Planned Maintenance

Gearing Towards A Pro-Active Maintenance System

Table of Contents

Preface

Most industries today perform their maintenance on a firefighting or reactive mode, fix when it fails syndrome, others called this the “Bandaid Therapy.” This generation of maintenance evolved during the 1940’s way before the Japanese bombed Pearl Harbor. Equipment’s at that time were simple hence this type of maintenance does not seem to make an effect on production at all. But as time passed by, more and more developments had been made, equipment’s are highly modernize and automated to perform the task required, but still most Maintenance Managers can’t seem to get away from the concept of Reactive Maintenance. Most companies hire and look for maintenance people with adequate experience of the equipment and not on the systems of maintenance, that’s why there are only few people with such understanding of the maintenance system.

Maybe you had been using the concept of Preventive Maintenance and have standards set forth and followed overhauling or replacing some parts on a specific set of time indicated in the equipment’s manual, and from time to time with your customers visiting your plant finding some loopholes in your system try to add a couple of lists in your maintenance tasks, and you have 20 customers, hence before your maintenance lists only compose of 10 activities now it’s up to 100. My question is does increasing the activities of maintenance task ensures a higher reliability of your equipment or it’s the other way around ? Perhaps doing more maintenance on an equipment will do you more harm than good in the long run.

I have studied and trained on TPM Methodology, RCM2 by John Moubray and implemented a prototype team in one of our divisions, and after exhausting meetings we finally arrived with a comprehensive indebt and true maintenance task that must be performed on their equipments, and this were product of continuous brainstorming of the most experience people in their field which the team composed of. The team had been stunned by their final report which minimize their activities by at least 100 inspections, so when we set the time for it to implement the new system, the team were somewhat afraid, and implementation had been delayed. Later on I found out that most of the inspection items listed in their maintenance tasks came from their customers and included in their maintenance standards or specs during customer audit. I tried to talk to their superior, and finally after exhausting hours of explaining to them that this is a more reliable maintenance task, they agree, but said that they can’t remove the old task so they will do them both simultaneously. This is like disposing your garbage and after doing it, you again put some more garbage. finally, I told their boss and the team if your not going to perform what you know is right, then you make your choice., The RCM data had been completed but never implemented in their division it’s in one of the drawers of the team and maybe it will stay there until it become some scratch paper in the future.

Preface

Some lessons learned is that when making some changes in your maintenance task be sure to have the guts to back it up since you might be facing some walls in front of you. I am referring here to customers, equipment vendors, Quality teams where they will penalize you if you don't perform this task which is included in the standards, be sure that the standards will be changed and these people must be educated on the new system, I believe that increasing the number of maintenance task will not actually lead you to a more better reliable equipment but it's the other way around.

It is not easy to change a maintenance system that had been in your company for many years, but it is possible for every company to transform from a reactive to a proactive stage, and this is the objective of this book. I have detailed every step so you can follow them thoroughly. Let us face the facts about your system of maintenance so we can learn from them. Many companies are struggling to survive together with their competition, maintenance is one big factor where the company can save on cost if one has sufficient knowledge to convert their maintenance task into a proactive one. I do not meant here on cutting maintenance cost where Maintenance Manager disapproves all P.R. (Purchase Order) of parts needed for a monthly Preventive Maintenance.

There is no such thing as overnight success or one day transformation, it will take you several months and years of achieving a world class maintenance system so you can stay competitive in your arena.

Your greatest investment here will be time, but I guarantee that this will pay you off by reducing your cost in maintenance. Make these changes now, not because you can sleep soundly at night without your phone ringing and asking you to report to your plant due to unexpected breakdowns but because every company that exists are on a survival mode. Millions of dollars can be saved and avoided on maintenance by adopting a change in your system of maintenance some investments had to be made and this is not where you should cut on costs. The first step in every change is getting yourself educated, and attending trainings.

Having a good maintenance system is not about having the best maintenance software in town that can automate your task, print them and have the lists on what your going to do. This is about how spare parts behave and understanding them so you can determine the most appropriate maintenance task for that part. This is about learning the basics and addressing basic equipment condition which had been neglected These basic equipment condition includes cleaning, lubricating, bolting yet when you check your own equipment, how many bolts are missing or not the same due to the number of times it had been repaired, overhauled or undergone Preventive Maintenance Schedule. Perform the basic first before you can advance to any improvement program.

So the question of what is the best maintenance system to adopt, the answer is doing the 4 Phases of Planned Maintenance :

- Phase 1 : Stabilize MTBF – Establishing the Need For A Basic Equipment Condition
- Phase 2 : Lengthening Equipment Lifetime – Addressing Design Weaknesses
- Phase 3 : Knowing when to use the different Maintenance Tasks on Hand
- Phase 4 : Using Predictive Maintenance Technology

A Typical Day With Operations

Perhaps you had been called late at night to come back to the plant due to some failures the maintenance can't handle, you came to the plant at about 3:00 am and it took you about a couple of hours to get the equipment running, it's 5:00 am now in the morning and it will take you a couple of hours to go home so you decided to stay on the plant looking exhausted, your maintenance manager shakes your hand and asked you how you'd fixed it, chat with you over a cup of coffee.

Another typical experience is that production needs to deliver x output for the day then suddenly, a major equipment fails, now maintenance is called to do the repair. You have not experience this fault or failure before, and soon hours is passing by but still you can't fix the problem. The operation manager is now worried and stays in your back, he becomes impatient and soon tells you what to do, and after following him, the problem had been doubled. He starts to increase his voice , which creates a panic within you.

Or it had been a day when Machine no. 13 is due for a "Preventive Maintenance Overhaul", you had advise the operations on the said schedule through e-mail, but who cares, the time had come to finally shut down the equipment, but operations won't agree, finally in order to settle the feud, you get a waiver in your hand and let the operations sign it, in which the last part of the paragraph reads that whatever happens to this equipment, maintenance will not be held liable, you give the form and the operations manager place it in his upcoming files which is about 2 feet high,

Chapter 1

I Introduction on Planned Maintenance

I Introduction on Planned Maintenance

1.1 Understanding The Need For A Planned Maintenance System

In every industry there seems to be a misunderstanding between operations and maintenance people. The never ending saga of feuds between the production and maintenance people is evidently rampant where maintenance accuse the operations of flocking their equipments to death and when the machine is due for a Scheduled-Maintenance Overhaul, they endorse it to operations but it takes more than a shift to get it in running condition, and this time it's production turn to strike on their enemy. Does this exist in your company ? Don't worry, your not alone. Does the maintenance lack skills in performing their duties, or the system in place needs to be replaced.

