Increase in OEE of lathe machine TS 600x- 1500 using TPM: A Review

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***Abstract*:** The manufacturing industry has gone through significant changes in the last decade. Competition has increased dramatically. Total Productive Maintenance (TPM) is a methodology that aims to increase the Overall Equipment and Effectiveness (OEE) of existing equipment. The aim of this paper is to study the effectiveness and implementation of TPM program in a manufacturing organization. Through this study of implementing TPM in manufacturing organization, the increase in efficiency of machines in terms of Overall Equipment Effectiveness (OEE) are discussed. The process of TPM is applied on the lathe machine (TS-670X1500) of the NINAD organization.

Keywords: *OEE, TPM*

INTRODUCTION

TPM focus on improvement in equipment availability, performance and quality with assuring health and safety of employees and protection of environment. TPM helps for eliminating equipment breakdown and improving quality performance of equipment, thus the achievement in TPM strongly supports in attaining the lean concepts which includes the elimination of waiting time, defects in process etc. TPM is a program that addresses equipment maintenance through a comprehensive productive-maintenance delivery system covering the entire life of the equipment and involving all employees from production and maintenance personnel to top management. It is intended to "bring both functions (production and maintenance) together by a combination of good working practices, team working, and continuous improvement.

TPM is characterized by 5 key elements:
1. TPM aims to maximize equipment effectiveness.
2. TPM establishes a thorough system of Preventive Maintenance (PM) for the equipment's entire life span.

3. TPM is cross-functional, implemented by various departments (engineering, operators, maintenance, managers).

4. TPM involves every single employee.
5. TPM is based on the promotion of Preventive Maintenance through the motivation of management and autonomous Small Group Activity (SGA).

II. TPM PILLAR

i. Total effectiveness indicates TPM's pursuit of economic efficiency or profitability which includes productivity, cost, quality, delivery, safety, environment, health and morale.
ii. Total maintenance system includes maintenance prevention and maintainability improvement as well as preventive maintenance.
iii. Total participation of all employees includes autonomous maintenance by operators through small group activities :the small group activities promote planned maintenance through "motivation management".

TPM starts with 5S. It is a systematic process of housekeeping to achieve a serene environment in the work place involving the employees with a commitment to sincerely implement and practice housekeeping. Problems cannot be clearly seen when the work place is unorganized. Cleaning and organizing the workplace helps the team to uncover problems. Making problems visible is the first step of improvement. 5S is a foundation program before the implementation of TPM.

If this 5S is not taken up seriously, then it leads to 5D delays, defects, dissatisfied customers, declining profits, and demoralized employees. This 5S implementation has to be carried out in phased manner. First the current situation of the workplace has to be studied by conducting a 5S audit. This audit uses check sheets to evaluate the current situation. This check sheet consists of various parameters to be rated say on a 5-point basis for each 'S'. The ratings give the current situation. The each of the abovementioned 5S is implemented and audit is conducted at regular intervals to monitor the progress

and evaluate the success of implementation. After the completion of implementation of 5S random audits could be conducted using company check sheets to ensure that it is observed in true spirits by everyone in the work place.

The world class manufacturing concepts are:

- Total quality management (TQM)
- Total productive management (TPM)
- Just in time production (JIT)
- Total employee involvement (TEI)
- Continuous quality improvement (CQI)

LITERATURE SURVEY

Chetan S. Sethia et al. [1] found that success of tpm depends on various pillars such as 5S, KK, PM, QM, Office TPM and safety, Health and with the involvement of each and everyone in the organization by implementing the TPM strategy most of the waste can be eliminated increasing efficiency of the plant.

I.P.S. Ahuja et al. [2] has highlighted the contributions of various TPM implementation initiatives for accruing strategic benefits for meeting the challenges posed by global competition.

Wasim S. hangad et al. [3] experimented TPM for Indian approach, advocating that TPM implementation is not a short-term fix program. It is a continuous journey based on changing the work-area, then the equipment, so as to achieve a clean, neat, safe workplace through a "PULL" as opposed to a "PUSH" culture.

Krimit Solanki et al. [4] has implemented tpm by overcoming problems such as poor safety, poor scheduling and lack of knowledge, increased the efficiency of each machine, thus increasing effectiveness of whole machine shop area.

P.K.Suresh [5] has implemented TPM in a food industry by Plan Do Check Act approach. He also found that employee attitude change or the organizations cultural change is the hurdles in TPM implementation and it can be overcome by involvement of top management.

Abhay Kulkarni et al. [6] has analyzed the link between TPM and employees. He has also analyzed by Studying and investigating how human aspects of TPM helps to develop more sustainable and with less lead time to implementation.

Vinayak Suryawanshi [7] has studied and implemented TPM on the Wire cut CNC machine in manufacturing organization thereby increasing Overall Equipment Effectiveness.

Halim Mad Lazim [8] has found through his study that the cost and quality were improved significantly by reducing and minimizing equipment deterioration and failures, thus improvinf Oee significantly.

Prof Pradeep Kumar [9] has comparatively studied difference between World Class industries where TPM has been implemented and industries which do not follow TPM. He has also identified the various problems leading to decrease in the overall efficiency of the industry and has provided valuable suggestions focusing on the benefits and methodology for implementing TPM in industries.

G Ananth et al. [10] has reviewed the chances for fall or dereliction in micro industries by carrying out SWOT analysis to support, implement as well as explore the possibilities for a fall.

