

# Total Productive Maintenance : The Zero-Based Approach to Enhance Plant Efficiency - A Case Study

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## ABSTRACT

The TPM concept, designed by Japan Institute of Plant Maintenance (JIPM) focuses on reducing costs in an absolute sense by changing the mindset, attitude and direction by looking at every aspect of the production process. It equips the company to aim for zero breakdowns, no downtime, zero quality defects and zero accidents. Within a span of three years after initiating the TPM programme at Century Pulp and Paper, significant gains have resulted in terms of overall Operational Efficiency, Product Quality and Equipment Maintenance. Ownership of the equipments and high morale are the other distinct benefits. The paper outlines the TPM concepts, and philosophy, deployment of TPM at the mills and benefits derived.

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## INTRODUCTION

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Many industrial units are pursuing TPM, an integrated management system that originated in Japan almost 25 years ago across the country. Hard-pressed to improve their bottom-lines in the recent troubled times of industrial recession, combined with the global competition and low prices, it is imperative that we strive to reduce costs and optimize maintenance and plant efficiency by adopting new and innovative approach. TPM is an effective management system in this direction: with thrust on Zero breakdown, Zero failure, Zero defect and Zero accidents.

TPM has been defined as a set of activities for restoring the equipment to its original conditions and changing the work environment to maintain those conditions. During the course of its implementation at the mills, we propagated a number of ways to define TPM viz. 'Total Profit Management', 'Total Perfect Manufacturing', 'Total Power Management and Total Positive Mind' to cite a few.

Maintaining optimal equipment conditions means more than just making sure that each machine runs well. It means ensuring that it runs so well that it never breaks down, always operates at the designed speed with no idling or stoppages, never produces a defective product; and causes a minimum of set-up and adjustment losses. Besides this, TPM also covers establishing and maintaining standardized methods for equipment diagnosis, early detection of abnormalities and why-why analyses of failures.

TPM is not simply a maintenance programme. It requires cooperation and involvement at all levels and divisions of the company, breaking the traditional attitudes towards specialization and establishment of educational systems designed to upgrade skill levels of maintenance and production personnel.

### TPM philosophy

It is not always practical to achieve Zero breakdown or Zero defects if the Equipment Management is primarily practiced by the Maintenance Department. Based on the small group activities, TPM takes productive maintenance companywide with the support and cooperation of employees at all levels. People most likely to first notice equipment abnormalities are not the maintenance staff but the operator who works with the equipment. The best way to prevent breakdown is to have the operator give prompt notice of abnormalities and then have the maintenance staff promptly respond this corrective measures.

TPM therefore is characterized by production department workers participating in the maintenance activities, an approach known as Autonomous Maintenance.

Productivity, Quality, Cost, Delivery, Safety and Morale (PQCDSM) are the parameters by which the performance of any industry can be measured in to-day's context. However, in an environment of stiff competition on price and quality, manufacturing goods with high level of Productivity, Quality (O-Defects), Low Manufacturing Costs, On-Time Delivery to all customers all the time is not an easy task. The other