Doing maintenance is a serious business since it can constitute to 3 to 50 % of production costs, and without a good system in place, not only can it be costly but might affect your company's survival as well. Some may advert to continuous improvement programs, modifications, purchasing the best maintenance software in town, benchmarking other companies, cost cutting programs, but mind you each of them have their own sets of limitation. Let me give you an example, in the company I previously work, there seems to be a battle of programs, more than a dozen programs exists, TPM was in place and modifications and improvements was done, but the team missed out something, a very important point, the product the equipment is capable of producing was going to be phase out in a couple of months, so as the machine. And after a couple of months, the machine was pulled out, crated and stocked. Thousands of dollars, in improvement cost were gone.

Developing a strategic maintenance system must be done 2 folds, both a short term and a long term plan. The long term is where most maintenance managers and people lack, it is not sufficiently enough that " We Stop The Bleeding Syndrome" neglecting the fact that possibility of other parts might be affected which can take a month or more to take effect. A good maintenance leader always sees this aspect in 2 ways, both the short term and the long term plan.

The sad fact is when we compare equipments 50 years ago nowadays, we can see a more complex, automated equipments, the change had been rapid, but the maintenance tasks performed most of the time had not change from a firefighting or reactive (fix when it broke) still to a firefighting or reactive mode. And when we speak of a strategic maintenance system that must be in place we must not only speak of lower cost and higher availability, but a maintenance perspective on the following basis must be in effect :

- Higher Plant Availability and Reliability
- Greater Safety
- Better product quality
- No damage to the environment
- Longer equipment life
- Greater cost effectiveness

Therefore, in a nutshell, when we speak of a system of maintenance that would be a dream for every Maintenance Managers which is to select the most appropriate techniques in order to deal with each type of failure process in order to fulfill all the expectation of the owners of their equipment, in the most cost effective maximizing it's total Life Cycle Cost with the active support and participation of both operations and maintenance together

Therefore, the concept and basic understanding of Planned Maintenance is essential, it is not a cure all for your equipment problems, however, when you have applied the steps involved, not only can you have a piece of mind where you can sleep at night without the maintenance shift supervisor calling you early in the morning for a failure they can't handle, but a structured and effective Planned Maintenance system can guarantee you that the machine is expected to perform on it's optimum condition, and damages in cost savings on repair and maintenance would thus be reduced.

Planned Maintenance is a long term solution for your daily day to day problems, we need to put a stop on firefighting practices, an accumulation of such practice will hurt your plant financially, shorten the life of your equipment, delayed deliveries to customers, long cycle time, high costs on spares. A company that wants to survive with their competition and an economic slowdown must focus on a rigid framework on their maintenance structure and strategy they must adopt the Planned Maintenance System.

1.2 Planned Maintenance Defined

TPM composed of 8 major pillars Autonomous Maintenance, Planned Maintenance, Office TPM, Focused Improvement, Training and Education, Quality Maintenance, Initial Flow Control Activities and Environmental Health and Safety. There are Chapters on JIPM (Japan Institute of Plant Maintenance) books that covers the Planned Maintenance, and it's definition varies from one author to another.

Planned Maintenance is the deliberate activity of building and continuously improving such a maintenance System. **by : Tokutaro Suzuki**

Planned Maintenance is defined as maintenance activities performed on a pre-determined schedule of activities. **by Charles Robinson & Andrew Ginder**

Although there may be more definitions on Planned Maintenance, I think that Suzuki's definition is the simplest way of defining it. Every company had their own system of maintenance in place, the job of Planned Maintenance is to continuously improved such a maintenance system. Planned Maintenance is a pillar in TPM which aims to achieve high reliability of equipments while minimizing maintenance costs. These are achieved through proper application of all the maintenance tasks such as Breakdown Maintenance, Predictive Maintenance, Preventive Maintenance, Corrective Maintenance which we shall define in the later part of the chapter, it also aims at targeting a complete zero reduction in unplanned breakdowns

1.3 What Planned Maintenance Pillar Includes

A complete strategy on Planned Maintenance includes a Master Plan for the 8 major activities involved although the major focus would be on implementing the step by step activities on Planned Maintenance, In 4 Phases. The best way to carry out Planned Maintenance activities is to set a a time frame of completion for each phase for JIPM having a Master Plan. It includes.

- Guidance and support for Autonomous Maintenance Activities
- Planned Maintenance 4 Phase Activities
- Lubrication Management Activities
- Setting Up the Planned Maintenance Structure
- Spare Parts Management
- Reduction In Maintenance Cost Activities
- Enhancement and Upgrading of Maintenance Skills
- Success in Using Predictive Maintenance Instruments

1.4 Equipment 6 Big Losses

Equipment losses vary from one another, below are TPM's lists of losses an equipment can suffer. This does not include interruptions or downtimes caused by outside factors such as power, facilities requirements, operator skills, and others. It is important to note what type of losses your equipment encounter most of the time and who should address them. It is recommended that each losses be treated separately as this type of losses needs different types of people to be addressed. Each of the losses specified below must not be addressed by the maintenance people alone, but by a cross selection of expertise.

Breakdown Loss

Sometimes called as Equipment Failure loss is a loss when machine stops due to loses in its specified Functions. There are two types of breakdowns, Function Reduction Breakdown which is when deterioration of equipment causes other losses in function even when the equipment can still operate. Imagine your car running, and stating that the primary function of a car is to travel from distance A to distance B. It can comply with the function, but one of the car's headlight is busted, side mirror is missing, wheels hub is missing, car have excessive oil leak due to damage in seal, car's aircon does not work, wiper is missing and so on, but still the car can function and travel from distance A to distance B, this is what Function Reduction Breakdown is and most equipment's suffer this type of losses and it seems that most of the time this type of losses are being neglected. These are breakdowns which account for the largest proportion of overall equipment losses. The second one is Function-Loss Breakdown which is failure in which equipment stops completely. These are losses in which production is stopped another term is unplanned downtime.

Breakdowns halt production, deliveries are delayed, quality problems arises, maintenance cost is increased, a single breakdown can create havoc throughout the plant. Analysis in the breakdown failure can be attributed mostly to human problems, basic neglection, design problems, lack of operator skills, lack of repair skills. That's why a basic understanding of the failure must be address thoroughly.

Breakdowns are caused by many factors, and most of the time slight deteriorations are overlooked which Contribute highly to equipment's breakdown. Improvement in equipment performance can be done by Simple addressing minor problems such as loose and missing screws, abrasion, debris and contaminant Are addressed. Zero unplanned breakdown can be established by addressing the following :

- Prevent accelerated deterioration
- Maintaining Basic Equipment Condition
- Maintaining Operating Condition
- Improvement of Maintenance Quality
- Addressing rootcauses of breakdowns
- Correcting Design weaknesses

Once a breakdown occurred be certain to possibly learn everything you can and studying the causes, conditions, maintenance tasks involved, repair method, much can be learned to prevent it from happening. The basic responsibility of each maintenance is not to repair breakdowns but to analyze what had caused The breakdown problem and draw measures to prevent the recurrence of the problem. If this is not being Performed, you will just be wasting your precious time on doing repairs and quick fixes on the same problem over and over again.

