

"TPM" - A Philosophy for Further Enhancement of Performance

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ABSTRACT

The global market place is highly competitive and organizations that want to survive long term, have to continuously improve, change and adapt according to market demands. Improvements in a Company's performance should focus on cost reduction, increasing productivity levels, safety, environmental performance, quality and prompt deliveries in order to delight customers. Total Productive Maintenance (TPM) is one of the methods to achieve these goals. This paper discusses the basics of TPM, its implementation procedure, measurements of its results, barriers, key success factors, benefits and an action plan for implementation of the same in Indian Paper Industry.

INTRODUCTION

According to Japanese companies, for achieving competitive advantage organizations must have strong manufacturing capabilities and produce "attractive products". To have strong manufacturing capability, Japanese organizations developed and embraced Total Quality Management (TQM), Total Productive Maintenance (TPM) and Just in Time (JIT). Japanese equated the management of an organization to a human body. They considered TQM as the brain, TPM as the muscles and JIT as nerve system. TPM is the concept originated and developed by Japan Institute of Plant Maintenance (JIPM) in Tokyo, since late sixties. JIPM-TPM is the key for the operational excellence of many Japanese companies.

In this paper, we discuss the concept of TPM, its 12-step implementation process and measurement of results in 2. The benefits and success key factors from published case studies and surveys are also discussed along with the barriers to TPM implementation are given and an action programme for the Indian paper Industry.

EXPERIMENTAL

TPM concepts and 12 step implementation process and measurement of results

The development of TPM began in 1970s with the recognition of the fact: it is the plant operators who are

best placed to know the status of the machines and processes and it is they who can prevent break down. In TPM, Head of operation assumes ownership for the plant and breaks the barrier between maintenance and production. Operators participate in maintenance function by becoming responsible for the prevention of deterioration, and thereby achieve the status of competitive manufacturing.

TPM is an innovative approach to maintenance that maximizes equipment effectiveness, eliminates breakdowns, and promotes autonomous maintenance through day-to-day activities involving the total work force. TPM aims at Zero breakdowns, Zero Defects, Zero Rejections, Zero Accidents and Zero Pollution. All these are taken care of to ensure greater reliability, cutting cost and minimizing waste. TPM focuses on wastes and losses. When these are eliminated, everything in the process that does not add value gets extinct. TPM paves the way for excellent planning, organizing, monitoring and controlling practices.

TPM Implementation Process-12 Steps

TPM is implemented in twelve steps² These are:

Preparation Stage

- (I) Formally announce decision to introduce TPM,
- (II) Conduct TPM introductory education and publicity campaign,
- (III) Create TPM promotion organization,
- (IV) Establish basic TPM Policy & Goals,

(V) Draft a master plan for implementation of TPM,

Introduction Stage

(VI) Kick off TPM initiative,

Implementation Stage

(VII) Build a corporate constitution to conduct focused improvement activities, establish and deploy autonomous maintenance, implement planned maintenance and conduct operation and maintenance skills training programme,

(VIII) Build a "development management" system for developing new products and developing equipment that high equipment effectiveness

(IX) Build a quality maintenance system to achieve conditions of zero defects.

(X) Build an effective administration and support system.

(XI) Develop a system for managing health, safety and the environment to achieve accident free and pollution free environment and

Consolidation Stage

(XII) Sustain full TPM implementation and raise levels.

Table 1 OPE of a Bleach Plant

Parameter	Unit	Formula	Value
Availability			
Calendar Hours	Hours/month	a	744.00
No Demand	Hours/month	b1	48.00
(Not Required)			
Available Hours	Hours/month	a1	696.00
Down Time	Hours/month	b	21.25
Running Hours	Hours/month	a-b	674.75
Availability	%	c=(a-b)/a	97%
Performance rate			
Total Production	Tons/month	d	3565
Average Production	Tons/Hr	e=d/(a-b)	5.3
Standard Production	Tons/Hr	f	5.5
Performance Rate	%	g=e/f	96%
Quality rate			
Bleached Pulp with pH > = 8	% of pulp	h	100%
Bleached Pulp with brightness > = 80%	% of pulp	i	99.0%
Bleached Pulp which is clean	% of pulp	j	98.7%
Bleached Pulp without Cl ₂ traces	% of pulp	k	100%
Quality Rate	%	l=min(h,i,j,k)	98.7%
Overall Plant Effectiveness	%	cxgxl	91.9%

