

Autonomous Maintenance: A Case Study on Step -4 Implementation at Detergent Manufacturing Plant Under FMCG Category

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Abstract: This comprehensive study delves into the intricate dynamics of Autonomous Maintenance (AM), a pivotal component of the Total Productive Maintenance (TPM) philosophy, as an instrumental strategy employed by companies to elevate the competitiveness of their products. Focusing specifically on the manufacturing sector, with an emphasis on plant and machinery, the research emphasizes the critical role of AM in minimizing losses attributed to breakdowns, thereby contributing to overall cost reduction. The initial stages of AM, encompassing Steps 1, 2, and 3, are dedicated to restoring the fundamental conditions of machinery. These steps involve addressing underlying issues that lead to breakdowns, thus laying the groundwork for a more robust and efficient manufacturing process. In this context, the study underscores the strategic significance of AM in not only rectifying existing problems but also in preventing future disruptions. The crux of this investigation centers on Step 4 of AM, which shifts the focus from restoration to the sustained maintenance of gains achieved in the preceding steps. This step is crucial for ensuring the longevity of improvements and for establishing a proactive approach to maintenance. The study unfolds within the specific setting of a Detergent Manufacturing Plant operating within the Fast-Moving Consumer Goods (FMCG) category, offering a real-world context to the theoretical underpinnings of AM. The research scrutinizes the implementation of Step 4 at the Detergent Manufacturing Plant, elucidating the methodologies employed, challenges encountered, and outcomes realized in the ongoing pursuit of minimizing costly breakdowns. By delving into the intricacies of this implementation, the study seeks to provide nuanced insights into the practical implications and effectiveness of sustaining gains in the manufacturing process through the systematic application of AM principles. Anticipated outcomes of this case study include valuable lessons and best practices that can be extrapolated to benefit companies within the FMCG sector and beyond. As industries strive for operational excellence, the findings of this research are poised to offer actionable insights into the strategic deployment of Autonomous Maintenance for enhancing manufacturing competitiveness and reducing production-related losses.

Keywords: Autonomous Maintenance (AM); Total Productive Maintenance (TPM); Manufacturing process; Fast-Moving Consumer Goods (FMCG); Proactive maintenance

1. INTRODUCTION

Changes in how employees see and use company-wide equipment can lead to improved corporate business results as well as a more enjoyable and productive work environment. Within every TPM programme, AM is one of the most fundamental building components. The official separation of operations and maintenance occurred after preventative maintenance was brought to Japan from America. Employees eventually lost the sense of personal responsibility that came with operating and maintaining their machinery. This propensity is countered by TPM's autonomous maintenance processes. In order to slow down forced degradation, manage contamination, and guard against equipment issues, operators engage in routine maintenance and improvement tasks. Usually carried out in stages, autonomous maintenance (AM) operations are only successful when the flow from one stage to the next is closely regulated. Perform audits following each stage in order to control this; the FM should complete the final audit and grant approval for the subsequent phase. Why is strict control so crucial? For instance, preliminary cleaning (Step-1) entails considerably greater than just sanitising and cleaning the surrounding surfaces and machinery. It will be impossible to eradicate and manage degradation if team efforts are not concentrated on recognizing and addressing issues discovered during cleaning. Likewise, weather conditions such as rain, snow, and salt spray may erode the foundations of the plant and damage its machinery, contingent upon its position. Products that disperse, leak, obstruct, and so on can also push equipment to deteriorate. Typical examples of these products are solids, gases, powders, liquids, and furthermore. The climate, the tools, or the nature of the product will all have an impact on how such degradation is handled. However, the programme will regress to step-1 or even lower if step-2 of AM—action targeting pollution sources and inaccessible places—is not carried out correctly. Implementing autonomous maintenance successfully requires step-by-step auditing of team actions to maintain correct focus.

1.2 The Need for Autonomous Maintenance

In ancient times, factory workers had the responsibility of regularly inspecting and repairing machinery to ensure it continued functioning smoothly. Different companies had different rules, but most wanted operators to completely clean and fix equipment like pumps. Overall, plants did a lot of maintenance on their own. Improvements in computer technology are making it easier for machines to operate on their own without human help. A significant challenge is the extensive maintenance required to support all the sensors essential for automation. Furthermore, process industries must address challenges such as leaks, spills, and blockages.

The people who know the workplace best (the operators) are the best ones to solve these problems, so there's a growing need for them to be able to do maintenance on their own. In today's environment, the production and maintenance departments frequently have hostile interactions. When machines break and work can't be done, the production department gets really upset. They say the people who fix the machines don't know what they're doing, and it takes a long time to get them working again. They also say the machines are too old and that's why they keep breaking. Then the people who take care of fixing things say they don't have time to do important daily inspections. Meanwhile, the maintenance department criticizes the production team: "We prepare the standards, but they don't do the checks", they don't know how to operate their equipment properly", or they don't lubricate their machines. The maintenance department excuses its own failings by claiming it has too many repairs and not enough people to do them. Finally, it plays its trump card: We want to do major overhauling, but we don't have the money for it. With these attitudes on both sides, there is no way the goal of good maintenance – detecting and dealing with equipment abnormalities promptly – can ever be achieved. The production department must abandon the "I make & you fix mind set". They have to assume ownership of their own equipment and take responsibility for preventing deterioration. Only then can the maintenance department properly carry out the specialized maintenance techniques that ensure effective maintenance. Both departments must clearly define and agree to their respective roles and remove any barriers through mutual understanding and support. They must integrate their efforts until they stand like the two sides of a coin. This is the only way to create a failure – free, trouble-free workplace.

1.3 The Goals of Autonomous Maintenance Study

The primary responsibility of the production department is to create high-quality products efficiently and cost-effectively. One of the most important things it does is find and fix problems with equipment quickly, which is the aim of good maintenance. AM encompasses all tasks carried out by the production team to maintain the plant's smooth and efficient operation for the planned production.

- ◆ Maintaining proper functioning and frequent inspections can help prevent equipment damage.
- ◆ Restore and properly maintain equipment to return it to optimal condition.
- ◆ Identify the fundamental requirements for maintaining equipment in good working order.
- ◆ Teach individuals how to think and operate differently by using the tools.

