPM is carried out to bring in improvements in the critical machine.

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