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A Brief Literature Review on Total Productive Maintenance

A Positive Approach to Solve manufacturing Problem

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Abstract: This paper present the literature review of Total productive maintenance (TPM). which is a positive approach to solve manufacturing problem, aiming zero defect and hence increase productivity and quality in manufacturing industries. This paper also explains the overview of TPM pillars and how it Play an active role in manufacturing system. OEE (Overall Equipment Effectiveness) is used to identify the improvement or success in TPM.

Keyword: Availability, performance, Quality, Productivity, Maintenance, Efficiency.

I. INTRODUCTION

Nowadays maintenance is a critical factor to improve productivity and quality in manufacturing industries**.** Total Productive Maintenance (TPM) is a technique which helps in increase productivity and quality by reduce waste, proper maintenance and availability of equipments and aiming zero defects i.e. zero equipment breakdown and zero product defect leads to increase in productivity by reducing waste. It is a lean tool to optimize the effectiveness of manufacturing equipment and tooling.TPM concept has been accepted by many industries to solve different type of problems in manufacturing system. TPM aims to maximize equipment effectiveness .it is a continuous process. The implementation of this concept was First done in-group Nippon Denso (a subsidiary of the Toyota Group).

TPM was first introduced by Seiichi Nakajima [1] known as the Father of TPM gives basic fundamental of Total productive maintenance and aim of TPM and explains the basic steps for implementing TPM. It establishes a thorough system of Preventive Maintenance (PM) for the equipment's entire life span. He also conclude that Productive Maintenance (TPM) is positive approach to maximize equipment effectiveness.

Osama Taisir R.Almeanazel [2] describe the goals and benefits of implementing Total Productive Maintenance, and also focusing on the overall equipment effectiveness (OEE) author also explain about six BIG losses in industry . A case study analysis of TPM and OEE in Steel Company in Jordan, After implementing author found that quality factor is increase to 99% of overall equipment effectiveness equation and availability reaches 76% where in performance it got 72%. Different type of techniques like Single minute exchange die, computer maintenance management system, and production planning and control were suggested to the industry to improve their maintenance procedures and increase the productivity.

Faisal Talib, Zillur Rahman, M.N.Qureshi [7] In this paper Author describes that to satisfy customer need continuously improvement of the performance of products, processes, and services is must. Some key factors are to be identified which play an important role in the success of TQM. These key factors are termed as critical success factors (CSFs) and for sorting of the CSFs they use Pareto analysis quality tool.

Veronika I.D. Buech, Alexandra Michel, Karlheinz Sonntag [3] The purpose of this paper is to focus on suggestion scheme which investigate processes underlying employees involvement and examines the relationship between interactional justice of the suggestion system, valence of the suggestion system (VSS), employees' wellbeing, and their motivation to submit suggestions. A case study taken from manufacturing company in a German. In total, 142 questionnaires were completed and response rate: 71 percent. suggestion systems motives the employee and play a vital role for organizations.

I.P.S.Ahuja and J.S.Khamba[5] In this paper author review the literature on Total Productive Maintenance(TPM) and success of TPM by implementing 8 pillars and explains that the ultimate goals of TPM are zero breakdowns, zero defects, zero accidents and zero waste by presenting an overview of TPM implementation. The paper presents the overview of various TPM implementation practices. It also highlights the approaches suggested by various researchers and practitioners and critically evaluates the reasons behind failure of TPM programmes in the organizations. The paper systematically categorizes the published literature and then analyzes and reviews it methodically which is helpful to understand the significance of TPM.

J. Venkatesh [6] In this paper Author explains the concept of TPM and its importance and necessity and introduced similarities and differences between TQM and TPM. Author also describe various types of maintenance stages in TPM implementation and conclude that employees must be educated and bring to the reason 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.

Ranteshwar Singh et al [4] implementing TPM concept in automotive manufacturing company at Gujarat and conclude after implementation of TPM Overall Equipment Effectiveness has improved from 63% to 79% indicating the improvement in productivity and improvement in quality of product.