2. RESEARCH METHODOLOGY

Data collection: HUL-Chhindwara Detergent Factory

Methodology: Autonomous Maintenance

Statistical tool: WWBLA and PM analysis

2.1 Autonomous Maintenance Implementation Framework

AM is implemented in seven steps; one additional step is added to that i.e. step-0. Following are the steps of AM:

- | | | |
|----------------|--------------|--|
| ➤
-0 | Step | Safety |
| ➤
-1 | Step | Initial cleaning |
| ➤
-2 | Step | Eliminate sources of contamination and inaccessible areas. |
| ➤
-3 | Step | Establish cleaning and checking standards (Preparation of the tentative standards) |
| ➤
-4 | Step | Equipment general inspection |
| ➤
5 | Step- | General process inspection (Autonomous Inspection) |
| ➤
-6 | Step | Standardization |
| ➤
-7 | Step | Autonomous management (Practice full self-management) |

Step 1 to 3 is all about getting rid of things that make things break down faster, fixing things that are already broken, and keeping equipment in good shape. The aim of these steps is to make operators interested in their equipment and to change their self-image from just pushing buttons to being more skilled. In steps 4 and 5, the leaders of the team will show their team members how to check things carefully. The checking will go from just looking at the individual parts to looking at the entire process. The aim of these steps is to prevent mistakes and help operators better understand their equipment and process. Steps 6 and 7 are meant to make sure that maintenance is done well and to improve how things are done by making systems and methods standard and

including other areas, like stores and distribution. The main goal of these steps is to create a strong organization and culture where every workplace can manage itself well.

2.2 STEP -4 EQUIPMENT GENERAL INSPECTIONS

The initial steps of JH (Step 1, 2 & 3) are carried out to restore the basic condition (CLIT) of equipment and prevent deterioration. Till step 3 the operator uses his senses i.e. look, listen, feel to check the equipment condition. The objective of step 4 is to enhance operator’s awareness through inspection points to further stabilize the results gained by implementing all the initial three steps. Also, the goal of this step is to transform operator into engineer level. Initially utilizing a general inspection handbook developed by the circle leader, an officer, the circle participants get instruction in these inspection techniques (one inspection category at a time). Team members collaborate to focus on issues found during the overall equipment examination. Training for general equipment inspections must be conducted one area at a time, starting with skill development. Its efficacy is verified by audits and strengthened by further instruction and real-world use. For every inspection category, this cycle of application, auditing, training, and adjustment is carried out once more. Since every operator needs to learn how to recognize irregularities, Step 4 takes over a year to finish. The first three steps of JH focus on meeting basic requirements, therefore efforts at this early stage may not always show dramatic results. By the end of step 4, however, the unit should see amazing changes, such as an 80% reduction in equipment failure or an overall equipment effectiveness rate of over 80%. If results have not appeared by this time, the skills taught in the early steps probably have not been mastered. It may also indicate a generally low level of technical expertise. If this is the case, it is better to start over and begin by working to raise the technical level.

2.2.1 MASTER PLAN

The circle leader (Officer) after discussing with the circle members and engineering team should prepare a detail master plan for all the activities involved in implementing step 4. The activity must have a definite time frame for completion and it should be monitored on a regular basis. Following table shows a detail master plan prepared for implementing step 4.

Table 1: Master plan for Implementing Step 4

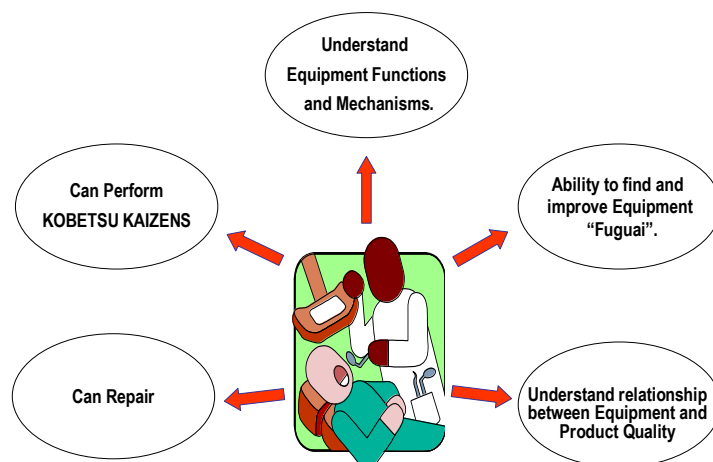
ITEM	JQ'99	SQ'99	DQ'99	MQ'00	JQ'00	SQ'00	DQ'00	MQ'01	JQ'01
IDENTIFICATION OF SUBJECTS	● →	▽							
PREPARATION OF TRAINING MATERIAL	● →		▽						
CONDUCTING BASIC TRAINING		● →			▽				
IMPLEMENTING ON MODEL MACHINE			● →				▽		
PREPARATION OF FUGAI LIST			● →				▽		
INSPECTION SKILL CHECKS					● →		▽		
AUDIT						● →		▽	
ROLL OUT ON ALL M/Cs							● →		▽
○ START	▽	FINISH		→ PLAN			→ ACTUAL		

2.2.2 GOALS OF STEP-4

Table 2: Steps of JH

Activities	Hardware Goals	Human Goals	Roles of managers & Officers
<p>Teach inspection skills using inspection manuals as a guide.</p> <p>Perform a general examination on each piece of equipment to ensure it is in optimal condition.</p> <p>Make equipment modifications to make inspection easier. Frequently utilize VCs</p>	<p>Improve reliability by performing general inspection and reversing deterioration for each equipment category (nuts & bolts, drive systems, etc)</p> <p>Enable anyone to inspect reliably by introducing VCs such as V-belt specification displays, lubricant type and quantity displays, operating range plays on gauges, valve on-off indicators, rotation direction indicators etc.</p>	<p>Learn equipment structure, functions, and assessment criteria and master checking skills through hands –on checking training</p> <p>Learn to deal with equipment abnormalities through on –the spot practice</p> <p>Let people understand the usefulness of data by collecting general inspection data</p>	<p>Create troubleshooting case studies and general examination guides, and instruct circle participants on inspection techniques.</p> <p>Draw up inspection schedules</p> <p>Give on the spot training in simple methods of rectifying abnormalities</p> <p>Give guidance in improving visual controls</p> <p>Involve circle members in maintenance planning</p>

The operators are required to have a strong ability to perform the following in operating and adjusting equipment correctly:



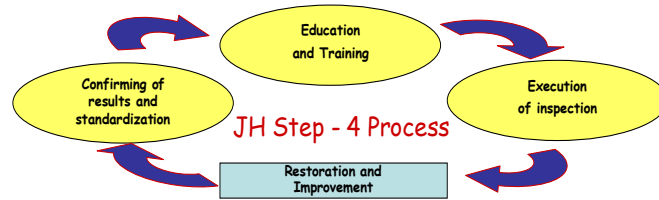
2.3 Preparing for Equipment General Inspection Training

General Inspection of Equipment Training includes exposing participants to a range of equipment kinds, establishing precise goals for the development of skills, and offering comprehensive general inspection guides. Theoretical principles are reinforced by practical, hands-on workshops that may be offered in a Technical Training Centre (TTC). The training emphasizes cooperation and instills a continuous improvement mentality in order to enable operators to achieve engineer-level competency in inspections. Through the integration of assessment and feedback mechanisms and the connection of training to organizational goals, such as long-term success and competitive advantage, businesses can guarantee that their personnel are adequately equipped to maintain equipment effectively and contribute to overall operational excellence.