# TPM

## TPM PROMOTIONAL ORGANISATION

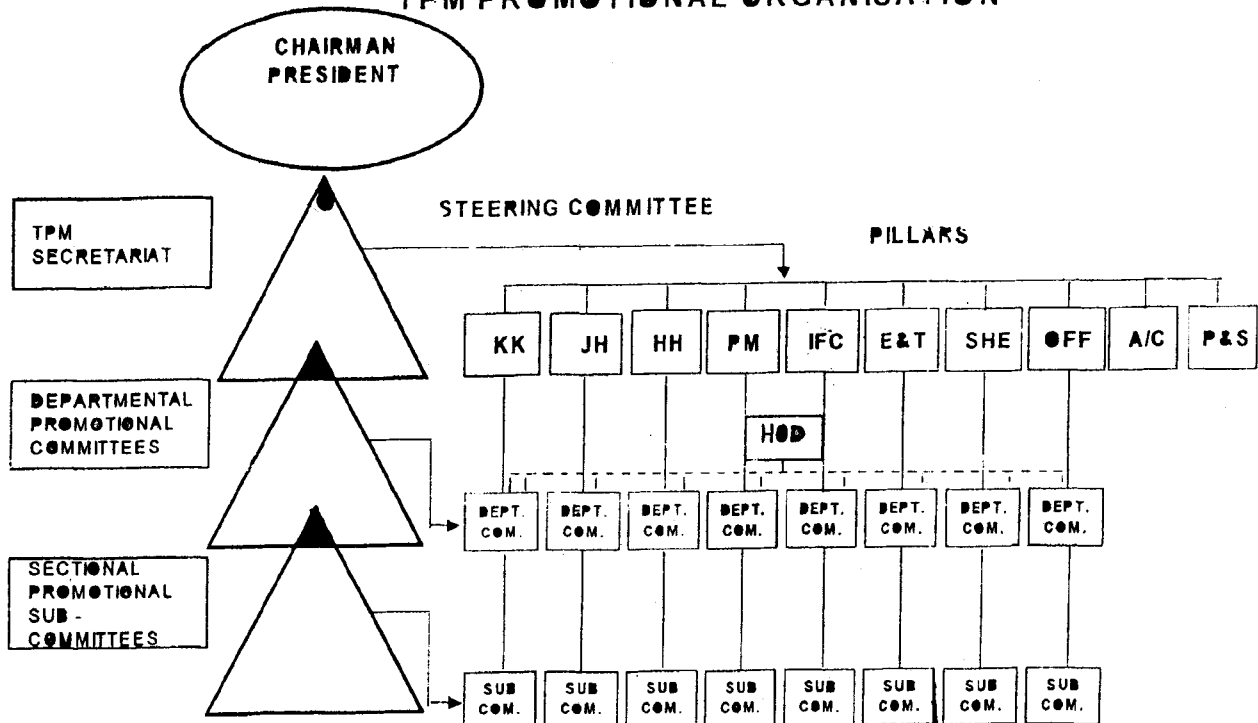


Fig. 1 : Dept. Committees comprising members from regp/wpp/bag.pulp/bag. paper/power house/rec. Section subcommittees for each pillar head functions : millwide.

major factor in this challenging task is the 'People' dimension without whose collaborative working inside an organization (Safety & Morale), neither building nor maintaining PQCDMS becomes a reality. TPM is a unique way of achieving and maintaining PQCDMS to a high standard in an industry.

### TPM deployment at the mills

Having equipped with the ISO-9001-2000 QMS and ISO-14001 EMS accreditations, CPP embarked on the TPM implementation three years back with an objective to bring about further improvements in its operations particularly with regard to Plant Maintenance activities. The deployment covered following steps :

### Organizational structure

A well defined organizational structure was formulated comprising of :

- TPM Secretariat: to coordinate and facilitate the system
- Steering Committee: to review the progress and offers guidelines.
- Pillar Heads: covering eight functions on the mill-wise basis.
- HODs : covering all production and support departments.

Table 1 TPM: Training and awareness programme

Year	No. of Programme	Staff	Workman
1999-2000	54	475	994
2000-2001	32	324	935
2001-2002	18	251	461
2002-2003	14	96	588
E&T Pillar (OJT)	85	151	411

Overlapping Committees/Sub-committees covering all Pillar and Department functions (Fig. 1).

### **Training & awareness**

Major thrust was given to the training and awareness programme by the TPM Facilitator on the various aspects of the system: both classroom and online job during the first year. The programme are still ongoing as per monthly training Calendar and during the bimonthly visit of the facilitator. Total number of 203 training programmes has so far been conducted covering persons from all departments (Table 1).

### **The 8-Pillar activity**

TPM deployment covers implementation of the following 8 activities in small and synchronized steps. These steps are designed to steadily graduate people and activities from one level of achievement to the next and gradually modifying traditional ways of working into TPM way. TPM, in this way, aims to bring in a cultural change in the organization.

The 8-Pillar activities under TPM are :

#### **Autonomous maintenance (JISHU HOZEN)**

- Maintaining basic conditions on shop floor and in machines.
- All over participation through over lapping committees.
- Selection of Model Machines for autonomous maintenance.

#### **Individual (Focused) improvement**

- Loss identification and focused improvement.
- Deptt. Cost-Loss Kaizen Matrix
- Kaizens : registration and monitoring
- Targets : three year basis; reviewed.

#### **Planned maintenance**

- Focus on prevention
- Why-Why analyses
- Improvement in Reliability, Maintainability and Cost

#### **Quality maintenance**

- Eliminating in process defects
- Developing perfect machine for zero defect in products.

#### **Office**

- Improving office man-hour efficiency by eliminating Nonvalue Added (NVA) activities.
- Office oriented for excellent support for manufacturing.

#### **Education & Training**

- Skill development for uniformity of work practices

- Skill for zero defect, zero breakdown, zero accident

### **Safety, Health & Environment**

- To achieve zero accidents, zero health hazard at work.
- To maintain clean environment

### **Initial flow control**

- Minimal start up loss for machinery and new product development.
- Appropriate design changes.

