Continual Improvement Using Jishu Hozen Pillar of Total Productive Maintenance in Manufacturing Organization

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Abstract: For any industrial firm, the most important thing is Safety, Quality & Productivity. Everyday tasks are aimed at sustaining and increasing it. After all, it determines the profit of the firm. It is also crucial for the economic progress of the country. High productivity refers to doing the job in the shortest possible time with minimum inputs and wastage but without sacrificing safety & quality. This is where Japanese improvement tool “Total Productive Maintenance” comes into the picture. This thesis aims to implement JH pillar of TPM in manufacturing company which will help in determining the improved methods to perform the required activities.

Keywords: Total Productive Maintenance, Jishu Hozen pillar, JH step 1-3 implementation, Kaizens

1. Introduction

1.1 TPM

Total Productive Maintenance (TPM) is a process or technique. This technique was first introduced by Japanese in 1952. This is an extension to TQM. TPM is a well-defined and organized program which eliminate the losses caused by break-down of machines and equipment’s by identifying and attacking all causes of equipment break downs and system down time. TPM is a cost-effective technique through this technique it is possible to maintain the plant, machiner/equipment and tools in productive state in least cost. Well maintained machines leads to productivity. There is relation between cost of maintenance and cost of quality. We can’t think quality outputs without quality inputs and one of the important input is TPM.

1.2 Definition TPM

TPM is a Japanese tool/methodology which is used to get excellence aiming Zero accident, zero defect, zero breakdown and Employee motivation through TPM culture at all levels of organization and Bringing customer satisfaction through customer rating and competitive prices. TPM is a system of maintaining and improving the integrity of production, safety and quality systems through the machines, equipment, processes, and employees that add business value to an organization.

1.3 Why to do TPM?

Zero Accident, Zero Defect, Zero Breakdown

1.4 Pillars of TPM

2. JH Pillar/ Jishu Hozen/ Autonomous Maintenance

2.1 Introduction to JH Pillar

Workplace Ownership: “I operate the machine; I will maintain it also.” Jishu Hozen, which means autonomous or self-maintenance, promotes development of production operators to be able to take care of small maintenance tasks, such as cleaning, inspecting, and lubricating their equipment, thus freeing the maintenance associates to spend time on more value-added activities and technical repairs. The operators are responsible for upkeep of their equipment to prevent it from deteriorating.

2.2 CLIT Inspection in JH Pillar

Through autonomous maintenance initiatives, production operators are expected to perform the TPM Activities of Cleaning, Lubrication, Inspection & Tightening on a Daily basis.

2.3 Seven steps of JH Pillar

<table>
<thead>
<tr>
<th>Step</th>
<th>Name</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clean and inspect</td>
<td>Eliminate all dirt and grime on the machine.</td>
</tr>
</tbody>
</table>
3. Problem Formulation & Methodology

3.1 Problem Statement

For any industrial firm, the most important thing is Safety, Quality & Productivity. Everyday tasks are aimed at sustaining and increasing it.

3.2 Motivation / Need for Research

In this research work, I will implement Jishu Hozen pillar which is called Autonomous Maintenance also. In production there is misconception among production operators “I run the machine, Maintenance maintain my machine” They think that their responsibility is to run machine & do production only. They are not responsible for maintaining the machine. Machine will be maintained by Maintenance department of company. Due to this misconception, they regularly neglect many abnormalities in daily routine. These abnormalities if neglected for long time can lead to accident, defected part production, machine breakdown. Using JH pillar this misconception is changed into “I run the machine, I am responsible to maintain the machine”. Operator starts capturing all abnormalities which can lead to any accident, defect & breakdown. These abnormalities are timely removed.

3.3 Methodology

- Use JH step 0 methodology.
- Use JH step 1 methodology.
- Use JH step 2 methodology.
- Use JH step 3 methodology.
- Use JH step 4 methodology

3.4 Tools

There is a requirement of several equipment and machines for this research work. Some of them are stated below

- Moulding section machines
- Power press section machines
- CNC section machines
- Fibro moulding section machines
- Die casting section machines
- Assembly section machines

4. Experimentation & Analysis

4.1 Outline

4.1.1 Background

The aim of JH pillar is to change the mind set of operator from “I operate you maintain” to “I operate I maintain”.