Select general inspection items: First identify what operator needs to be taught in order to operate their equipment correctly and what they are required to inspect. To select the inspection items most appropriate to the particular workplace, consider the equipment’s design specifications and frequency of problems such as failures and defects. Always include general purpose equipment such as valves, pumps, and fans, along with the equipment’s basic functional elements (nuts, bolts, lubrication systems, drive systems, pneumatics, hydraulics, electrical systems, instrumentation, and so on.)

Prepare material for training: List down all the items that are required to be checked by the operators using their five senses, and summarize them into general inspection check sheet. Decide what operator needs to be learnt so that he is able to carry out the checks. For educating the operators, the officer (responsible for that circle) must prepare general inspection manuals by involving the technicians and engineering officer. This manual should list and describe the basic functions and structure of the equipment to be inspected, its components with their names and functions, pass – fail criteria, inspection procedures and action to take when abnormalities are discovered.

APPROACH (EQUIPMENT GENERAL INSPECTION



IMPLEMENTATION STEPS (EQUIPMENT GENERAL INSPECTION

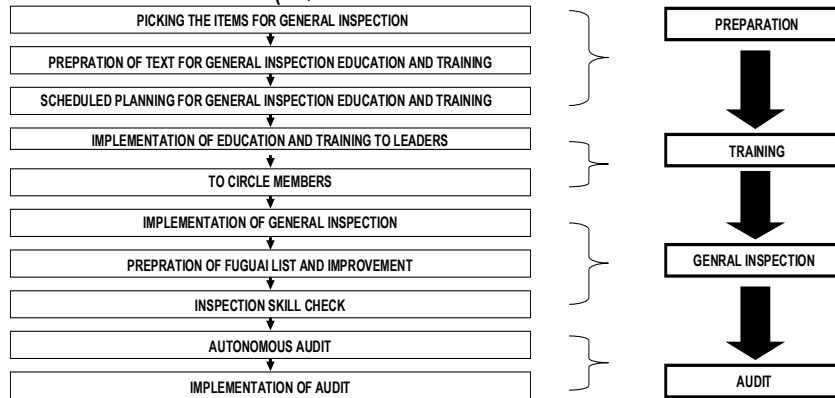


Figure 2: General Inspection Testing

The manuals alone are not sufficient enough to train the operators fully, a technical training center (TTC) must be set up inside the factory and various models, cut sections, wall charts, flow diagram, actual sample of worn shafts, dirty oil, working models and so on, related to the eight training subjects must provide in the TTC.

2.4 Subjects for General Inspection Education and Training

The subject for general inspection education & training is based on the type of plant and equipment unit is having. The systems and mechanisms used in the equipment must be checked and list should be prepared. Typically, in our company all the plants and equipment fall under the following listed eight subjects:

- Drive System
- Pneumatic System
- Hydraulic System
- Electrical System
- Machining Condition
- Lubrication System
- Fasteners
- Safety

Prepare training calendar equipment wise for the equipment which has cleared step3 audit. All the circle members should be imparted training with respect to the eight subjects specific to their equipment. As mentioned earlier training should be conducted category wise (subject wise) by using working models, cut section, actual parts/components, manuals, OPIs , know why sheets, general inspection sheets (prepared in house), video taps, flow charts and system diagrams. After completing the training that particular section of the equipment must be opened and the circle members should be asked to identify the abnormalities and tag them. During the process of inspection the circle members will come out with the checks required to keep that section healthy. The tags attached should be attended then and there if possible; otherwise it must be corrected on the coming maintenance day. Sufficient number of OPLs and know why sheets will generate during the process of inspection. Engineering team should be involved in the entire process of step 4, infect the engineering

officers must take a lead role in imparting training to the operators to promptly identify and correct the deterioration by carrying out vital checks.

Once this activity is through, the same procedure should be repeated for the next subject. At the end a written test needs to be conducted for all the subjects for all the circle members in local language, any member scoring less than 50% should be retrained. Photographs of the circle members who have cleared the test should be displayed in TTC and on shop floor. A simple training calendar of step 4 is shown below:

TRAINING CALANDER FOR 2005												
	Subject	Subject							Training Aids Used	Location	Month	
		Fasteners	Lubrication	Transmission	Pneumatics	Hydraulics	Electrical	Safety				
Equipment	HSQ Wrapping M/C	✓	✓	✓	✓		✓	✓	▲▼	TTC	Jan-05	
	Metal Detector	✓		✓	✓		✓	✓	▲		Feb-05	
	Autostamper	✓	✓	✓	✓		✓	✓	■▲		Mar-05	
	Plidders	✓	✓				✓	✓	◆▲		Apr-05	
	Multiscrew	✓	✓	✓			✓	✓	▲■		May-05	
	Mixer	✓	✓	✓		✓	✓	✓	▲■		Jun-05	
	CLD Taping M/c	✓	✓	✓	✓		✓	✓	▲		Jul-05	
	Nichrome M/C	✓	✓	✓	✓		✓	✓	▲▼		Aug-05	
	PSM	✓	✓	✓	✓		✓	✓	▲		Sep-05	
	Bucket Elevator	✓	✓	✓			✓	✓	■▲		Oct-05	
Concretemixer	✓	✓	✓		✓	✓	✓	▲	Nov-05			
PHS Vibrofeeders	✓	✓	✓	✓		✓	✓	▲	Dec-05			
Training Aid												
Manual	▲	AFTER COMPLETING THE TRAINING PUT THE PHOTOGRAPH OF THE OPERATOR IN TTC AND NEAR THE MACHINE										
Cut Section	▼											
Working Models	■											
CD's	◆											

Figure 3: Training Calendar for 2005

2.5 Training Facilities In Ttc - Technical Training Center

A good TTC is equipped with following training aids:

- Equipment manuals
- OPLs
- General inspection sheets
- Video taps/CDs
- Working models
- Cutaway models
- Flow charts
- System diagram

2.5.1 TTC View (Technical Training Center)



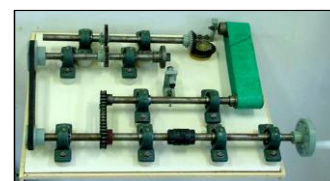
TECHNICAL TRAINING CENTER



Model Mechanical - Pipe Fittings



Model Mechanical - Fasteners



Model Mechanical - Drives

Figure 4: Technical Training Center

The Figure 4 indicates a variety of instructive mechanical models in a technical training facility. For educational purposes, a variety of mechanical parts, such as pipes and gears, are arranged on the tables.