### **Implementation and monitoring**

All the pillar activities are conducted as per a well-designed plan, through the over lapping committees. While the Pillar Heads execute and monitor the respective pillar functions on a mill wide basis, the HODs are responsible for implementation in the departments. Committees have representation from various areas which facilitates communication and working as a team. Weekly meetings are held by the Pillars and HODs to monitor progress and review the action plans. The steering committee chaired by the President holds the meeting on monthly basis.

Under the Autonomous Maintenance (JISHU HOZEN), various machines are selected as 'Models' to implement and demonstrate the concepts. A group comprising persons from both Production and Maintenance departments perform the JH activities in the following steps :

- Knowledge of Machine and Safety aspects.
- Initial Cleaning and Inspection.
- Identify Sources of Contamination and Eliminate/Identify FUGUAIS (Abnormalities).
- Developing Cleaning, Inspection and Lubrication standards.
- General Inspection Skills Training.
- Implement Improvements to Make Operation easier.
- Collect and Analyze Various Data for Improvements.

An activity board at the site displays the status and records of various tasks performed. Stepwise audits are conducted on the model machines to ascertain proper implementation and continual improvement. Presently 99 such model machines are identified millwide which are under different stages of progress i.e. audit steps. Individual (focused) improvement (KOBETSU KAIZEN) aims at identifying losses, registering KAIZENS (improvement) and tracking the progress on a three-year target fixation. An important feature is the 'Cost-Loss Kaizen Matrix' which is as per Table 2. The objective is to identify losses and fixing targets to eliminate these losses through implementation of Kaizens. During the last couple of years, total number of 5478 Kaizens have been registered and the saving as certified by the Accounts department comes to Rs. 3258.57 lacs.

**Table 2**

Century Pulp And Paper Cost-Loss Kaizen Matrix	
•	SI No.
•	Particulars : Production, Raw material, Chemicals Steam, Power : Total
•	Unit
•	Rate : Rs./tonne
•	Bench mark : 2002-2003
•	Target : Next three years
•	Loss compared to bench mark : Quality/ Amount
•	Gains due to kaizens : Nos. / Amount
•	Balance loss : Amount
•	Remarks

Planned Maintenance incorporates tracking of equipment failures, Why-Why- Analyses and counter measures to avoid recurrence. The thrust is given to the number of 'Root Causes' elimination. A check is also made on the maintenance expenditure under various heads in different departments.

Quality maintenance (HINSHITSU HOZEN), besides tracking the down-gradation and quality complaints on a monthly basis emphasizes on the identification or root

causes of defects through 4-M analysis (Man, Material, Machine, Method), stratifies the causes and aims at making the root causes of defects zero.

Under the SHE Pillar activities, thrust is given to the why-why analyses of accidents and eliminating the unsafe conditions. A unique feature is to record incidents (Near-Misses) with an objective to avoid occurrence of any accident. Safety patrols are a regular activity to identify unsafe conditions and acts and take remedial measures to set them right.

Education and Training programmes are classified into the following broad categories :

- Behavioral
- Basic Knowledge
- Fire and Safety
- TPM Awareness

Training needs are identified for all individuals and markings are made on the skill- levels after the training; to assess the effectiveness of training. The TPM facilitator provides specific training sessions and inputs on critical aspects. One point lesson (OPL) sheets are made departmentwise to impart On-Job-Training (OJT) on the shop floors. A simple example of the OPL is as per Fig. 2.

Theme	Correct oil level in gear box			No.	13			
				Date of Preparation	12-7-2001			
Classification	<input type="checkbox"/> Basic Knowledge	<input type="checkbox"/> Improvement Cases	<input type="checkbox"/> Trouble Cases	Prod. incharge	Engg. Incharge	Group Leader	Prepared by	
				NPS	RKS	RCR	DA	

**Century Pulp and Paper TPM One-point lesson**

Actual Results	Date Executed	14/7	16/7	18/7	19/7							
	Trainer	NKT	DA	RCR	DKG							
	Trainee	4	4	3	2							

**Fig. 2 Century Pulp and Paper TPM One-point lesson**

Table 3

Total Productive Maintenance				
Bagasse depither plant : Model Machine				
No. of Kaizens done : 36				
Particulars	1999-00	2000-02	2001-02	2002-03
Plant rate TPH		63.82	89.25	96.13 77.19
Depither rate TPH		11.12	13.79	14.68 14.83
Power Cons. KWH/T		13.78	12.08	11.36 11.12
Downtime %		7.6	5.4	3.74 3.30

Office TPM aims at identifying non-value-added/ repetitive activities and eliminate the same to provided proficient services to the manufacturing function.