4.1.3 Objective

To achieve Zero Accident, Zero Defect, Zero Breakdown and Zero Waste due to weak JH.

4.1.4 Benchmark & Targets

<table>
<thead>
<tr>
<th>SL</th>
<th>KPI</th>
<th>UOM</th>
<th>FY 16-17</th>
<th>FY 17-18</th>
<th>FY 18-19</th>
<th>FY 19-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Safety</td>
<td>Accidents due to weak JH</td>
<td>=</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Customer Rating</td>
<td>Defects due to weak JH</td>
<td>%</td>
<td>1.1</td>
<td>&lt;0.35</td>
<td>&lt;0.30</td>
</tr>
<tr>
<td>3</td>
<td>Breakdown hrs due to weak JH</td>
<td></td>
<td>H*</td>
<td>130</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>Manufacturing Cost</td>
<td>CLT time reduction</td>
<td>%</td>
<td>15</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Minor Stoppages</td>
<td>No.</td>
<td>5047</td>
<td>2400</td>
<td>1200</td>
<td>1200</td>
</tr>
</tbody>
</table>

Table 4.1: Benchmark & Targets

4.2 Key Points of Activity

4.2.1 Master Plan

Table 4.2: Master Plan
4.2.2 Pillar Structure
For implementing the JH practice across the plant, we formed a team who gives training and monitor the JH activities.

4.3 Audit Methodology

4.4 Activity Status of Each Step
4.4.1 JH Step 0 Activity

4.4.1.1 Training: Knowledge about machine

4.4.1.2 Training: Knowledge about abnormalities

4.4.1.3 Training: Red Tags & White Tags

4.4.1.4 JH Step 0: 1S Implementation
1S Sorting

4.4.1.5 JH Step 0: 1S Implementation
1S Sorting

4.4.1.6 JH Step 0: 1S Implementation
1S Sorting
4.4.1.5 JH Step 0: 2S Implementation

2S Arrangement

Define location for everything and everything on its place was done during 2S implementation.

- NG parts separation
- Dept. files streamed: 2S done
- Maintenance tools rack: 2S done
- Used PPE’s container location: fixed
- Gauges location: fixed

Fig. 4.9 – 2S Arrangement

4.4.1.6 JH step 0: 1S, 2S Audit sheet

4.4.1.7 JH Step 0: 1S, 2S Overall Plant benefits

4.4.1.8 JH step 0: 1S, 2S Results

Step 0 is completed. After completion of Step 0, Step 1 started.

4.4.2 JH step 1 Activity Methodology

4.4.2.1 Cleaning with inspection & Tagging of abnormalities

- Cleaning with inspection & tagging of abnormalities
- Fugai matrix & Tag stratification

- List of Abnormalities

4.4.2.2 Fugai matrix & Tag stratification – Moulding machine

We prepared the list of abnormalities and we identified total 24 tags as under:

**List Of Abnormalities ‘Fugai’ - Moulding Machine**

**Figure 4.12: List of Abnormalities**
FUGAI MATRIX

<table>
<thead>
<tr>
<th>SN</th>
<th>Abnormality Location</th>
<th>L</th>
<th>S</th>
<th>C</th>
<th>CLIT</th>
<th>Total</th>
<th>Abnormality Leads to</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Machine Control Panel</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Hydraulic cylinder</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Lock assembly</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Machine Footage</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Machine A side</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Machine B side</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Machine Bottom side</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Top Side</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>Moving Table</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4.3 Fugai matrix

TAG STRATIFICATION

4.4.3.1 Countermeasure of Source of Contamination (SOC)
Countermeasures has been taken against all source of contamination and one example is shown below.

**Fig 4.13 Countermeasure of SOC**

4.4.3.2 Countermeasure to Hard to Access (HTA)

**Pressure gauge was behind the machine**

**Fig 4.13 Countermeasure of HTA**

4.4.3.3 CLIT time reduction activity – Moulding m/c 1

CLIT time of Moulding machine 1 reduced as described below in activity chart.

**Fig 4.13 CLIT Time Reduction Activity**

4.4.3.4 Three layers of audit Step 2 – Moulding

After completion of step 2, step 3 has been started.