2.5.2 Cut Sections & Models



Model Mechanical - Gear



Model Electrical - Star-delta Starter



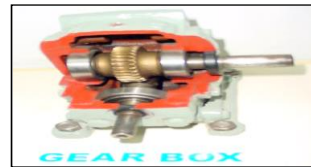
Model Mechanical - HSQ Assembly Units



Model Cut Sections - Mechanical Equipment



Black Treasure



Cut Section Mechanical - Gear Box



Cut Section Mechanical - FRL Unit



Cut Section Electrical - Motor



Abnormality Display Board - Chain & Belt Drive

Figure 5: Cut sections and Models

2.5.3 Working Models



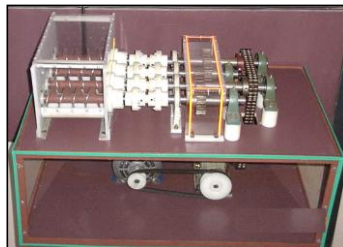
Models Mechanical - Bucket Elevator



Model Mechanical - Nichrome Laminate Feeding



WORKING MODEL OF SIGMA MIXER



WORKING MODEL OF MULTI SCREW



PLOUGHSHEAR MIXER

Figure 6: Working Models

2.5.4 Sample of Manuals & OPLs

SAMPLE OF MANUALS



ONE POINT LESSONS

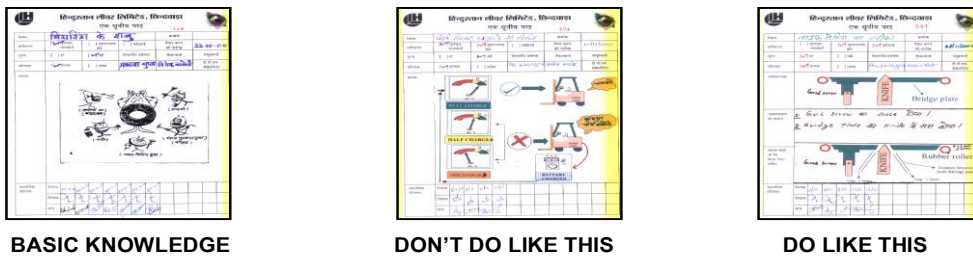


Figure 7: Sample of manuals & OPLs

2.5.5 Sample of General Inspection Sheet

GENERAL INSPECTION SHEET STEP - 4		PART : Spur Gear	
<p>General inspection points :</p> <ul style="list-style-type: none"> •Check for looseness in key. If found loose report to maintenance. चाभी का ढीलापन चेक करें, यदि चाभी ढीली हो तो मरम्मत विभाग को सूचित करें । •Check for wear and tear on teeth. गियर के दंतों का घिसाव एवं क्षरण चेक करें । •Check proper greasing between gears. गियर के बीच में उचित ग्रीसिंग को चेक करें । •Check for any abnormal sound. किसी भी प्रकार की असामान्य आवाज को चेक करें । 			
		<p>Fig. 26-b. Gear or toothed wheel.</p>	
		<p>Fig. 26-c. Terms used in gears.</p>	

Figure 7: Generation inspection Sheet

3.1 MECHANISM FOR CARRYING OUT GENERAL INSPECTION

Select a machine which has completed step3 audit, typically a model machine. Divide the machine into 4-5 critical sections. List down the subjects (out of eight subjects) applicable to each section and prepare a matrix. Having done the listing, collect all the details in the form of training aids. Impart training to the circle members one subject at a time and open that section complete for carrying out general inspection, list the abnormalities as written above and repeat the process for next subject. Do not forget to involve fitters & electricians in the process. Once the step 4 activity is completed, the step 3 check sheet would under go revision. In the new check list which is called step 4 check sheet, the critical check points related to eight subjects would be added which was not know to the operators during step 3. As a result of new check points the CLIT timing would go up by 50%. This new check sheet must be prepared involving the team who are going to operate that particular equipment.

