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IMPLEMENTATION OF TOTAL PRODUCTIVE MAINTENANCE FOR CAPACITY ENHANCEMENT BY IMPROVING OVERALL EQUIPMENT EFFECTIVENESS OF SLOTTING AND HONING MACHINE

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ABSTRACT:
Productivity is a measure of the rate at which outputs of goods and services are produced per unit of input (labour, capital, raw materials, etc.). It is calculated as the ratio of the amount of outputs produced to some measure of the amount of inputs used. Productivity measures are used at the level of firms, industries and entire economies. The goal of the any TPM program is to improve productivity and quality along with increased employee morale and job satisfaction. It is essential requirement for longer life cycle of machines in an industry. In this paper experience of implementing Total Productive Maintenance is shared and investigated for a company manufacturing compressors. Concept is implemented in the machine shop having CNC machines, honing machines of different capacity. Overall Equipment Effectiveness is used as the measure of success of TPM implementation. The losses associated with equipment effectiveness are identified. All the pillars of TPM are implemented in a phased manner eliminating the losses and thus improving the utilization of machines. Finally we got there is much improvement in OEE, reduction in losses of machine.

KEYWORDS: TPM, OEE, Quality, Availability, Performance.

INTRODUCTION:

The changes in the economic, political and technological landscape during the last thirty years, have drastically affected manufacturing. The traditional localized and centralized manufacturing transformed into a globalized and decentralized paradigm. Stable markets, at the same time, become highly volatile and unpredictable. The role of customer changed from that of a product buyer to an integrated entity in the product design and development. Currently, manufacturers and service providers are presented with challenges such as reduced product life cycles, increased product, service and system complexity, and immense pressure from global competition. These challenges are partly generated by the highly volatile demand and exploding product variety introduced by the mass customization and product personalization paradigms. Their impact on the design and operation of modern globalized.

ABOUT COMPANY AND PROBLEM DEFINITION:

Emerson was founded in 1880 by John Emerson in St. Louis, Missouri, USA as the manufacturing of electric motors and fans. Over the past hundred plus years, Emerson has grown from regional manufacturer into a global technology solution power house. Due to increased demand of the model named "CR compressors" series, Emerson has planned to increase the production capacity. The current production rate of this compressor model is 2900 units per day. And due to increased demand they are planning to increase it up to 3600 units per day. There are many stages of manufacturing of compressor In this I have selected machining area. Machining is done on body as well as on crank shafts. But I have selected machining of CR compressor body. Various machining processes done on the body at Emerson are:-

- Fine boring and Face milling on SPM.
- Slotting on milling machine.
- Pin hole on milling machine. (Slotting and pin hole is also done on same machine named Mazak CNC machine.)
- Deburring
- Honing on honing machine.

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Among these processes there were bottlenecks at Mazak CNC machine and honing machine. Thus I have selected these two machines for

CASE STUDY:

ABNORMALITIES IDENTIFIED:

Sr. No.	Description of Abnormalities found on Slotting Machine
1	Accumulations of chips of machining
2	Loose control cables
3	Low production capacity
4	Oil leaking
5	Too many hand gloves found on machine

Sr. No.	Description of Abnormalities found on Honing Machine
1	Insufficient supply of Honing oil
2	Variations in stroke length of honing spindle
3	Variations in spindle speed
4	Variations in cycle time
5	Erretic linear speed of honing spindle
6	No safety guard available
7	Too many hand gloves found on machine
8	Jamming of drain pipe due to accumulation of machining burr.