RESULTS AND DISCUSSION

Measurement of TPM results

Its Effectiveness is measured by a matrix P, Q, C, D, S, M and OPE (Overall Plant Efficiency) index. These are explained below:

- P - Productivity improvement due to reduction in sporadic failures and equipment operating hours
- Q - Quality improvement due to reduction in product defects resulting in reduced customer complaints
- C - Cost Reduction due to maintenance by avoiding breakdowns
- D - Delivery cycle time improvement leading to reduction in product inventories
- S - Safety improvement by reduction in accidents and elimination of pollution
- M - Improvement in Employee Morale by way of increased suggestions

The "Overall Plant Efficiency" is calculated as follows:

$$OPE = \text{Availability} \times \text{Performance efficiency} \times \text{Rate of Quality Products}$$

Typical calculations for OPE of a bleach plant are given in Table 1:

Benefits and key success factors from case studies and surveys

Given the fact that only 10% or less of companies succeed in implementing TPM, what key factors are responsible for their success? and what benefits have been realized due to TPM. These questions are addressed in this section by reviewing published surveys and case studies.

TPM in UK Companies

Ireland and Dale have studied TPM implementation in three organizations in UK. In all the three companies they found that senior management had supported TPM and set up suitable organizational structures to facilitate its implementation. With the setting of up autonomous maintenance, they gradually changed over from breakdown maintenance to planned, preventive and predictive maintenance. One company manufacturing rubber products in UK started TPM in 1992 and received JIPM Preventive Maintenance (PM) award in 1995. The company spent 0.40 million for TPM implementation and realized over 2 million as benefits. The organizational structure was reduced from five levels (Director, manager, department manager, supervisor, and operator) to three levels (factory management team, factory team and shift team).

TPM in the South African pulp and paper industry (SAPPI)

The Entra mill, one of Sappi mills employing 1000 people and producing 160,000 tons of fine paper/annu implemented TPM. Autonomous maintenance, measurement and improvement of six major machine losses were implemented. Visual management aids were introduced with graphical trends showing progress on quality, cost, delivery, environmental and people. The main reason for successful implementation of TPM in Entra mill is due to good knowledge of TPM among employees and commitment of employees and top management. The benefits are improvements in the run rate, equipment availability, productivity, quality and reduction in cost.

TPM in USA

Lawrence has studied⁵ TPM implementation in US companies. He concluded that one of the hardest aspects of implementation is changing the organization culture. Successful implementation requires breaking the wall between maintenance and production employees, establishing new cultures, changing attitudes, creating new work environments and accomplishing paradigm shifts. Top management support is critical to bring the necessary change in the culture. Providing training and adjusting the reward systems to accommodate the new approach to maintenance are the other requirements for changing the culture. With the introduction of TPM environment he found that

- (i) Overtime of jobs reduced and performance of on-time jobs improved.
- (ii) Equipment and plant availability increased by minimizing unscheduled jobs

According to an article published in website⁶ Ford Motors, Harley Davidson, Allen Bradley, Eastman, Kodak and Texas Instruments are the few companies that have implemented TPM successfully. All these companies have reported 50% or greater reduction in down time, reduced spare parts inventory and increased on time deliveries. Texas Instruments reported 80%-increased production in some areas. Similarly Kodak reported that an investment of US\$ 5 million in a successful TPM programme resulted in a \$ 16 million increase in profits.

The key success factors in these companies are approaching TPM realistically, developing a practical schedule, changing prevailing attitudes towards maintenance, training and deploying TPM coordinators with time and resources, developing relevant measures of performance and continuously monitoring and publishing benefits in financial terms and determination to keep going with TPM. Further TPM facilitated improved relationship among production and maintenance sections and change in organizational culture. Operators and technicians developed multiple

skills, leading to job enrichment and improved flexibility of workers and better coordination. This has resulted in reduced delays, downtime and improved productivity.

Bragg has studied⁷ TPM implementation at the M/s National Semiconductor in Arlington, Texas, USA. It took more than three years for implementing TPM in National Semiconductor. The company took long time for changing people's behavior. Their success factors for TPM include management commitment, initial investment in time and money and long-term commitment. The advantages achieved by them are zero unscheduled down time, higher skilled people, less inventory, and greater productivity.