3.2 DIFFERENT SECTIONS OF HSQ WRAPPING MACHINE

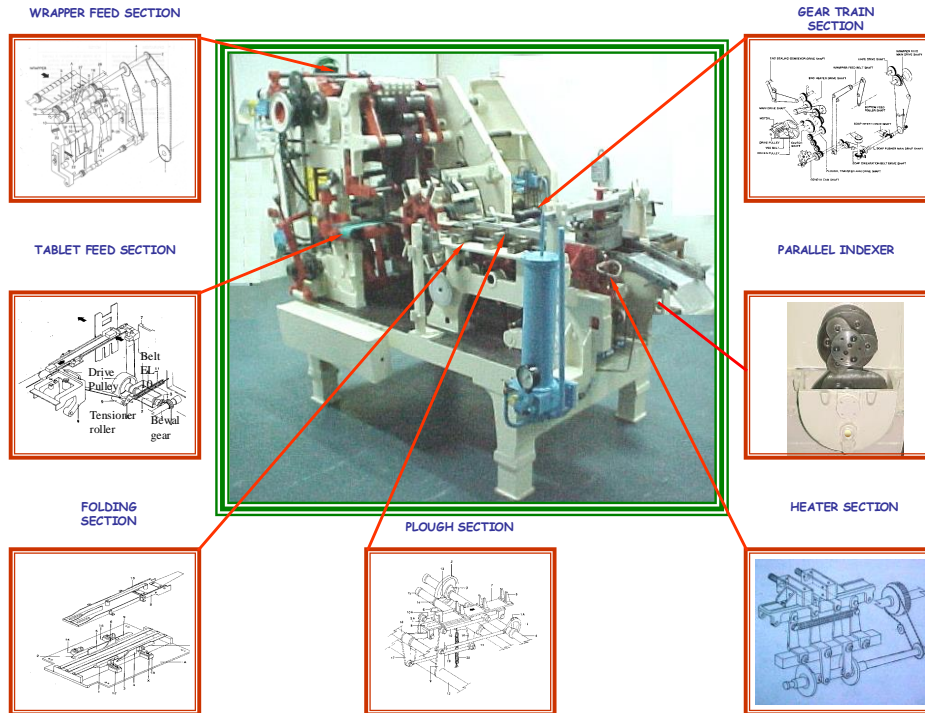


Figure 8: Different Section of HSQ wrapping Machines

3.3 VARIOUS SUBJECTS OF HSQ WRAPPING MACHINE

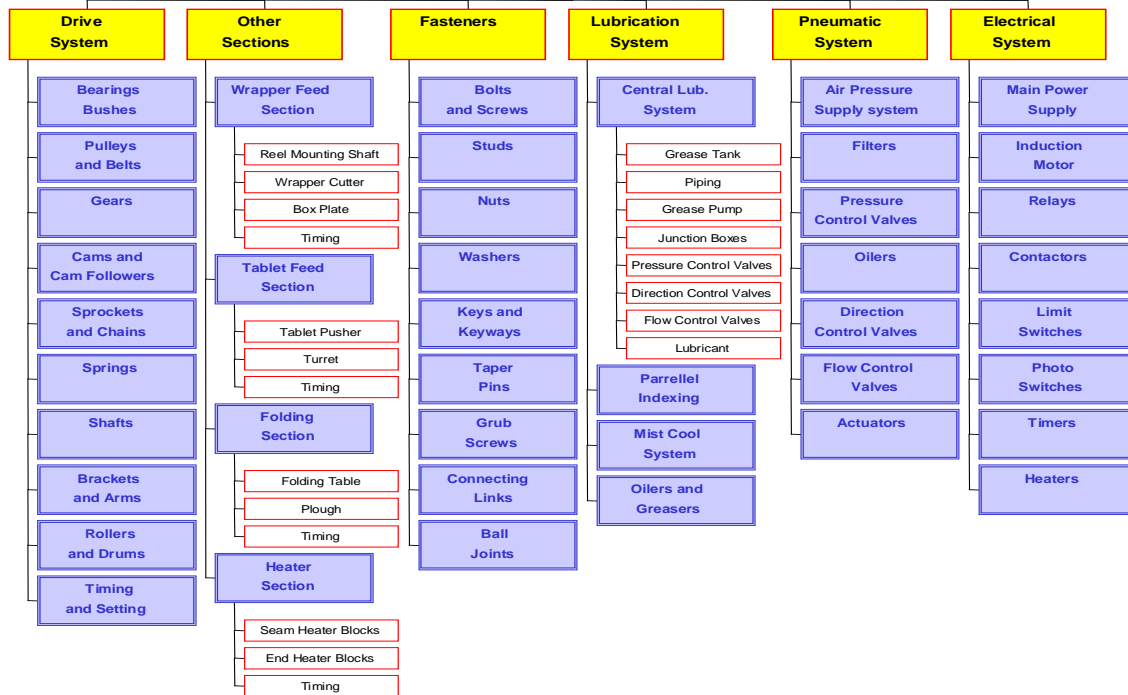


Figure 9: Subjects o HSQ wrapping Machine

3.4 LUBRICATION SYSTEM FLOW

System diagrams like, lubrication flow diagram, wrapper flow diagram, tablet flow diagram, mechanisms of the machine etc needs to be made for educating the operators. The below figure shoes lubrication system flow diagram of HSQ wrapping machine.

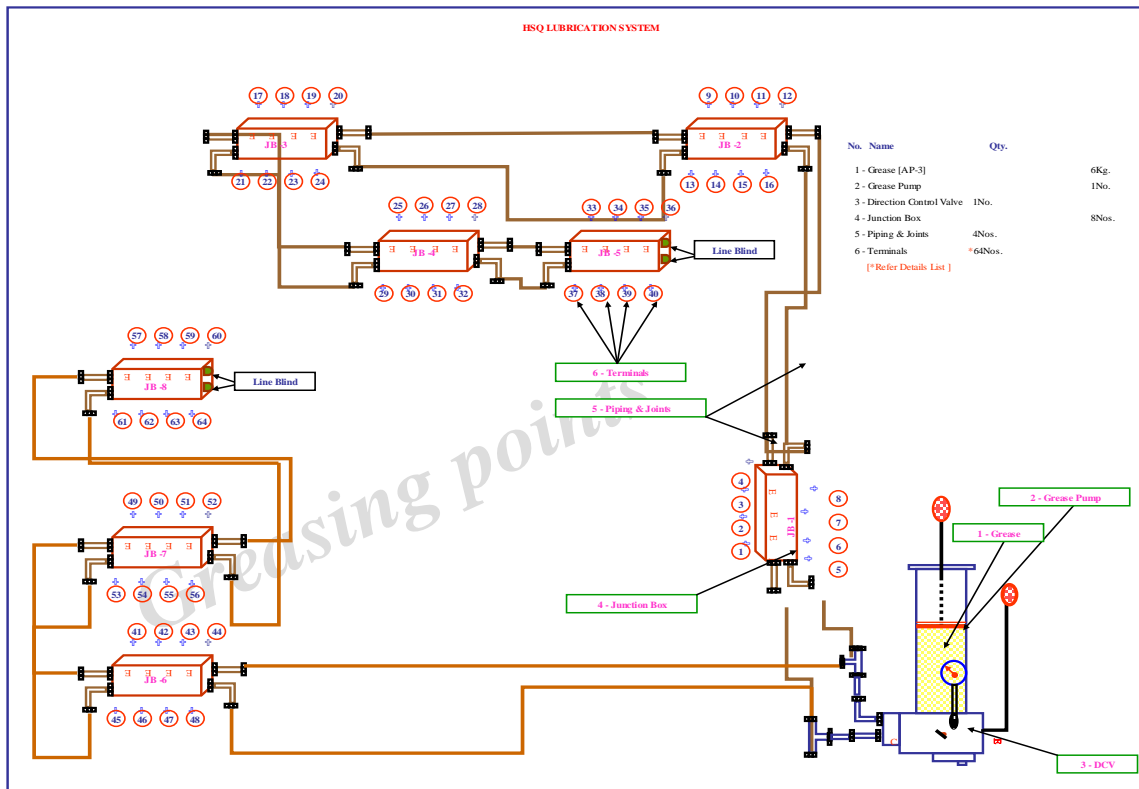


Figure 10: Flow diagram of Lubrication System

3.5 Know WHY SHEET

Know why sheet is a specific, focused, to the point training module. It emphasis more on the “KNOW WHY” aspect of the training. It is slightly in more detail, and elaborates the technical specification of the subject. As mentioned earlier know why sheet is prepared for educating the people w.r.t any specific problem which has occurred in future or may likely to happen which can result in serious breakdown, quality defects or unsafe condition. It explains the procedure to anticipate and avoid the problem in advance or to handle the problem in case if it has happened. As the name indicates “know why” explains the operator about the technical know how of that particular part/component and makes him understand why it is important, means if he doesn’t follows it what consequence is going to happen in terms of breakdown, quality defects or safety. Before preparing know why sheet for any equipment (equipment which are in step 4) prepare part problem matrix. Part problem matrix is a simple matrix where in the left hand column indicates the guide word and the top row indicates the part name. According to the guide word, categories the parts into red, blue and green. Red stands for failure happened before, blue stands for failure may happen in future and green, failure will not happen in future. These are all based on actual data and little bit of prediction. The part problem matrix becomes basis for preparation of know why sheet for the parts/component which are in the red and blue zone. Below table shows a sample part problem matrix and know why sheet.