STRATIFICATION OF LOSSES:

Stratification of all losses is done foe getting the clear idea of contribution of each type of losses for equipment abnormal performance. Fig. shows the stratification of all the losses. Out of all these losses the failure loss is main loss. It comprises 36% of total loss, change over loss is 21%, Set up loss is 15%, reduced speed loss is 10%, minor stoppage loss is 10%, shut down loss is 5%, rework loss is 3%, scrap loss is 2%,

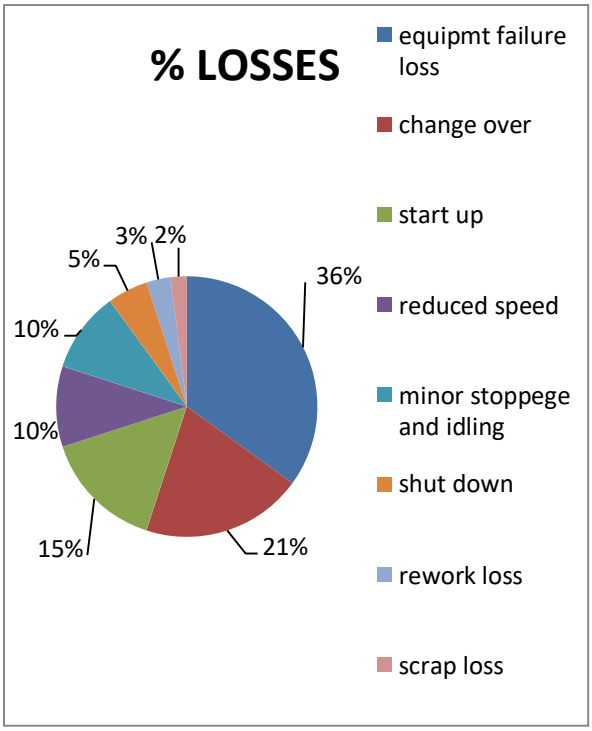

Fig. 1 Stratification of losses

PILLAR WISE CLASSIFICATION OF LOSSES:

The various pillars of TPM are

1. Focused Improvement /Kobestu Kaizen.
2. Autonomous Maintenance / Jishu Hozen.
3. Planned Maintenance.
4. Quality Maintenance.
5. Education and Training.
6. Development management
7. Office TPM.
8. Safety, Health and Environment.

Out of these eight pillars we will cover first three pillars for dissertation work. These three pillars are Focused Improvement /Kobestu Kaizen, Autonomous Maintenance / Jishu Hozen, planned maintenance, quality maintenance. These pillars are selected because they are more useful in eliminating various abnormalities that causes losses. These losses are responsible for low performance of equipment effectiveness. Table shows the classification of all losses, which are contributing in the less availability, performance efficiency and rate of quality products are as follows:

factors	losses	pillars
Rate of availability	Equipment failure	Planned maintenance
	Change and set up	Jishu hozen
	Tool change	Kobetsu kaizen
	Start up loss	Kobetsu kaizen
	Unavailability of man	Education and training
Rate performance efficiency	Minor stoppage	Kobetsu kaizen
	Reduced speed	Kobetsu kaizen/ Planned maintenance
Rate of quality products	Scrap	Quality maintenance
	rework	Quality maintenance

RESULT AND DISCUSSION:

IMPACT OF TPM ON VARIOUS LOSSES:

Figure shows the reduction in equipment failure loss. before implementation i.e. in the last priod equipment failure loss was 4750 minutes. This is reduced to 500 minutes per month at the end of last period of 2016 (after implementation).

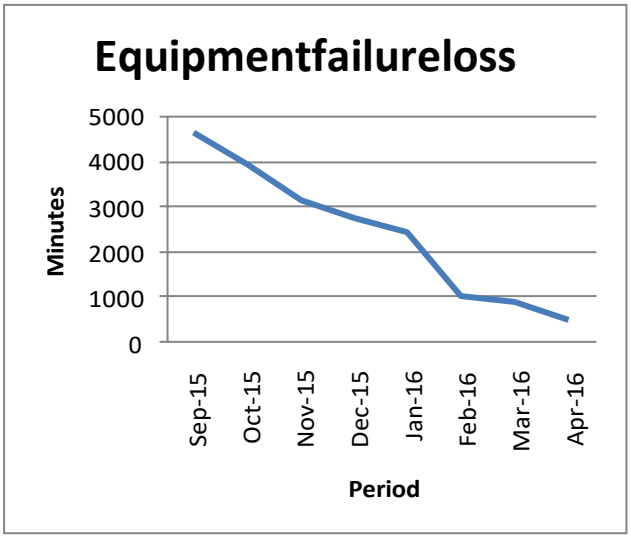

Fig.2 Reduction in Equipment failure losses

Figure shows the reduction in the changes and set up loss. before implementation i.e. in the first period change and set up loss was 1145 minutes per month. This is reduced 500 Minutes per month at the end of period of 2016 (after implementation).