TPM in the dishwasher manufacturing plant of Whirlpool corporation, Findlay, Ohio. This has resulted in 21% increase in production and massive improvements in overall equipment effectiveness. The major factors for TPM success are the team efforts of process operators, skilled trades and management in eliminating the defects that cause breakdowns.

Survey on TPM

www.plantmaintenance.com have conducted a survey on TPM over the Internet through their web site. Four TPM companies have responded to the survey. For these 4 give for companies, TPM Implementation period varied from 2 to 5 years. The benefits realized are reduction in operating cost, reduction in cost of maintenance towards labour and material, improvements in availability and reliability of equipment, product quality, etc. The important aspects that led to TPM success are senior management commitment, effective training on TPM, measuring and communicating the TPM improvements and persistence.

TPM in China

Tsang and Chan have studied⁹ TPM implementation in a high-precision machining factory at China manufacturing semiconductors. Starting mid-1995, the company implemented TPM in three phases over a period of 5 years. The benefits realized are 24% drop in breakdowns, meeting of tight production targets due to reduced failures and clean and tidy work place and factory area is kept clean and tidy. The critical success factors are commitment by senior management, allocation of required time and resources, cultural change of operators towards autonomous maintenance, training of employees, forming committees, demonstrating initial success through pilot project, developing trust between management and work force through open communication and maintaining focus on the change programme.

TPM in India

To promote TPM amongst Indian Industry, TPM club of India (www.tpmclubindia.com) was set up in the year 1998. It assists industry to implement TPM through training and consultancy. It also provide support to JIPM

in its activities in India. Further it organizes seminars/conferences, publication of manuals and conducts plant tours to award winning companies. With the membership of over 250 companies, (Sueo Yamaguchi, 2002). Some Industrial clusters of companies jointly facilitated by Maruti, TVS Motor and Bajaj Auto adopted TPM and 20 have won the TPM awards.

The TPM Excellence award companies in India are Vikram Cement (1995), Sundaram Fastners Ltd (1998), Tanfac Ltd (1999), Birla Tyres (BK Birla Group), Hindustan Lever Ltd (Sumerpur plant) and Indo Gulf Fertilisers (AV Birla Group) (2000), Grasim Industries Ltd (Aditya cement unit and Orient Cement unit), Hindustan Lever Ltd (Chhindwara Plant, Silvassa pp, Yavatmal unit) and Usha Beltron (Jamshedpur) (2001). At present more than 200 companies are in the process of implementing TPM.

Barriers to successful implementation of TPM

While the reaction of the Indian Industries to TPM is a welcome sign, its application in Indian Paper Industry is slowly yet to picking up. JK Paper Mill there are many barriers to implement TPM depending upon the organization, its managers, supervisors and workers. Some of the barriers are

- barrier between production and maintenance,
- lack of understanding of the total effort required,
- lack of management support,
- lack of sufficient TPM staff,
- union resistance,
- not enough training carried out,
- change of priorities,
- lack of persistence,
- feeling among employees that their positions are threatened.
- keeping technical matters as secrets by maintenance technicians thinking that they only make them more valuable.
- failure to develop a good implementation strategy, and
- simply choosing the wrong approach.

Action programme for the Indian paper industry

Considering the global competition in Indian Paper Industry, implementation of TPM is one of the solutions for overcoming the impact of competition. It is suggested that, the paper mill that is interested in TPM implementation may follow the following action program for implementation of TPM.

CONCLUSION

As defined by JIPM, TPM aims at building a corporate culture that thoroughly pursues production system efficiency improvement, construct a system to prevent every kind of loss, cover all department and requires total involvement from top management to front line employees. It achieves zero losses by overlapping small

group activities. One of the important steps in TPM implementation is the autonomous maintenance. Key success factors for TPM implementation are commitment by management and employees, training of employees to enhance their knowledge, continuous monitoring and publishing of benefits. The major benefits are reduction in down time and breakdowns (unscheduled stoppages), increase in production rate and equipment/plant availability, improvement in productivity and quality, reduction in cost, over time, inventory, accidents and customer complaints. The major barrier to be smashed is the boundary between maintenance and production. An action plan is suggested for the Indian Paper Mills to grasp yet another performance enhancement philosophy - the TPM.

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