II. PILLARS OF TPM

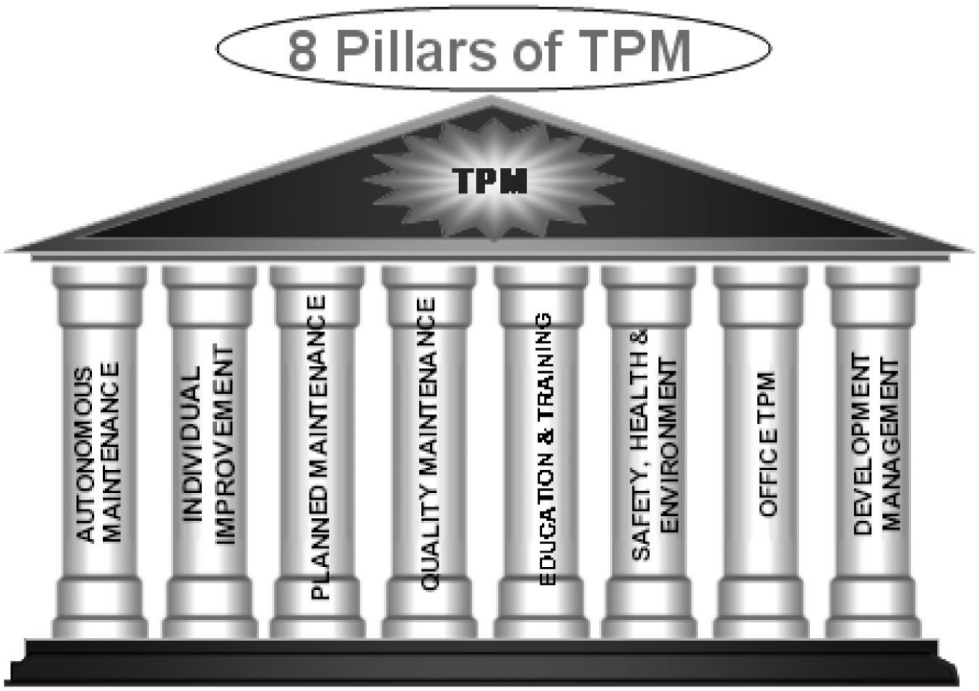

Figure 1. Pillars of TPM

1. Individual Improvement (5S)

5S predicts and prevents the downtime loss to achieve good quality, efficiency organization should be clean, safe and orderly and neat.

5S stands for:

Table 1. 5S meaning

Japanese Term	English Translation	Equivalent 'S' term
Seiri	Organization	Sort
Seiton	Tidiness	Systematize
Seiso	Cleaning	Sweep
Seiketsu	Standardization	Standardize
Shitsuke	Discipline	Self-Discipline