Overall Inspection, Jishu Hozen Step - 4						
Part Problem Matrix						
Process Bars	Equipment : HSQ Wrapping Machine	Section : End Heater			Circle : 4	Date : 05.08.00
Problem		Part Name :				
Category	Name	Cam & Balancing Lever bush wear off	Cam and Balancing lever pin wear off	Housing bracket nut wear off	Heater Housing grub screw wear off	
	Broken	●	●	●	●	
	Stuck	●	●	●	●	
	Crack	●	●	●	●	
	Chipping	●	●	●	●	
	Shift	●	●	●	●	
	Heater shift	●	●	●	●	
	Tablet damage	●	●	●	●	
	Open end seal	●	●	●	●	
	Wrinkle on end seal	●	●	●	●	
	Poor end seal	●	●	●	●	
2 Categories, Machine & Product		● RED Happened before		● BLUE May happen in future		● GREEN Will not happen

Figure 11: Part problem matrix

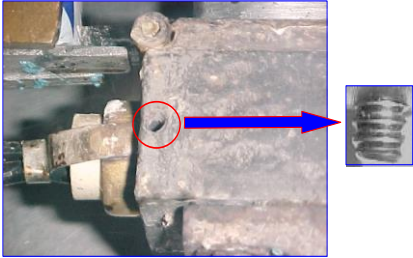
Overall Inspection , Jishu Hozen Step - 4											
Know-why Sheet											
Process	Section	Assembly Name	Component Name/No.	Part Name	Confirmed by	Prepared by	Date of preparation	Revision			
Bars	Heater	End Heater	Housing blocks 20 , 21	Grub Screw	A Rustagi	R.B.Waghole	05.08.2000	0			
Structural diagram (Disassembly diagram)				Basic function of this part :							
				Name : Grub Screw							
				Specifications : OPL No. 17, (5/16 " X 5/16 ")							
				Function : To hold the heater in position							
No.	Inspection Item	Inspection Method	Criteria / Standard	Action if found problem	Who	OPL No.	KNOW - WHY				
1	1.1 Heater housing block screw (Grub Screw)	1.2 Visual inspection	1.3 Heater should not vibrate or shift from its position. Tight fit.	1.4 Stop the Machine	Operator	EHSA/17	Screw threads / tip wear off				
				1.4.1 Open the grub screw			Loosening of heater in bore				
		1.4.2 Inspect the threads and grubbing tip				Vibration of heater					
						Shifting	Damage of heater				
		1.4.3 Replace if found damaged				Coming Out	Element broken				
						No heating of plates					
						End seal open					

Figure 12: Know why sheet

4.1 Process Point Analysis

Process point analysis is a tool to find out critical component called “Q” component which plays vital role in delivering flawless product. Process point analysis is carried out for various processing point in the equipment. For identifying the processing point, detail sketch of the equipment needs to be prepared as shown in the given figure. In the equipment wherever the product and processing aid like detergent tablet and wrapper are coming in contact with the various parts and the point where the form of the product and processing aids are changing that point is called processing point (PP). A machine can have numbers of PP; each and every processing point should be assign a particular number and process point analysis should be done to find out the “Q” component. The concept of QC/QA is becoming obsolete day by day since these two systems focuses more on analysis after commencement of the production, however these two systems holds good for collecting the data to find out the reasons of deviation for taking corrective action, but the new concept quality maintenance (QM) emphasis on fixing the condition of “Q” component in such a way that it doesn’t generates defective products. Fixing of “Q” component means setting the parameters of the components/parts which are directly adding value in terms of quality with respect to the dimension of parts, profile of parts, condition of parts, parameters like temperature, pressure, vacuum etc. PPA is carried out under three categories:

- System that maintains the continuity of the processing point.
- System that positions the processing point.
- System that forms the processing point.

Once the process point analysis is through to identify the “Q” component, prepare know why sheets to train the operators, hence PPA also becomes basis for preparation of know why sheets. Following figure shows various process points of HSQ wrapping machine and sample PPA of end heater section.