Set-Up Loss

It is the time required to remove dies, jigs for one product, clean-up, prepare dies and jigs for the next product, reassemble the equipment, adjust the equipment, perform trial runs and make further adjustments until product of acceptable quality is obtained. It begins when the production of one product is Completed and ends when standard quality is attained on production on the next type of product being Processed. Shigeo Shingo's (SMED) Single Minute Exchange of Dies deals in techniques in reducing Set-up time and adjustment time without reducing its accuracy. According to him, a good set-up time in Manufacturing must fall between 10 minutes and below. Findings of Shigeo Shingo, why set-up time is prolonged is due to the following :

- Preparation of materials, jigs, tools and fittings 20 %
- Removal and attachment of jigs, tools and dies 20 %
- Centering and Dimensioning 10 %
- Trial Processing and Adjustments 50 %

The first step in improving Set-Up is to distinguished activities that can be performed while the equipment is running from those that can be performed only when it is shut down. Differential External from Internal Set-Up. External Set-Up are those activities which can be performed while the machine is running while an Internal Set-Up are those activities which can be performed only when the machine had been shut down for conversion. The goal on Set-Up is to minimize the time to perform it, and one of the techniques is to write down all the steps performed in doing your set-up, then converting Internal Set-Up to External Set-Up This can be accomplished by using a standard one touch jig, compare the shapes of tools and jigs for different products and consider preparing a standard jig that can be shared by all. Eliminate adjustments during internal Set-Up time by using intermediate jigs.

Here are 2 steps that can be taken to eliminate the need for adjustment

- In many cases adjustments can be scaled down simply by improving the precision of equipment, jigs and tools. The accumulation of imprecise settings creates the need for many avoidable adjustments.
- Standardize procedures. Lack of consistency in the standards for measurement, quantification, and Other operation and maintenance procedures is another cause of unnecessary adjustments.

Set-up losses cannot be eliminated but they can be reduced dramatically, poor set-up can cause other Losses such as breakdown, quality problems and it is best that procedures on each product set-up be Standardize. One maintenance can set-up one equipment differently and might take 15 processes while One may take as much as 20 to 25 steps. What is important is that whoever is performing the set-up Procedure have a set of standards to follow. Much can be learn by knowing the difference between what Are internal and external set-up practices and most of them only needs common sense

Tips on Shortening Internal Set-Up Time

- Simplify clamping mechanism by using quick fitting jigs
- Adapt parallel operations, 2 people working together can perform a set-up faster and more effective
- Optimize the no. of workers and division of labor specially for large and complicated set-ups

Doing this simple basic steps will greatly reduce your set-up time

Eliminating Small Losses In Set-Up

- What type of preparations need to be made in advance ?
- What tools must be on hand ?
- Are the jigs and tools to be installed in good condition ?
- What type of workbench is needed ?
- Where should jigs and dies be placed after removal ?
- How will they be transported ?
- What types of parts are necessary ?
- How many maintenance people are needed to perform the set-up ?

Idling and Minor Stoppages

As equipment becomes more complex and automated, more losses are attributed with Idling and Minor Stoppages (some companies term this as assists). First let us define this type of loss. A minor stoppage occurs when a failure or an error in automatic handling, processing or assembly of parts and workpieces, or an equipment stoppage due to the occurrence of quality related abnormality. This type of losses arises mostly in automated processes and include the following :

- Workpiece flow stops
- Operator resets workpieces correctly
- Operator reactivates process and machine runs

The problem with this type of losses is the number of occurrence or frequency, and most of the time this type of error is left unrecorded since the time to fix it can be done by just resetting the buttons and it will spend more time to record and write down the error. Idling and Minor stoppages sometimes are mistaken for breakdowns, which must not be the case, these must be separated from breakdowns. These type of losses can be addressed by Autonomous Maintenance through initial cleaning, JIPM experts believe that having an equipment free from dirt and dust can reduced minor stoppages from 20 to 60%. While more complicated minor stoppages which cannot be reduced through cleaning must be addressed by a cross functional Focused Improvement team composing of engineers and maintenance people. Some examples of Idling and Minor Stoppages includes a workpiece jamming, resetting of sensors, error reading on monitor of computerized equipment where the machine is stopped temporarily, operator resets and machine starts running again. This problems occur more frequently in automated equipments. In addressing minor stoppages, ensure the following :

- Observe what is happening. These can be done by carefully observing the equipment until an minor stoppage had occurred and plan corrective measures
- Correcting slight or minor defects defects, a small dent in the chute may be a cause of minor stoppages and oftentimes we overlook this factor, maintaining a clean equipment can minimize stoppages

Design Speed Loss

Design Speed Loss is the loss production caused by the difference between the design or theoretical speed and the actual operating speed. Lack of care at the design stage of the equipment may result in speed reduction. Equipment is operated beyond its operating speed limit, quality defects and break-downs are encountered. Although Japanese and Europeans systems of maintenance had conflicts

on this type of losses as later discussed in this chapter, Japanese TPM experts still consider this to be a loss and according to them to reduce speed loss we must :

- Level 1 : Achieve Standard Operating Speed for each product
- Level 2 : Increase Standard Operating Speed for each product
- Level 3 : Achieve Design Speed
- Level 4 : Surpass Design Speed

Equipment may be run at less than the design or ideal speed for a variety of reasons which may contribute to mechanical problems, quality and defect problems, history of past problems, and sometimes not knowing what is the optimal speed. On the other hand deliberately increasing the operating speed actually contributes to problem solving by revealing latent defects in equipment conditions.

Start-Up Loss

Start-Up loss is a type of loss that occurs until the start-up, running in and machine conditions of the conditions of the equipment have been.

- Start-Up Loss means that the material loss caused at the initial stage of production launching, namely namely the loss caused during the period from start-up of production to stabilized production stage
- It's frequency depends on several factors such as unstable machining conditions, poor maintenance, and operator skills
- Start-Up loss can also occurs after a poor set-up or conversion, after overhauling an equipment subject subject to their Preventive Maintenance Schedule. It takes sometime for a machine to stabilize.

Start-up loss are difficult to identify. Their scope includes the stability of processing conditions, workers skills and training, loss incurred by test operations and other factors. A thorough understanding of why this type of loss occurs can be addressed through RCM2 or Reliability-Centred Maintenance which is covered in Chapter 4.

Defect and Rework Loss

This is the loss caused when defects are found and the product have to be reworked. In general, these defects are likely to be considered as a waste which should be disposed of but since even the reworked products need wasted manpower to repair them. Included on this type of loss are products being shipped back due to customer complaints. Products are returned and reworked in the production area.

Quality Defects and rework losses are caused by malfunctioning production equipment. In general, sporadic defects are easily. Chronic defects require a thorough investigation and innovative remedial Action. The conditions surrounding and causing the defect must be determined and then effectively Controlled. Tools such as P-M Analysis is suitable in dealing with chronic problems, it aims at reducing Defects to zero, however, P-M Analysis must only be used after extensive use of conventional tools Had been used and around 1 to 5 % of the problems still exists, this is where P-M Analysis must be used Ideally. Sporadic defects are easy to solve and it is more difficult to solve chronic defects.