The IFC pillar on the new equipments indented maintains a track and a check- list is filled in to ensure that every critical aspect is taken care of and all stalk holders are aware; to avoid any startup loss.

The monthly progress is monitored by the TPM secretariat based on the PQCDMS indices for the overall mill performance and by the Steering Committee. Every two months, a three day visit is made by the TPM facilitator to assess the progress and give further guidelines. During this visit, a presentation is made by the steering committee on the overall results of CPP, all Pillar Heads on the respective Pillar activities and HODs for their departments.

Few workmen also make presentation on the Kaizen themes and the progress of Autonomous Maintenance (JH) conducted by them on the model machines in their respective departments. Three best Kaizen sheets along with the photographs of the concerned person is displayed on boards in a Kaizen Gallery; to recognize and motivate employees.

**Gains through TPM**

Though the Company is in the initial stages of TPM implementation and a lot need to be covered, signs of improvements are quite distinct; and significant gains have resulted in terms of savings, enhanced productivity and quality improvements. A much better coordination between Production and Maintenance Department to enhance 'Overall Equipment Effectiveness' (OEE) and a high 'Employee Morale' have been some other important benefits the company has derived.

Some of the key benefits are depicted as follows:

- Improvement in the operational efficiency in the bagasse depither plant which was selected as the 'Managers Model Machine' is as shown in the Table-3.
- The financial gains accrued through various Kaizens implemented across the company is as per

Table 4

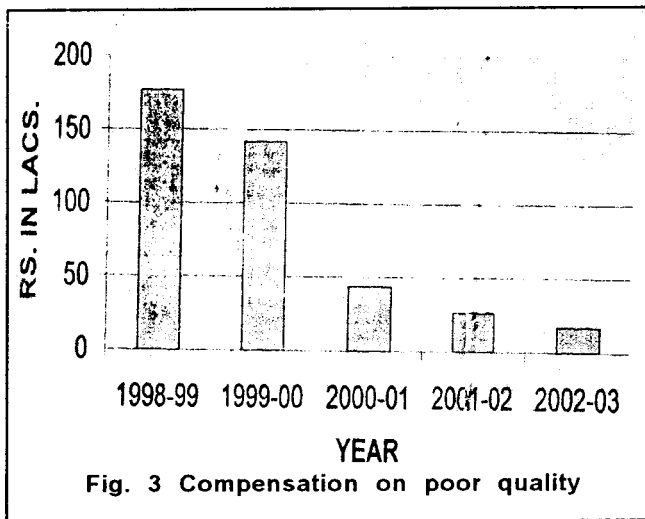
TPM Finance gains through kaiznes	
No. of Kaizens registered	: 5478
Savings through kaizens	: Rs. 3258.57
Saving/Kaizen	: Rs. Lacs 0.59
Saving/employee	: Rs. Lacs1.23
Kaizen/employee No.	: 2.07
Rate of adoption %	: 65

Table 5 TPM Department-wise Kaizen details

Department	Kaizens registered	Kaizens implemented
RG plant	480	409
WPP plant	436	305
Bagasse	815	586
Power house	227	119
Recovery	290	216
Electrical	1657	944
Instruments	579	259
ETP/WTP	283	208
QC/R&D	152	43
Accounts	116	69
Stores & Pur.	239	175
Raw material	180	76
Dr. Office	24	18
<b>Total</b>	<b>5478</b>	<b>3527</b>

Table-4.

- Number of Kaizens registered and implemented is as depicted in the Table -5. The number reflects the "Morale Index' of the workforce.
- Quality shows an improvement trend which is reflected in the Figures of 'Compensation' paid due to poor quality over the years; as shown in Fig. 3.
- The house keeping and cleanliness got a major



boost through JH activities. All machines are adjudged for the difference in the upkeep 'Before and After' the TPM measures.

### CONCLUSION

TPM offers a systematic approach to enhance plant efficiency, involving persons from all disciplines. Significant gains have been reported by organizations that have adopted TPM. The system encompasses the concepts of ISO-9001, ISO14001, and OHSAS etc.;

with a greater degree of involvement and ownership, and is easily adaptable. Century Pulp and Paper has greatly benefited in terms of Overall Plant Efficiency, House Keeping and Employee Morale.

### ACKNOWLEDGEMENT

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