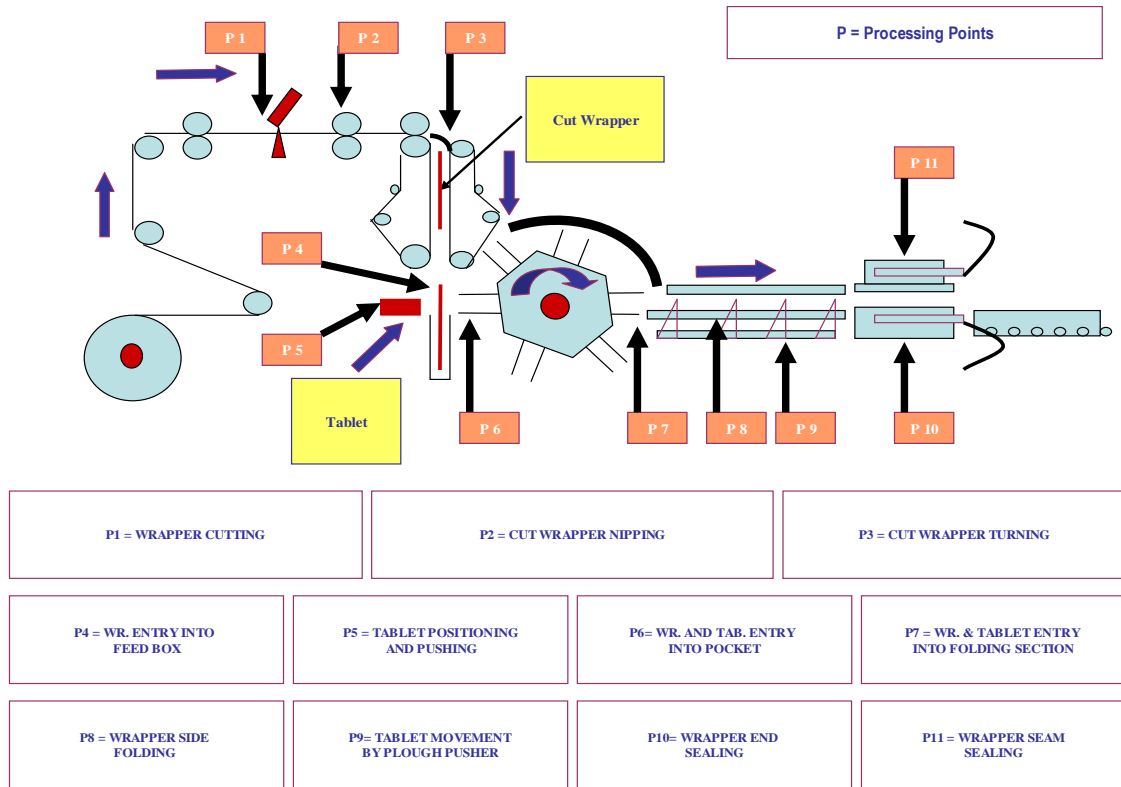


Figure 13: Architecture of wrapping machine

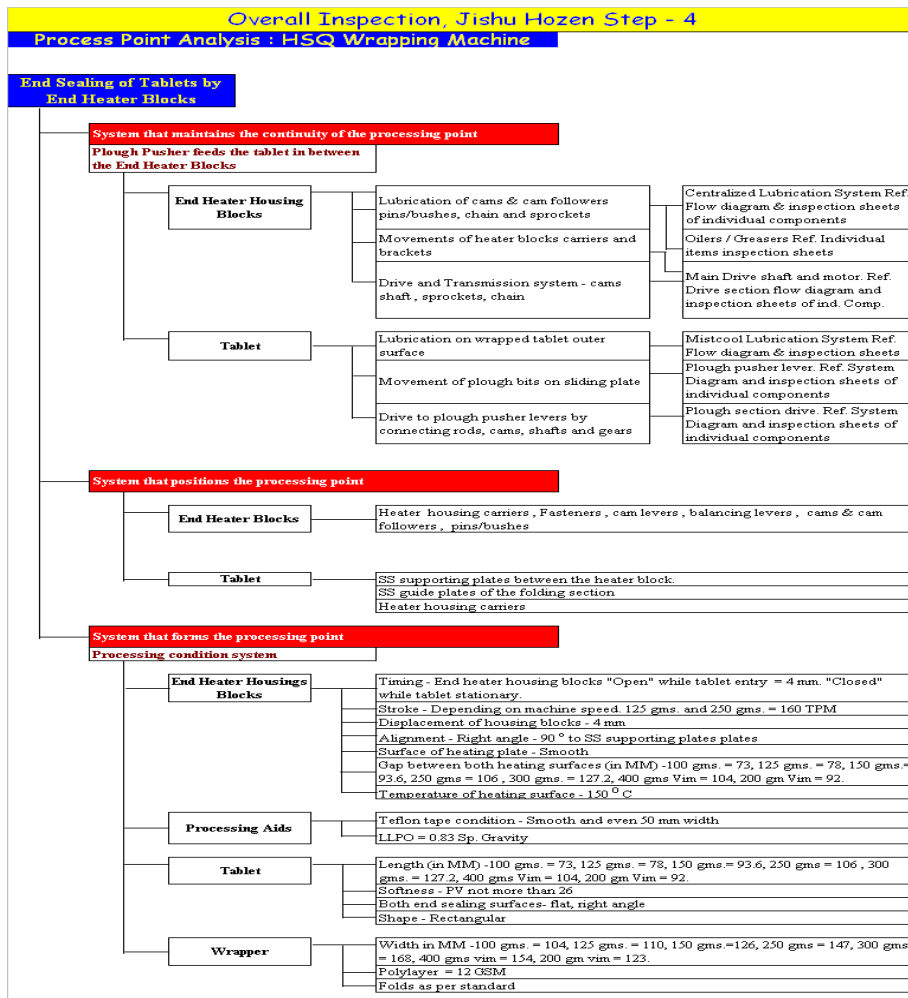


Figure 14: Process point analysis

Step 4 mainly focuses on imparting knowledge & skill to the operators with respect to all the eight subjects. The audit sheet of step 4 talks about evaluation of knowledge and skill level of operators about the eight subjects. In this step as the operator learns more & more about the eight subjects, he develops certain skills to check the critical points w.r.t all the subjects, therefore the checking time (CLIT) goes up (normally 25 – 30 Mins) after implementation of step 4. In step 4 all the four pillar, JH, PM, HH, and E&T should work together to achieve the objective of step 4. The success of step 4 lies in the proper co-ordination and understanding of these four pillars. As mentioned earlier without proper implementation of step 4 the back bone of TPM activity i.e. JH cannot be sustained.

MERGER ACTIVITY OF 4 PILLAR

Activities of AM , PM and HH Pillar merged after imparting training with the help of Education and Training pillar on various quality parameters.