Although other TPM books includes 8 Major Equipment Losses, the other two losses mentioned are shutdown loss which means stopping the equipment for periodical or Time-Based Maintenance and Cutting blade change which is loss caused by line stoppage for replacing grinding wheel, cutter, bits which might be broken or worn out after excessive usage.

Responsibility For Each Losses

No.	Type Of Loss	Responsible	Indices / Measurement to Use
1	Breakdown Loss	Maintenance People	BDO and MTBF
2	Set-Up Loss	Cross Functional Team	Improvement In Set-Up Time, MTTS
3	Minor Stoppages	Major - Cross Functional Team Minor - Operators	MTBA and Frequency of Assist
4	Design Speed Loss	Cross Functional Team	No. of Output
5	Start-Up Loss	Maintenance People	Downtime Loss due to Start-Up
6	Quality Defects and Reworks	Cross Functional Team	Yield

(Table 1-1)

Overall Equipment Effectiveness

The main indices or measurement which can be use to track the improvement of equipment is know as the OEE or Overall Equipment, however, for separate focused on improving each losses, I have detailed on the above table the most appropriate measurement of indices in improving them and responsibility for each type of losses. A cross functional team is a Focused Improvement Team composing of engineers, Quality People, Maintenance Experts, Production Supervisors and Operator teaming up to solve the losses. Team must compose of people with enough knowledge on the function and process of the equipment being involved, as a person who do not have enough understanding even on the basic equipment condition may not contribute to the problem they are solving. The goal is to determine which type of losses most of your equipment suffers, set-up the team to improve on them and replicate this improvements on equipment's with similar problems operating under the same conditions. Note : While it must also be studied whether the improvement must be done where marketability of the products is still in demand, equipment will still be used for a number of years, decision as to whether improvements should be replicated on similar machines under low loading, and other factors as modification, changes and improvement on equipments will cost and entail company's money.

OEE = Availability x Performance Rate x Quality Rate x 100 %

- Availability = improving availability will improve the number of breakdowns, reduce time to set-up
- Performance Rate = will improve Minor Stoppages and Design Speed loss
- Quality Rate = will improve defects and rework and start-up loss

OEE is the primary measure of performance in TPM. Calculating a true and meaningful measure is extremely important to any improvement process. Equally important is the visibility and communication of the measure to the people who can impact it the most. The higher OEE, the better the equipment is in terms of availability, performance rate and quality rate. For single product equipment computing OEE is simple, however for equipments processing 2 or more products, ideal cycle time for each product together with the time each product was process must be known. This is the safest and most accurate way to get the true OEE for that particular equipment rather than averaging. Target to achieve 85 % OEE on your equipment, isolate which losses contribute most and set-up Focused Improvement team to work.

1.5 World Class Management System

When asked on what does it take for your maintenance system to be world class, the answer is having a Pro-Active system of maintenance. Have you encountered this kind of maintenance meeting ?

- **Boss** : What's our status ?
- **Maintenance :** Operations running smooth, but we encounter some abnormal vibration on machine 4, it's still running normal, and we estimate 3 to 4 weeks until a major breakdown can occur, so we are now checking everything, spares availability, manpower needed, time it will be down will be couple of hours at the most and we have notified operations and gotten their approval for the repair, and possibility to use machine 9 as a back-up

Well if not, perhaps it's the same old meeting where maintenance boss gets mad over the same kind of problem and blames his people for not doing their job, and after the meeting another unexpected break-down happens, and when it comes to reviewing the maintenance cost for the current month which is way beyond their goals, maintenance boss orders not to list following parts that had been already used so it can be carried over to the next month.

Let us define the difference between having a Pro-active and Reactive type of maintenance. In a Reactive maintenance, meetings are held daily and discussed what had failed. Sometimes what is done to stop it from happening, this means dealing with failures after they have occurred. While in Pro-active maintenance

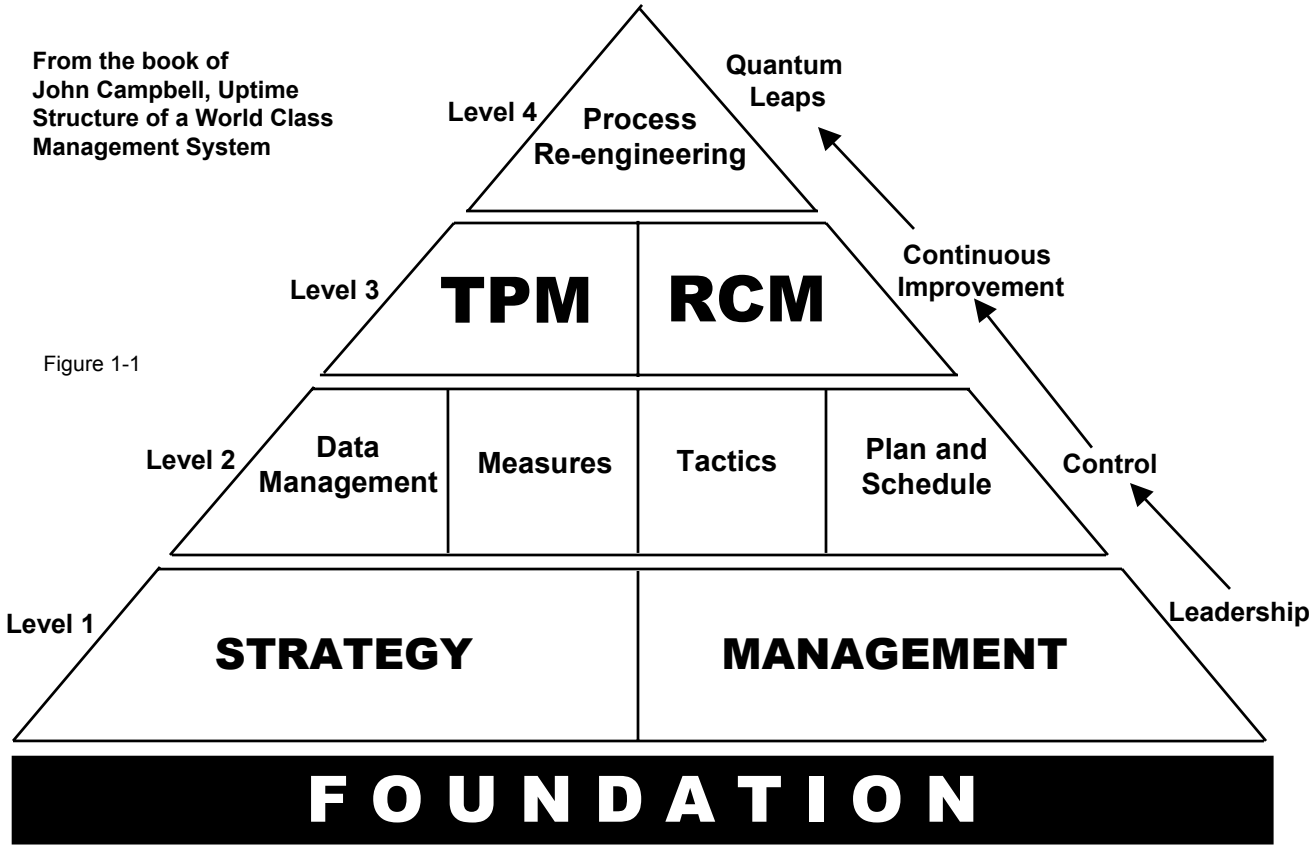


Figure 1-1

we deal with events before they are likely to occur, this can be done by identifying all failure modes which are likely to affect the equipment, determine what happens when it occurs and what should be done to a anticipate, prevent, detect, predict or modify it out.