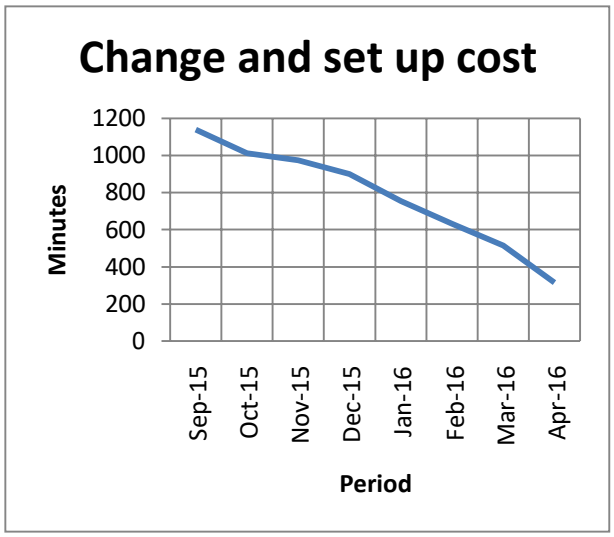

Fig.3 Reduction in change and set up cost

Figure shows the reduction in minor stoppage loss. before implementation implementation i.e. in the first period change and set up loss was 500 minutes. This is reduced to 50 Minutes at the end of period of 2016 (after implementation). Refer appendix.

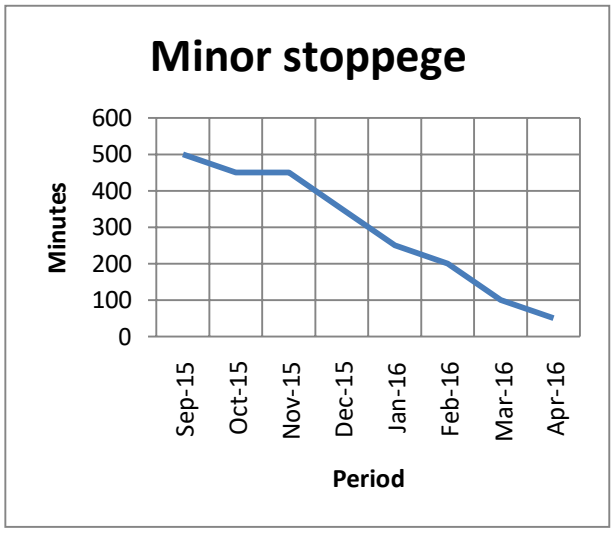

Fig.4 Reduction in minor stoppege

Figure shows the reduction scrap/waste loss. before implementation implementation i.e. in the first period change and set up loss was 180 bodies. This is reduced to 20 bodies at the end of period of 2016 (after implementation).

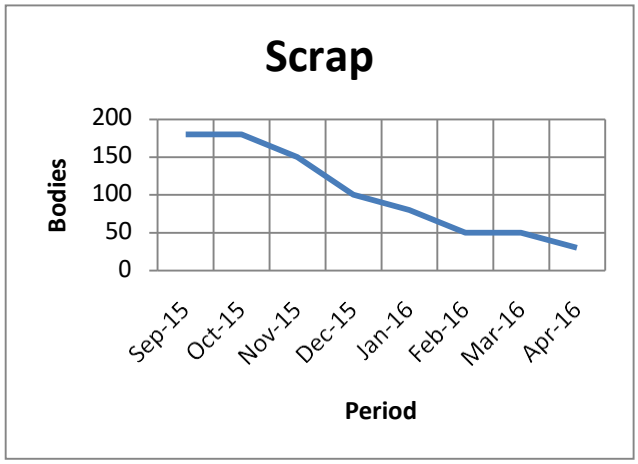

Fig.5 Reduction in scrap

EFFECT OF TPM ON MANUFACTURING PERFORMANCE:

Figure shows the improvement in the productivity in each period. Before implementation total output of honing was 400. It is increased to 450, 500, 550, in next periods. Productivity is improved to 650 at the end of period of April 2016 (after implementation). Refer appendix.