Sarang G. Katkamwar et al. [11] implemented TPM in medium scale cotton spinning industry, and has shown both direct and indirect benefits for the equipment and employees respectively, as improvement in the availability, performance efficiency and the quality rate, and improvement of the overall equipment effectiveness of the equipment.

Suzaituladwini Hashim et al. [12] implicated total productive maintenance and innovation performance in Malaysian automotive industry expecting it to benefit both researchers practitioners.

Amit Borikar et al. [13] proposed a methodology to compare the management methods and determine a method to optimize maintenance of Thermal Power Plants making the plants operate economically by using TPM.

Jagtar Singh et al. [14] has improved Oee in a two wheeler automobile Industry in India. They suggested techniques like Single Minute Exchange Die (SMED), computer maintenance management system, production planning to improve the maintenance procedures and productivity.

Suchisnata Pradhani et al. [15] evaluated various barriers and challenges influencing the successful implementation of TPM in manufacturing industries. She has also developed a framework of maintenance strategy.

Yash Parikh et al. [16] focuses on employee involvement in implementation of TPM and found that, it requires the motivation of employees within an organization to get ready to welcome the change for betterment. TPM will only succeed where people from all levels remain committed towards bringing the much needed cultural shift in the organization.

Melesse Workneh Wakjira et al. [17] correlated TPM implementation dimensions and manufacturing performance and evaluated, validated and employed overall equipment effectiveness (OEE) in boiler plant. Equipment deterioration was eliminated, and Autonomous maintenance activities were carried out with total employee participation.

D J Bennett et al. [18] used Action Research approach for the implementation of the TPM program in the newspaper industry. It proved to be a longer and more arduous approach than using conventional methods, but the overall benefits have been proved to outweigh the extra effort involved.

Nazrul Idzham Kasim et al. [19] recognized the need of efficient maintenance management system in production management. TPM is implemented in maintenance system, thus eliminating equipment losses related to availability, performance rate, and quality rate, thus increasing Oee.

E.Sivaselvam et al. [20] attempted to apply overall equipment effectiveness (OEE) to a plastic industry. Five bottleneck machines which were affecting productivity have been identified and studied and from the calculated OEE high cycle time, more waiting time and Low productivity were identified.

Bupe. G. Mwanza et al. [21] developed a TPM model for a chemical manufacturing company. It identified the gaps in the maintenance system, determined the key performance indicators to be included in the TPM model for effective implementation.

Ranteshwar Singh et al. [22] implemented TPM in a company manufacturing automotive component. The losses associated with equipment effectiveness have identified. Success of TPM has owed on its various pillars as 5-S, Jishu Hozen, Planned Maintenance, Quality maintenance, Kaizen, Office TPM and Safety, Health & Environment.

Taufik Djatna et al. [23] investigated slow managerial decision-making. Association Rule Mining (ARM) was formulated and relationship between measurable indicators of OEE with the response of action required taking in certain condition of machine utilization.

Marin Mâinea et al. [24] presented a new optimization method for the Overall Equipment Effectiveness maximization. Proposed method is applied in the case of refrigerators assembly with the known and deterministic operational times. With the appearance of perturbations, stochastic operational times have been applied as heuristics or stochastic algorithms.

Anand S. Relkar et al. [25] attempted to predict the OEE by using Design of Experiments (DOE). MiniTAb15 software is used and experimentation has been done on three factors and two level of OEE. Main effect plots and regression analysis provided information about the most influencing factor and classic relationship between availability, performance rate and quality rate. Counter plots and response surface method resulted into optimized values of three factors of OEE.

INITIATIVE OF TOTAL PRODUCTIVE MAINTENANCE

Autonomous maintenance

- Fostering operating skills
- Fostering operating ownership
- Perform cleaning- Lubricating- tightening- adjustment- inspection- readjustment on production equipment.

b) Planned Maintenance

- Planning efficient and effective PM, Pd .M& TBM systems over equipment like cycle
- Establishing PM check sheets Improving MTBF, MTTR

c) Quality maintenance

- Achieving Zero defects
- Tracking and addressing equipments problems and root cause
- Setting 3M (machine/man/material) condition

d) Education and training

- Imparting technological, Quality Control, Interpersonal skills
- Multi skilling of employees
- Aligning employees to organizational goals Periodic skilled valuation & updation.

CONCLUSION

It observes that there is a need for further study on the role of TPM in manufacturing industries. TPM increases the availability, performance efficiency and the quality rate, results in improvement of the overall

equipment effectiveness of the equipment. TPM also used to achieve zero breakdowns, zero defects and zero accident. TPM aims to create corporate environments able to respond positively to the changing business climate, technological advances, equipment sophistication, and management innovation.TPM is a maintenance system which promotes productive maintenance but it also contributes to a positive safety culture through management incentive, management commitment, participation of management and workers, communication, education and training, working conditions and procedures, morale and job satisfaction, and attitude and risk perception. Here using the T-test method which was used to compare the results obtained from the two different sample groups where to verify the effectiveness of TPM on safety culture. Finally a framework of TPM activities was developed for manufacturing organizations to improve safety performance. It increases the availability, performance efficiency and the quality rate, results in improvement of the overall equipment effectiveness of the equipment. TPM also used to achieve zero breakdowns, zero defects and zero accident. However, it is observes that there is a need for further study on the role of TPM in manufacturing industries. Based on the findings of this review therefore it is suggested that more tangible benefits to be addressed by future research related to TPM.

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