Reactive Maintenance

Failure Occurs ⟶ Action Taken

Pro-Active Maintenance

Action Taken ⟶ Possibility of Failure To Occurs

1.6 Different Approaches on Planned Maintenance

JIPM Chapters on Planned Maintenance approach it on a 4 Phase Implementation Stage, and there is a wide range on how to effectively apply the Planned Maintenance system, just to give you a glimpse of how Planned Maintenance is applied to different areas and companies worldwide.

Reference : TPM Industries by Tokutaro Suzuki

- Step 1 : Evaluate Equipment and Understand Current Conditions
- Step 2 : Restore Deterioration and Correct Design Weaknesses
- Step 3 : Build An Information Management System
- Step 4 : Build A Periodic Maintenance System
- Step 5 : Build A Predictive Maintenance System
- Step 6 : Evaluate the Planned Maintenance System

Reference : Nissan Motor Co., Ltd, Yokohama Plant
by : Yuichi Suzuki taken from TPM World Congress C4-2-8

- Phase 0 : Establishment Of Aims Of Planned Maintenance
- Phase 1 : Understanding Of Actual Conditions Of Equipment And Work
- Phase 2 : Restoration Of Deterioration
- Phase 3 : Recurrence Prevention and Countermeasure for Weak Points
- Phase 4 : Establishment Of Periodic Maintenance
- Phase 5 : Improvement Of Maintenance Efficiency
- Phase 6 : Horizontal Application
- Phase 7 : Condition Management Of Facilities

Reference : Idemetsu Kosan Co,. Ltd. Hokkaido Refinery
by : Akira Kitayamna

- Phase 1 : Deterioration, Repair / Elimination of Forced Deterioration
- Phase 2 : Extension Of Characteristic Life Span
- Phase 3 : Identify And Repairing Internal Deterioration / Linking Of Operations Daily Observation with Maintenance Planning
- Phase 4 : Pursue Predictive Maintenance And Forecasting Techniques

Reference : Harris Kuala Lumpur, Malaysia, Assembly and Test Operations
by : Adre Blanc

- 1994 : Breakdown Maintenance and Time-Based Maintenance
- 1995 : Established Planned Maintenance System (Automated Report System)
- 1996 : CMMS System
- 1997 : CBM On Selected Equipments

Reference : JIPM TPM Instructor's Course 2nd Revision March 1996
Approach Towards 4 Phases Through Zero Breakdowns

- Phase 1 : The Dispersion Of Reduced Or Extend MTBF (Mean Time Between Failure)
  - Restoration of Unattended Deterioration
  - Removal of Forced Deterioration And Establishing Key Operating Conditions
- Phase 2 : Life Span Should Be Extended
  - Extend Life Expectancy
  - Removal Of Sporadic Failures
  - Restore Appearance Of Deterioration
- Phase 3 : Time-Based Restoration Of Deteriorated Portion To Its Original State
  - Assume Lifespan and Time-Based Restoration Extend Life Expectancy
  - Understand Irregularity For Internal Deterioration Through The 5 Senses
- Phase 4 : Prediction Of Failure By The Equipment Diagnostic Techniques
  - Failure Mode For Diagnosis
  - Extension of Lifespan By Technical Analysis Of Catastrophic Failures

Reference : As per my previous employment and JIPM Consultant

- Step 0 : Preparatory Stage and Understanding The Need Of Planned Maintenance System
- Step 1 : Perform Initial Cleaning
- Step 2 : Restore Deteriorations Uncovered
- Step 3 : Preparation Of Standard Documents
- Step 4 : Countermeasure For Weak Points In Design
- Step 5 : Periodic – Preventive Maintenance
- Step 6 : Overall Audit and Diagnosis
- Step 7 : Machine Ultimate Utilization

I am showing you some of the variations on how Planned Maintenance adaptation varies from one another. Whatever steps of phase you apply in your system of Planned Maintenance boils down to a 4 Phase approach

- Phase 1 : Restoration and Establishing Basic Equipment Condition
- Phase 2 : Lengthening Equipment Lifetime By Addressing Design Weaknesses
- Phase 3 : Periodically Restore Deterioration
- Phase 4 : Predict Equipment Life

Reference : Maintenance Consultant, Chairman of Studio Base Group
by Mario Giberton

- Step 1 : Study The MTBF
- Step 2 : prolong The Duration Of MTBF
- Step 3 : Reduce MTTR (Mean Time To Repair)
- Step 4 : Forecast The Duration Of MTBF

This are the 4 essential Phases of Planned Maintenance, whatever or how they are re-arranged, their ultimate goal is to be Pro-Active with the use of sophisticated Condition-Based Maintenance Techniques or known as Predictive Maintenance. Failures cannot be eliminated, however, what is important is that they can be predict-

ted when they can occur, what are the necessary plans to undertake to prepare for such a failure. To build an effective Planned Maintenance System, maintenance personnel must be at a higher level of readiness and perform more advance work than operators in the area of productive maintenance. They must be determined through predictive and preventive measures never to permit failures or defects to occur. Their true tasks is not carrying out repairs but in eliminating failures.

To begin your journey on Planned Maintenance, the first step will always be for maintenance people to undergo basic training on Planned Maintenance. If your plant is active in TPM, a facilitator should be the once to conduct the training on Planned Maintenance, it must clearly be stated that the goal of maintenance is not on how many equipments they had completed in undergoing their PM schedule, it is not how many repairs, a maintenance technician had done, or how many parts they've replaced within their shift, but rather a more indebt understanding of the Basic Equipment Condition and it's functions, there job is to educate operators so that they can do minor repairs and set-up while they focus on more complicated and difficult chronic problems. Most oftentimes, the machine needs surgical operation, but due to cost cutting budget constrains, we perform the "Band Aid Therapy". Believe me this is not the way to cut corners, instead of saving this will induce you more cost in the long run. Having a system and investing in restoring equipment will be your responsibility to have a heart to heart talk with your superiors, do not take this message lightly.