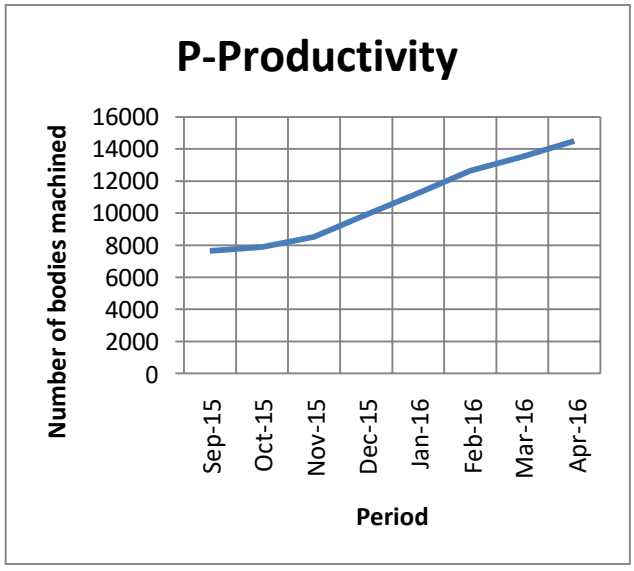

Fig.6 Improvement in productivity

Figure shows the reduction rework loss. Before implementation implementation rework loss was 745 bodies. This is reduced to 31 bodies at the end of period of April 2016 (after implementation).

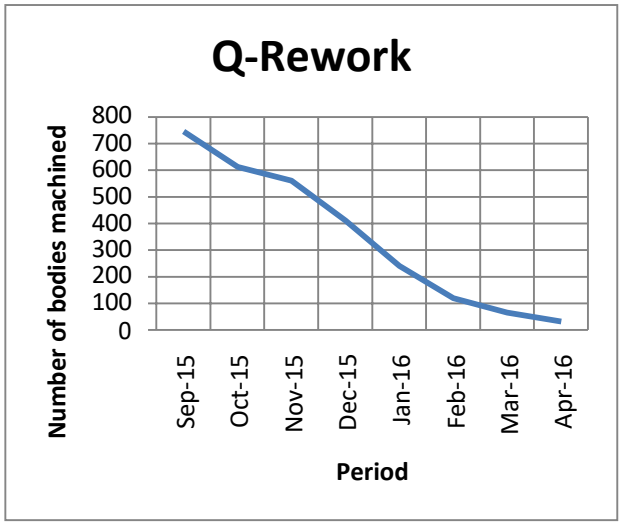

Fig.7 Reduction in rework

Figure shows the reduction maintenance cost. Before implementation implementation maintenance cost was RS 30,000/- bodies. This is reduced to 25000, 21,000. maintenance cost is reduced to 12000 at the end of period of April 2016 (after implementation).

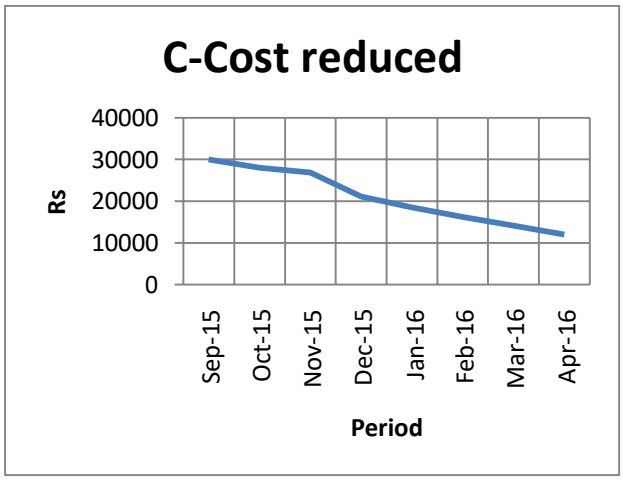

Fig.8 Reduction in cost

EFFECT OF TPM ON OVERALL EQUIPMENT EFFECTIVENESS:

The Availability, Performance and Quality calculations are same as initial OEE calculation

$$\text{Availability} = \frac{\text{Planned Operating time} - \text{Downtime}}{\text{Planned Operating time (Loading Time)}}$$

=(450-30)/450*100

= 93.33 %

$$\text{Performance} = \frac{\text{Production Quantity X Cycle Time}}{\text{Planned Operating time} - \text{Downtime}}$$

= (680 x 0.5)/(450-30) x 100

= 87.54%

$$\text{Quality} = \frac{\text{Total No.of Product} - \text{Total Rejection Quantity}}{\text{Total No.of Products}}$$

=(680-5)660 x 100

= 99 %

OEE = Availability x Performance x Quality

= 93.33 x 81.54 x 99

= 81%

RATE OF AVAILABILITY (ROA):

Figure shows the enhancement of equipment availability. It is observed that about 30% improvement is achieved through TPM. i.e. before implementation it was 60% and after implementation it is increased to 90%. Refer appendix.

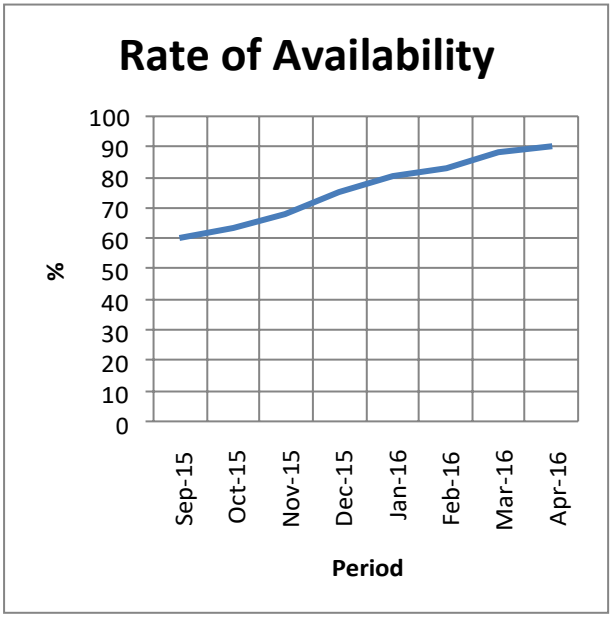

Fig.9 Increase in Rate of availability

RATE OF PERFORMANCE EFFICIENCY (ROP):

Figure shows the enhancement in performance efficiency. It is observed that about 15% improvement is achieved through TPM. i.e. before implementation it was 75% and after implementation it is increased to 90%. Refer appendix.

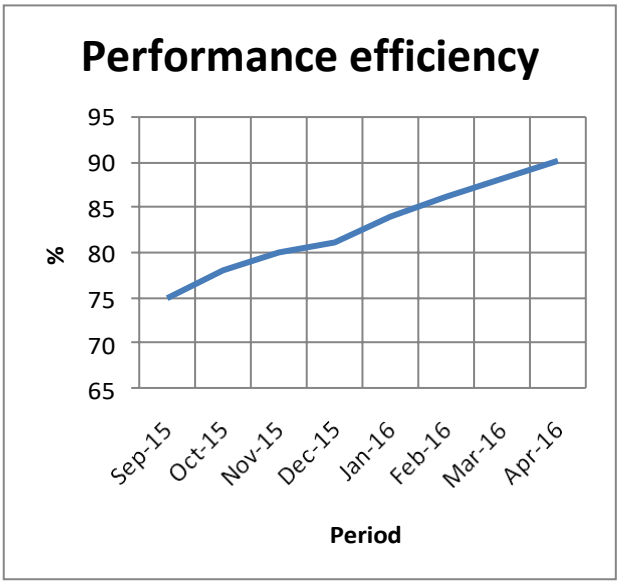

Fig.10 Increase in Performance Efficiency

RATE OF QUALITY PRODUCTS (ROA):