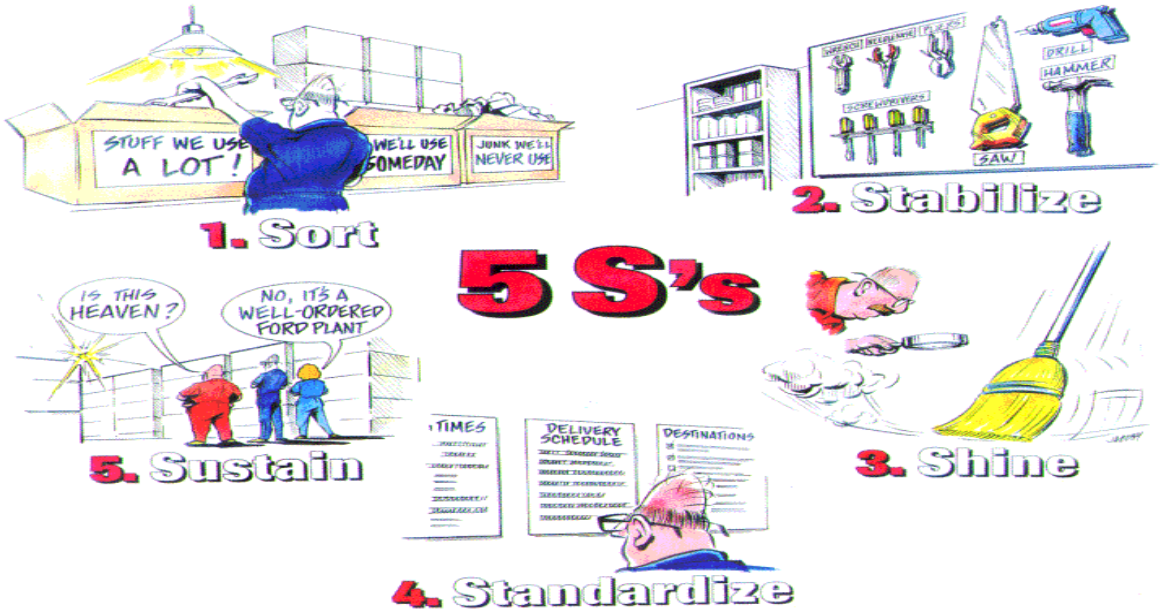

Figure 2. 5s Meaning

2. Autonomous Maintenance (JISHU HOZEN)

JISHU HOZEN means maintain one's own equipment by one self.

- This pillar develops operator to take care of small maintenance tasks and Eliminate the defects at source through active employee participation.

- Daily inspection, Lubrication, Minor repair, Parts replacement, Trouble shooting, Accuracy checks etc to prevent it from deterioting.
- Concentrate on value added and technical repairs and hence uninterrupted operation of equipments.
- The operator responsible for up keep of their equipment to prevent it from deteriorating

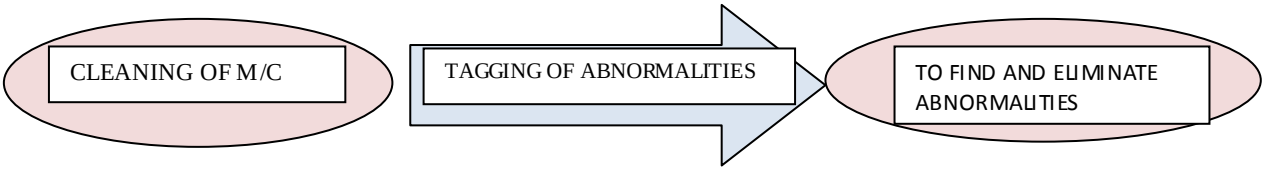

Figure 3. Jishu Hozen Concept

7 steps involve in autonomous maintenance:

1. Initial cleaning of machine
2. Take counter measures for the causes of forced deterioration
3. Preparation of tentative jh standards
4. General inspection
5. Autonomous inspection
6. Standardization
7. Autonomous management

3. Planned Maintenance (PM)

This pillar aimed towards
- Trouble free machines and equipments for improving reliability and maintainability.
- Defect free products for total customer satisfaction targeting zero equipment failure and break down.

Planned maintenance divided into four categories
- preventive maintenance
- break down maintenance
- corrective maintenance
- maintenance prevention

Benefits
- zero equipment failure
- optimum maintenance cost
- achieve and sustain availability of machines
- reduce maintenance cost
- reduces spares inventory
- improve reliability and maintainability of machines

4. Quality Maintenance (QM)

This pillar aimed towards
- defect free manufacturing
- reactive to proactive like (quality control to quality assurance)
- Focus of prevention of defects at source .

Benefits
1. Defect free condition and control of equipments
2. Focus of prevention of defects at source
3. Focus on poka-yoke (fool proof system)
4. In line detection and segregation of defects
5. Effective implementation of operator quality assurance
6. Achieve & sustain customer complaint zero

5. Education And Training (E&T)

This pillar aimed towards
- Developing multiskill employees whose morale is high and who has eager to come to work and perform all required functions effectively and independently
- Achieve and sustain zero losses due to lack of knowledge/skills/techniques.
- employees will be trained to address the problem by finding the root cause & eliminating them
- The goal is to create a factory full of experts and 100% participation in suggestion scheme.

Benefits
1. Achieve and sustain zero losses due to lack of knowledge /skills /technique
2. Remove fatigue and make work more enjoyable
3. Upgrading the operating & maintenance skills

6. Development Management (DM)

This pillar aimed towards
- Collection & utilization of feedback information regarding present products before the start of the design.
- Measuring needs for "easy of manufacturing "by analyzing the process for present products.
- Measuring needs for "easy of manufacturing" by analyzing process of new products in the stage of planning & design of products.