During one of my RCM2 trainings, a participant in Facilities asked me this question on what type of maintenance tasks can be done on AVR's, simply you can't open them and check every single electronic component, but I answered, if it's function is critical, then the only maintenance you can have here is having a Redundancy (In RCM terms redundancy means having a duplicate). The participant was not happy with the answer I gave him since this will cost hundreds of thousands of dollars which management will not Approved. I told him what will be the worst case when it fails, and said operation will stop and be halted. Anyway making the story short, 2 years later, a fire occurred in one of the Plants which started from the AVR, operation was stopped for more than a day. The lesson here is simple, if a single part or spare in your equipment will induce you severe consequences, justify to your top management in having a stock on hand, put into writing some cost comparison on if it is to fail and how it will affect your operations.

1.7 What Planned Maintenance Wants To Achieve

I always tell my participants during training that having an effective maintenance system is no different than coaching a basketball team. Imagine if I am the coach and I put my first 5 with the smallest person to be 6' 8" then I will be strong on rebound, but definitely I wont be able to have an effective guard, because all of them have the center position, or if I have a first five with the tallest being 5' 10", then our statistics shows we will be dominated on rebound. On the other side, your maintenance system must be balance, if you have your centers, forwards, and guards in the team, then you have an effective team, likewise in maintenance, if you know what parts will undergo breakdown maintenance, what parts will be on scheduled preventive maintenance, and what parts are under predictive maintenance then you have the best maintenance system. Most of the time all your tasks are under Preventive Maintenance, this is like having all centers in your team, balance them, if this is the case in your company then your maintenance is very costly.

Implementing a long term Planned Maintenance System will take years to accomplish, but it's results is what every maintenance personnel can dream of, it's benefits will have effect on the following

- Reduction In Maintenance Costs
- Higher MTBF and Reduced Planned Breakdowns
- Higher Equipment's Reliability and Availability
- Upgraded and Higher Maintenance Skills
- Making Your Maintenance Pro-Active and Not Reactive

Will it be the same old ways on your maintenance groundwork's, or I have made you stop to think it's about time to change your maintenance system. Is it time to do some revisiting on your maintenance checklist and check its effectiveness if it truly serve it's purpose, or are they a waste of time in doing it and the once that really need the overhauls and maintenance task are being neglected or not performed. Why not think about the long term plans on your maintenance activities.

Planned Maintenance activities are essential for any manufacturing or industry with equipments and the subject of maintenance must not be taken lightly. Most of the times this is neglected, while a company can hire the best maintenance manager truly capable of knowing every detail of the equipments he manage but lack in approach and systems in maintenance. I emphasize strongly in the contents of this book that it is 100 times better to have a maintenance system in place than having the best maintenance software in town. Prioritize in having a system of Planned Maintenance built in your organization. If done properly and correctly, this investment can impact you on saving cost which can amount to hundred of Thousand to million of dollars in waste on maintenance.

1.7 Planned Maintenance in 4 Phases

Phase 1 : Stabilize MTBF through Restoration

There are 3 main activities in Phase which include Perform restoration, recurrence prevention of deteriorations uncovered and Standardization. All these activities aim at establishing Basic Equipment Condition. deteriorations are exposed and corrected. Before conducting Phase 1 activities, equipment is subject to accelerated deterioration and failures occur frequently. Deteriorations are left unchecked even if maintenance are aware of it. These are perceived as normal and breakdowns cannot be eliminated since boss does not approved request for purchase of spare parts which need replacement. This attitude oftentimes spell disaster since one breakdown may lead to another causing more downtime and money. Activities on Phase 1 aims at changing the concept of the traditional approach on firefighting or reactive stage by doing the basics and restoring equipment to its original condition.

- Prevent accelerated deterioration, this tasks involves extending the equipment lifespan by prolonging MTBF or Mean Time Between Failure. The longer the interval for the time to repair the more the uptime of the equipment is utilized. Begin by tagging the equipment for deteriorations and abnormalities uncovered and correcting them all. Expect a dramatic reduction in Breakdowns once Phase 1 had been completed.
- Analyze why deteriorations occurred and perform countermeasures to prevent the recurrence of accelerated deteriorations. Simple why-why analysis must be performed at this level.

Phase 2 : Lengthen Equipment Lifetime

Once accelerated deterioration had been eliminated, equipments will suffer from natural deterioration. There are spares and parts of equipment that will deteriorate naturally. Team exposed themselves to study several parts of equipment with inherent short natural lifespan and correct design weaknesses by improving the parts dimension, strength of materials, construction dimensions and so on. An MP or Maintenance Prevention Design Form is usually used for this activity and later on feedback to the IFCA or Initial Flow Control Activity Group so that when the company decides to purchase future equipments these improvements are discussed with the designers to be included in the new equipment purchase. A cycle must be established where MP Design improvements must be feedback to IFCA.

Correcting design weaknesses can prevent major breakdowns from recurring unexpectedly. Teams Are trained on special tools such as P-M Analysis for a more detailed approach in dealing with Chronic Breakdowns. Likewise most breakdowns are caused by human errors, hence, both operators and maintenance must upgrade their skills to eliminate human errors, application of Poka-Yoke solution may solve human errors but not necessarily improve the level of understanding of the mistake caused by the person involved. Us the equipment's parts with design weakness are modified, this must run in parallel in improving the skills on how the operator operate the equipment and how maintenance repairing skills must be standardize as well.

Phase 3 : Periodically Restore Deterioration

A thorough study of the maintenance tasks must be done to establish the correct maintenance to be performed. RCM2 is a perfect methodology for this concept. Not all parts need to belong to the Time-Based or Preventive Maintenance Calendar System. This can be done by having a thorough understanding on how such tasks can be performed correctly. Each part have their own failure characteristic pattern. The key in this activity is to know the 6 failure pattern so you can derive the correct maintenance tasks for each function through an Algorithm or Decision Diagram. In this activity we are not dealing with equipments but a comprehensive maintenance system that must be adopted. What parts must undergo time-based, what parts can be predicted, what parts needs inspection and what parts does not have any consequences at all and can be left to the Run-To Fail Tasks.

Phase 4 : Predict Equipment Life

In Phase 4 we introduce the concept of Predictive Maintenance or Condition Based Monitoring Techniques, although this is similar in using the key senses of humans in a much higher perspective with the aid of Instruments. Several parts of equipment can be predicted through the use of these techniques, this is done by checking the condition of the equipment. The key on using these technique is to know the P-F Interval which is explained later in the chapter, if a part shows symptoms these are good candidate to use Predictive Maintenance in this regard. For example, a bearing may produce noise, increase in temperature, increase in vibration, these are the symptoms that a failure is likely to occur. Therefore, the maintenance can be well prepare for this occurrence. Advantage of Predictive Maintenance is you can utilize the part to it's maximum life without the need for a breakdown to occur. Parts can be replace within hrs its going to fail, this is the essence and beauty of having a Pro-active Maintenance. Both Predictive and Preventive are Pro-active maintenance once you know how to adopt them properly and the key is to understand the 6 failure pattern curves.