Figure shows the improvement in rate of quality. It is observed that about 3% improvement is achieved through TPM. i.e. before implementation it was 96% and after implementation it is increased to 99%. Refer appendix.

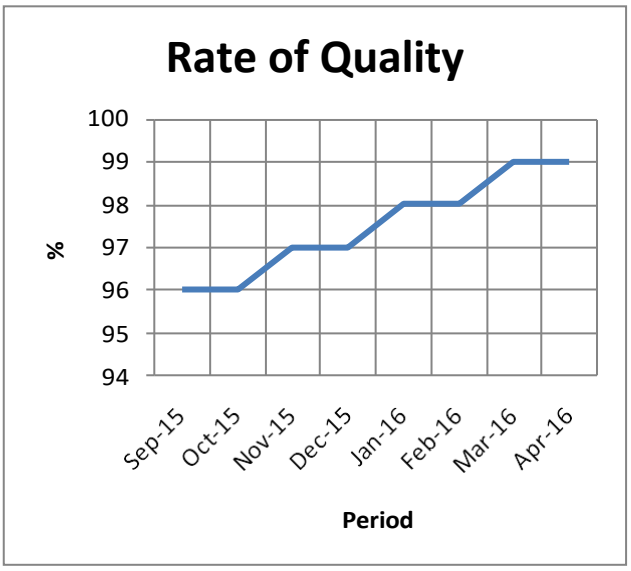

Fig.11 Increase in Rate of Quality

OVERALL EQUIPMENT EFFECTIVENESS:

Figure shows the enhancement in overall equipment effectiveness. It is observed that about 35% improvements achieved through TPM i.e. before it was 55% and after implementation it is 85%. In the between

it was improved to 60%, 65%, 75%, 80%. And in the last period it was 85%. (Refer Appendix)

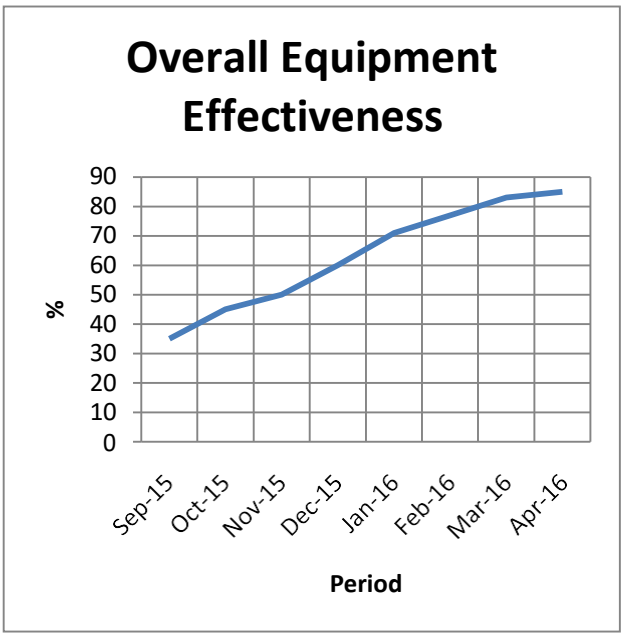

Fig.12 Increase in OEE

CONCLUSION:

Different losses of the OEE can be identified during its effective measurement. The major conclusion is found that OEE has improved by successful implantation of TPM activities. OEE for selected machines/cell is improved by 46% from 39% to 85%. Thus by eliminating the waste. The project gives new benefit to the company that improves the effectiveness of equipment but also reduce the total inventory cost. Calculated other losses of the OEE also gives the company where is the further chance to improvement.

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