**Fig 4.13 Three layers of audit Step 2**

4.4.4.4 JH Step 3 Activity

**Fig 4.13 JH Step 3 Activity**

**Fig 4.13 METHODOLOGY**

**Fig 4.13 METHODOLOGY**
4.4.4.1 Preparation & Implementation of Machine tentative standard – Moulding

Based on our learnings from step 1 and step 2 and abstractions found, we have prepared machine tentative standard for operators to carry out daily CLIT. Below is one sample is shown.

![Image of Tentative Standard](image)

**Fig. 4.17 Tentative Standard**

4.4.4.2 Visual aids displayed on machine

Following common visual frequencies added in JH machine checksheets across the shop floor.

<table>
<thead>
<tr>
<th>Type</th>
<th>Frequency</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - Air Pressure</td>
<td></td>
<td>Low pressure alarm</td>
</tr>
<tr>
<td>B - Lubrication</td>
<td></td>
<td>Lubrication level indicator</td>
</tr>
<tr>
<td>C - Curing Plate</td>
<td></td>
<td>Curing plate &amp; temper change</td>
</tr>
</tbody>
</table>

**Visual Standards Displayed on Machine**

We have added visual controls on machines for making them self-speaking machine as shown below.

- Adhesive Box direction
- Opening Panel Display
- Visual rotation

![Image of Visual Aids](image)

**Fig. 4.17 Visuals**

4.4.4.3 Checkpoints added in JH checksheet

We added visual controls on machines. Based on past breakdowns, past defect analysis & actions, “PM” and “Q” points were added in JH check sheet.

![Image of Checkpoints Added](image)

**Fig. 4.17 Checkpoints**

4.4.4.4 Three layers of audit Step 3 – Moulding machine

After completing step 3 activity, Machine passed 3 level of step 3 audits.

![Image of Audit Results](image)

**Fig. 5.1 Audit Results**

5. Results & Conclusion

5.1 KPI Results

<table>
<thead>
<tr>
<th>SN</th>
<th>KPI</th>
<th>UOM</th>
<th>FM</th>
<th>FY</th>
<th>Target</th>
<th>Actual</th>
<th>FY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Accident due to weak JH</td>
<td>Nos.</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Defects due to weak JH</td>
<td>%</td>
<td>1</td>
<td>0.53</td>
<td>0.57</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>3</td>
<td>Breakdown due to weak JH</td>
<td>Nos.</td>
<td>150</td>
<td>90</td>
<td>95</td>
<td>95</td>
<td>89</td>
</tr>
<tr>
<td>4</td>
<td>Clutter reduction</td>
<td>Nos.</td>
<td>34</td>
<td>25</td>
<td>22</td>
<td>21</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>Minor stoppage</td>
<td>Nos.</td>
<td>3340</td>
<td>2400</td>
<td>2210</td>
<td>1800</td>
<td>1700</td>
</tr>
</tbody>
</table>

**Table 5.1 KPI Results**

5.2 KAI Results

<table>
<thead>
<tr>
<th>SN</th>
<th>KPI</th>
<th>UOM</th>
<th>FM</th>
<th>FY</th>
<th>Target</th>
<th>Actual</th>
<th>FY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Accident</td>
<td>SHARE CONV.</td>
<td>Nos.</td>
<td>132</td>
<td>124</td>
<td>124</td>
<td>123</td>
</tr>
<tr>
<td>2</td>
<td>Defects due to power</td>
<td>%</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Testing &amp; removal of JH &amp; PM</td>
<td>Nos.</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Breakdown</td>
<td>%</td>
<td>100</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
</tbody>
</table>

**Table 5.2 KAI Results**

5.3 Intangible Benefits (Qualitative)

| 1 | Presentation skill improved |
| 2 | Analysis knowledge improved |
| 3 | Brainstorming skill improved |
| 4 | Communication skill improved |
| 5 | SS improved |
| 6 | Self-confidence improved |
| 7 | Morale improved & innovative consciousness |

**Table 5.3 Intangible Benefits**

5.3 Future Scope

<table>
<thead>
<tr>
<th>SN</th>
<th>OBJECTIVE</th>
<th>ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sustenance &amp; Monitoring</td>
<td>Step 1, 2, 3 sustenance in all the departments and monitoring all the results.</td>
</tr>
<tr>
<td>2</td>
<td>JH Step 4-7</td>
<td>Training and Implementation of JH steps</td>
</tr>
</tbody>
</table>

**Table 5.3 Future Scope**
References