Chapter 2

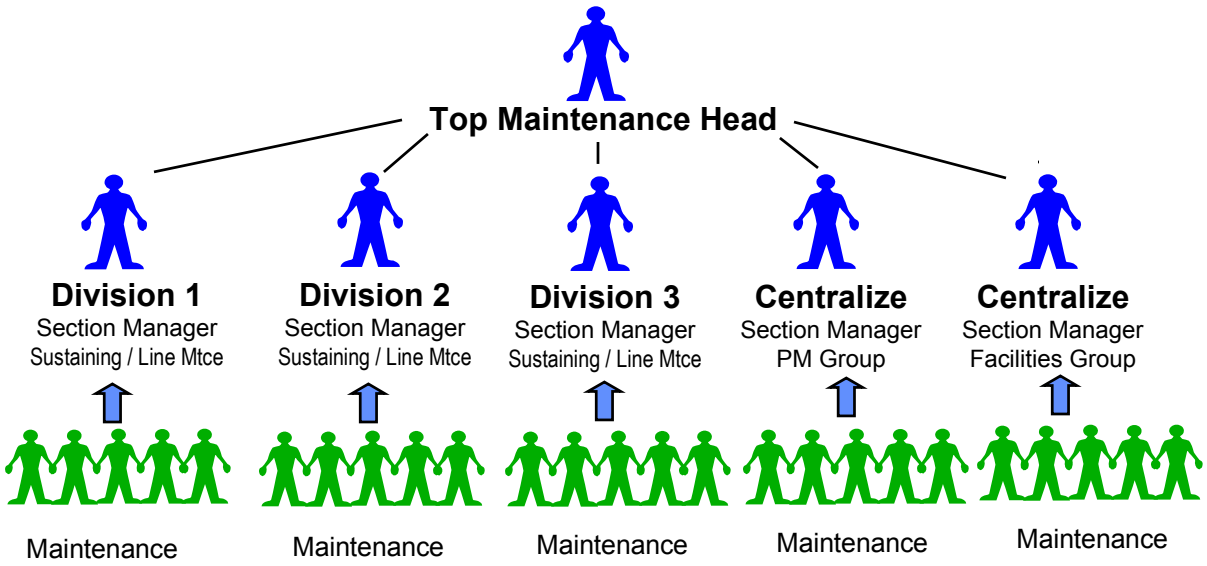
2 Phase 0 : Understanding The Need For A Planned Maintenance System

2 Phase 0 : Understanding The Need For A Planned Maintenance System

Phase 0 details the requirements needed to set-up an effective Planned Maintenance System in your company. These are the basic essentials needed for a strong foundation. Preparatory stage usually takes from 1 to 3 months. It is very important not to ignore this stage, otherwise building a Planned Maintenance System without establishing basic foundation is like building a house on a sand. It is best for a company starting on Planned Maintenance to hire persons to act as Facilitator, that specializes in this regard, I would prefer hiring since there are actually few people who give consultancy in this regard. The important thing is that maintenance people must own Planned Maintenance and must not be treated as a separate program from their day to day activities.

2.1 Building Your Planned Maintenance Organizational Structure

It is best that the whole Maintenance Department comprises the Planned Maintenance Organizational Structure, some companies have a separate organization for line maintenance or sustaining group and Preventive Maintenance group. Both must work together towards achieving a common goal. Top Maintenance Manager must spearhead the Planned Maintenance Implementation, with close communication from the Planned Maintenance Facilitator or Engineer, whose function is to develop the legwork needed, conduct trainings on Planned Maintenance, set-up the teams, and anything related to it. If your company is big with different divisions, it is best to set up a working Planned Maintenance Committee who shall represent their division, a maintenance section manager usually is best suited for this position



2.2 Planned Maintenance Kick-Off

This can be done by simply having a general meeting for all maintenance personnel and Top Maintenance Manager announces the launching of Planned Maintenance in their organization. Some companies provide foods, slide shows, inviting guest speakers specializing in the subject matter, spend 2 to 4 hours for this launching. Explain to your people the need for launching this program.

2.3 Define Roles and Responsibilities

Planned Maintenance Facilitator defines the roles and responsibilities of each member of the maintenance team. Each member involved must have an active part in the Planned Maintenance implementation from the top to the lowest ranks in the maintenance group

2 Phase 0 : Understanding The Need For A Planned Maintenance System

There are several points to be taken out if you are serious in Planned Maintenance Implementation

- 1st, during the preparatory stage, all divisions in the Planned Maintenance must be involved and participate
- 2nd Top Management must not only support but own the Planned Maintenance Activities. These are 2 different words that will spell success or failure on your implementation. This is a long term solution on your day to day problem on Maintenance. Not owning a program besides announcing it will create impact on all maintenance people enough to loose their enthusiasm.
- 3rd Include your Facilities on your Planned Maintenance Program as they will play a vital and important part as explained in the later part of the book
- 4th Doing TPM activities involved investment in time and money, be sure to support it. This will hurt as as you control your maintenance cost, but this will pay you off in the long run. Imagine a team conducting restoration and found out several parts that had been neglected and prepares a Purchase Order only to be denied. Give priorities and approve the once that really need to be restored.

Below are some guidelines to help you and the facilitator on the different responsibility each plays.

Roles and Responsibilities Of Top Maintenance Manager

- Launches the Planned Maintenance implementation in the company
- Conduct review with the PM Committee selected (weekly or bi-weekly)
- Track progress of completion on each activity involved in Planned Maintenance
- Approves logistical support and requirements needed by the teams
- Must own a at least one Model Team
- Provide simple recognition to teams that completed each Phase with good results
- Review overall indices set forth by the Planned Maintenance

Roles and Responsibilities Of Planned Maintenance Facilitator

- Define roles and responsibilities for each maintenance involved
- Conduct trainings on Planned Maintenance Steps
- Guide the team in their implementation
- Conduct Initial Audit together with the Maintenance Section Managers for each Phase completion
- Planned Maintenance facilitator must act as consultant on Planned Maintenance

Roles and Responsibilities Of Maintenance Managers

- Must own a at least one Model Team
- Review logistical support needed by their team and elevate them to Top Management
- Conduct Audit on their Team's completion and Machine Certification
- Review the teams on their Planned Maintenance Journey
- Summarize results obtained from implementing Planned Maintenance
- Set-up goals on maintenance indices, completion stages
- Attend trainings on Planned Maintenance

Roles and Responsibilities Of Maintenance Pilot Teams

- Complete the Planned Maintenance Activities
- Provide OPL's (one point lessons) to Operators and Fan-Out Teams
- Attend trainings on Planned Maintenance
- Monitor equipment's performance and results as they complete each Phase activity
- Set up a bulletin board and update them to show their activities performance
- Serve as a model to other teams and provide guidance and education on other teams
- Generate standards on maintenance and revised existing standards or specs
- Train operators on Basic Equipment Operation and Condition

2.4 Set Up Vision and Mission for the Planned Maintenance

This will be your creedo that every maintenance personnel will carry out and be guided by. It shall be your ultimate direction you are aiming for. Be sure that this is observe and that all activities that you perform on your Planned Maintenance activities relay to in achieving your Vision and Mission.