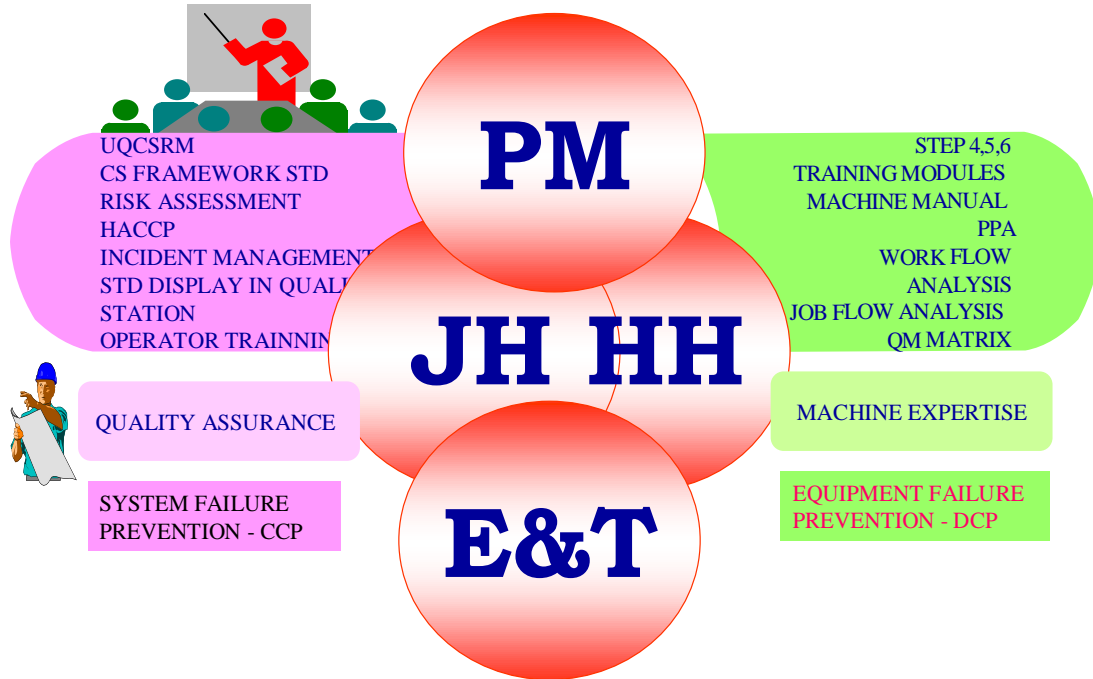


Figure 15: merger activity of 4 pillars

5. Interpretation and Analysis

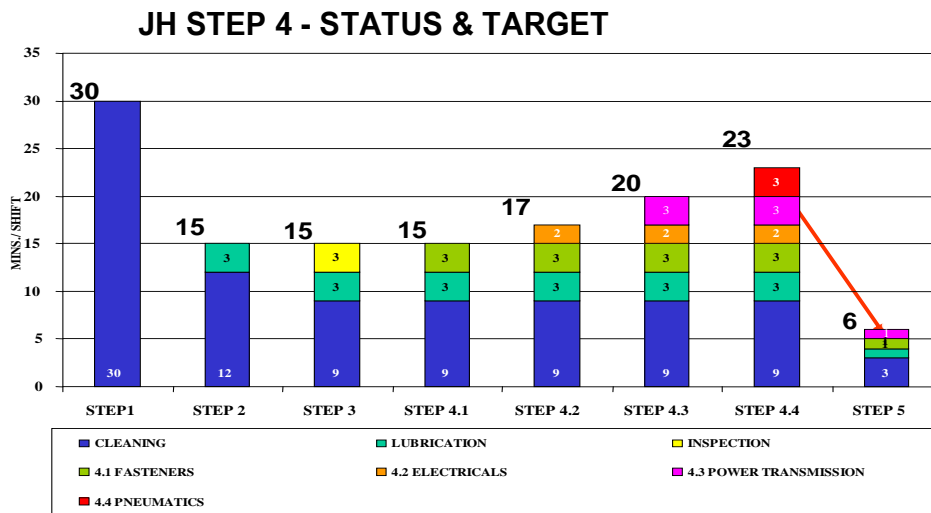


Figure 16: Status and Target

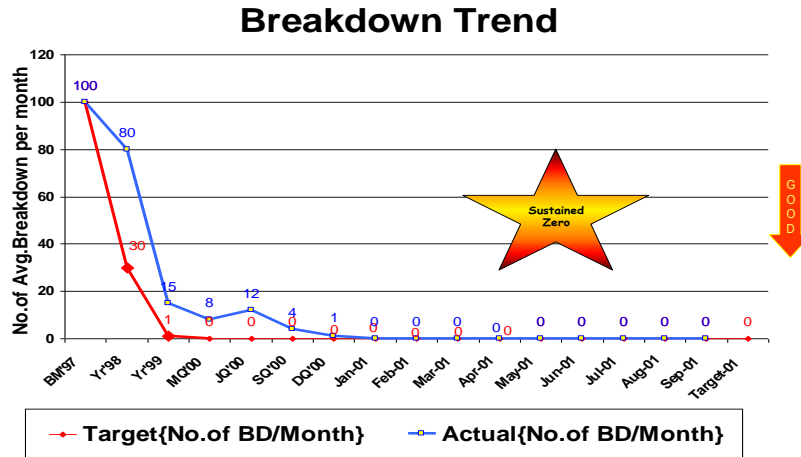


Figure 17: Breakdown Trend

Step 4 Audit Outcome

AUDIT SHEET (All Subjects) : STEP - 4

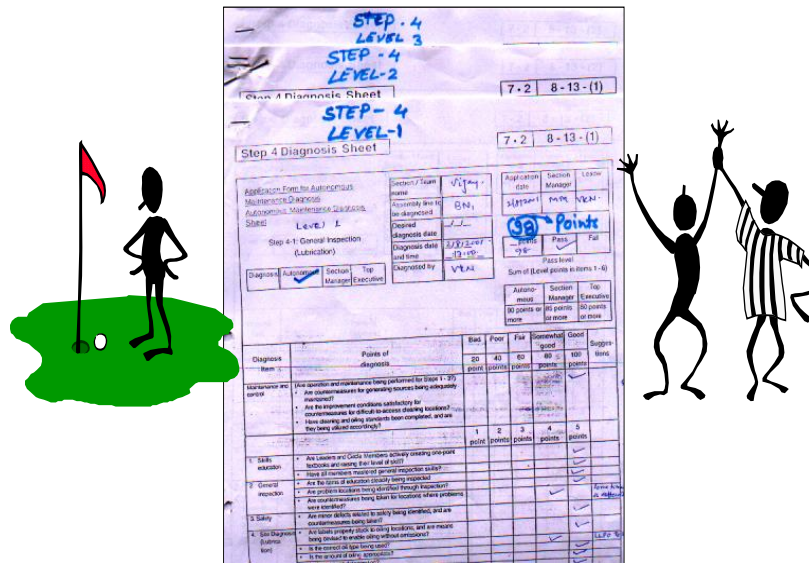
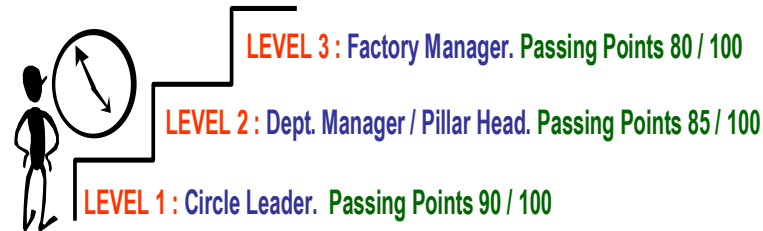


Figure 18: Three Level Audit Sheet

6. Conclusion

The integration of Jishu Hozen (JH) and Autonomous Maintenance (AM) not only emphasizes the critical role that operators play in maintaining equipment, but it also represents a shift in operators' roles from simple restoration work to engineer-level proficiency. The first stages of these approaches concentrate on getting things back to normal, while the later stages enable operators to become more technically proficient. Comprehensive general inspection guides and practical training offered by a specialized Technical Training Centre (TTC) aid in this advancement. The development of a collaborative culture is essential to the success of this strategy. Operator freedom and quality are fostered by this collaborative culture, which paves the way for long-term manufacturing success. The plan makes sure that the company not only has the knowledge and abilities needed to handle problems right away, but also fosters a culture of mastery and constant progress. As

a consequence, via increased operational efficiency and decreased downtime, the organization gets a competitive edge. Long-term manufacturing performance is influenced by the development of a strong maintenance culture and the investment in operator training. The result is not simply a piece of well-maintained machinery but also a strong, flexible company ready to face obstacles and adjust to changes in the ever-changing industrial environment. When combined with Autonomous Maintenance and Jishu Hozen, together with efficient training methods and a cooperative culture, the result is a synergy that spurs organizational expansion. This plan acts as a road map for businesses hoping to attain and maintain manufacturing process excellence, guaranteeing a competitive and future-ready enterprise.

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