  - By identifying failures possibilities based on design reviews of new products.
  - By identifying failures possibilities based on trail manufacturing & test of new products

Benefits
1. Reduces lead time to new product launch
2. Reduce the losses
3. Cost Effective

7. Safety Health& Environment (SHE)

This pillar aimed towards
- target
  - zero accident

- zero health damage
- zero fires

- create safe work place and safe work practice
- this pillar play vital role with other pillars on regular basis

Benefits

- zero accident
- zero fires
- zero health damages
- safe working condition
- safe work practice

8. Office TPM (OTPM)

Office TPM should be started after activating four other pillars of TPM (JH, KK, QM, and PM).

This pillar aimed towards

- To improve productivity
- Efficiency in the administrative functions and identify to eliminate losses
- Analyzing processes and procedures towards increased office automation

Benefits

- Inventory reduction
- Lead time reduction of critical process
- Equalizing the work load
- Retrieval time reduction (reduce repetitive work)
- Better utilized work area
- Reduction in administrative costs

III. OVERALL EQUIPMENT EFFECTIVENESS (OEE)

Overall Equipment Effectiveness (OEE) is best practice way to monitor and improve the efficiency of a manufacturing process in the organization. It is a tool to measure the productivity.

OEE is broken down into three factors, Availability, Performance, and Quality. OEE is given by the product of availability index, performance index and quality Indexes Calculation of OEE is based on these three factors availability, performance, and quality. The formulas for calculating the three factors are as follows:

- Availability
- Performance efficiency
- Quality Rate

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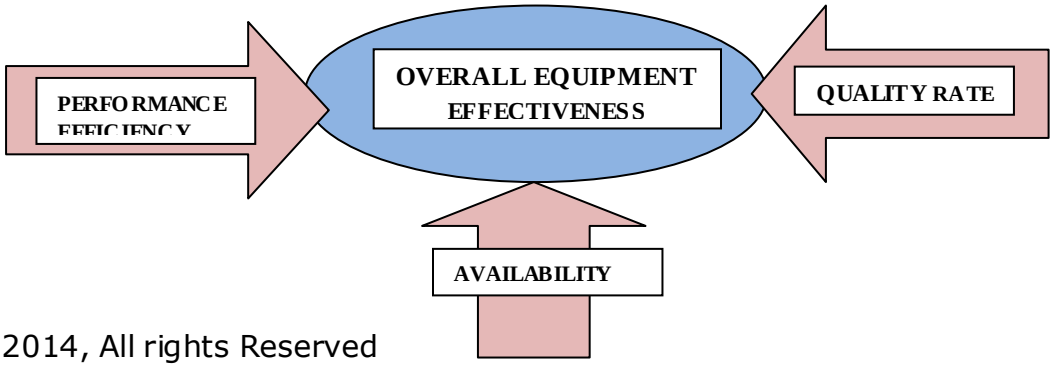

Figure 4. OEE and Their Factor

1. **Availability(A)** = Operating Time/Net Available Time

   Net Available Time :(Shift Length - Planned Scheduled Time) Planned scheduled Includes tea time, lunch break.

   Operating time: (net available time downtime) Downtime includes machine breakdown, minor stoppage, setup & Adjustments.

2. **Performance efficiency(PE)** = Actual Output/Total Capacity

3. **Quality Rate(QR)** = Good Output / Target Output

   Good output: (Total no. of products - No. of rejected parts)

   Therefore OEE (Overall Equipment Efficiency) = A*PE*QR

Table 2. World Class OEE

OEE Factor	World class
Availability	90.0 %
Performance	95.0 %
Quality	99.9 %
OEE	85.0 %

IV. CONCLUSION

- Success of TPM depends on various pillars like 5-S, Jishu Hozen, Planned Maintenance, Quality maintenance, Kaizen, Office TPM and Safety, Health & Environment

- TPM focuses on maximizing the Overall Equipment Efficiency (OEE) with involvement of each and everyone in the organization. And the key factors for this implementation are workers involvement and top management support.

- World class TPM implementation is possible with continual support at all the levels along with the supply of necessary resources.

- Reduce Defectives Or Scrap Increase Utilization And Equipment OEE. Defect And Equipment Break Down Prevention Hence It Is Lean Tool For Quality And Productivity.

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