2.5 Generate The Planned Maintenance Master Plan

A Planned Maintenance Master Plan is where you put the activities with their timeframe of completion. It is a piece of the cake for the overall TPM Master Plan, below is an example of a PM Master Plan.

SAMPLE - PLANNED MAINTENANCE MASTER PLAN

				INTRO		IMPLEMENTATION								FULL DEVELOPMENT				STABILIZE			
NO.		MASTER PLAN ACTIVITY		2000		2001				2002				2003				2004			
				Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	ZERO BREAKSDOWN ACTIVITIES	PM 7 STEP JOURNEY																			
		Step's 0 : Preparatory Stage	PLAN					Machine are categorized as Rank A, B													
		- Machine Ranking	ACTUAL																		
		Step's 1-3	PLAN			Attain ZERO Breakdown for all Rank A and Rank B Machines															
		- Initial Cleaning, Restore, Standards	ACTUAL																		
		Step 4 - Corrective Maintenance	PLAN				Apply P-M Analysis on Recurring Breakdowns and Feedback to IFCA														
		- Countermeasure for Design Weakness	ACTUAL																		
		Step 5 - Preventive Maintenance	PLAN					Final Inspection Standards - Time Based Maintenance													
		- Periodic - Preventive Maintenance	ACTUAL																		
		Step 6 - Predictive Maintenance	PLAN						Utilize Condition Based Maintenance Instruments & Techniques												
		- Overall Audit and Diagnosis	ACTUAL																		
		Step 7	PLAN																		
		- Machine Ultimate Utilization	ACTUAL																		
2	MTCE CONTROL SYSTEM	SPARE PARTS CONTROL	PLAN				Review and Improve Spare Parts Control and Utilization														
			ACTUAL																		
3		MAINTENANCE COST AND BUDGET CONTROL	PLAN			Review Maintenance Cost Control and Utilization															
			ACTUAL																		
3		MAINTENANCE INFORMATION MANAGEMENT & CONTROL SYSTEM	PLAN																		
			ACTUAL																		
4		MAINTENANCE WORK PLANNING AND MANAGEMENT	PLAN					Review PM System													
			ACTUAL																		
5	SUPPORT ACT	GUIDANCE AND SUPPORT FOR JISHU HOZEN	PLAN				PM Guidance and Support for Jishu Hozen Activities														
			ACTUAL																		
6		MAINTENANCE SKILLS ENHANCEMENT	PLAN																		
			ACTUAL																		
7		EVALUATION OF THE PLANNED	PLAN																		

Figure 2.1

2.6 Conduct Machine Inventory and Rank Equipments

List all your equipments by preparing a Machine Inventory Lists (appendix -), and conduct a machine ranking for all equipments. Rank A will be the worst and Rank C as the good machine. Only machines that are rank A and B should undergo the Planned Maintenance activities. Prepare a category for each equipment and rank them accordingly. Perform this on all your equipment lists.

Definition of breakdown must be clear to our Maintenance people and it must not be confused with Minor Stoppages or Assists. Planned Breakdowns or Schedules Time Based Maintenance must not be considered as breakdowns since they are Planned downtime. Once completed a summary of figures on machine ranking will give the maintenance team adequate data for their selection of their 1st pilot machine that will

undergo the 4 Phases of Planned Maintenance. This also gives the maintenance people which equipment to focus on improving them, remember the goal of maintenance is to improve equipments that seems to fail frequently. These machines will be the focus on Planned Maintenance

Included As Breakdowns

- Actual conversion and set-up
- Machine Stoppage caused by Idling and Minor stoppage (Mostly, errors, jamming due to dirt, etc.)
- Machine downtime caused by Preventive Maintenance Schedule such as overhauling of parts
- Machine downtime caused by replacement of parts as reflected from the tool algo (Stroke-Based Mtce) schedule
- Repairs and stoppages attributed by Predictive Maintenance Findings
- Machine stoppage caused by audits
- PM Schedule, shutdown of equipment , all Planned downtime
- No inventory and all non-machine related downtime

Following Must Not Be Included As Breakdowns

- Breakdowns caused by poor set-up and conversion, replace parts due poor set-up & conversion
- Breakdowns caused by defects and reworks, ex. Worn-out punch producing defects
- Function loss breakdown due to no available of spares
- Unscheduled repair or overhauling of equipment or replacing of parts
- Breakdown due to poor operator and maintenance skills
- Machine stoppage caused by Facilities unexpected interruption

Category On Machine Ranking

- Rank A Machines : Failure occurrences of more than 2x per month
- Rank B Machines : Failure occurrences of less than 2x a month
- Rank C Machines : No Failure occurrences

PM 7 - STEP ACTIVITY COMPLETION PLAN

Sa Planned Maintenance, Isang Misyon, Isang Direksyon . . . . .

PM STEPS	COVERAGE		2000			2001				2002				2003			
			Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Step 0		Plan	START	100%	END	CLASSIFICATION OF MACHINES THROUGH RANKING											
Necessity of PM	n.a.	Actual		100%													
Step's 1-3	Rank A & B only	Plan		START	2%	4%	19%	44%	70%	84%	89%	93%	96%	98%	100%	END	
S1 - Initial Cleaning	Rank A = 486	Actual			2%	4%	23%	44%									
S2 - Restoration	Rank B - 941				RANK A					RANK B MACHINES							
S3 - Standardization																	
Step 4	Rank A & B	Plan				START		0%	2%	4%	10%	10%	19%	25%	40%	50%	60%
S4 - Countermeasure for Weak Points	Machines	Actual															
Step 5	By Equipment	Plan				START		0%	2%	4%	10%	10%	19%	25%	40%	50%	60%
S5 - Periodic - Prev. Maintenance	Type / and per Sub-Assembly	Actual															
Step 6	By Equipment	Plan							START	2%	4%	10%	19%	25%	40%	50%	
S6 - Overall Audit and Diagnosis	Type	Actual															
Step 7	By Equipment	Plan								START	2%	4%	10%	19%	25%	40%	
S7 - Machine Ultimate Utilization	Type	Actual															

Figure 2-2

2 Phase 0 : Understanding The Need For A Planned Maintenance System

Equipment may differ from one industry to another, and gravity or severity of failure varies accordingly weight heavily if equipment have sever effect on safety and environment. Equipment's that will undergo Planned Maintenance activities must belong to either Rank A and B only. Other factors to be considered in performing your machine ranking are as follows :

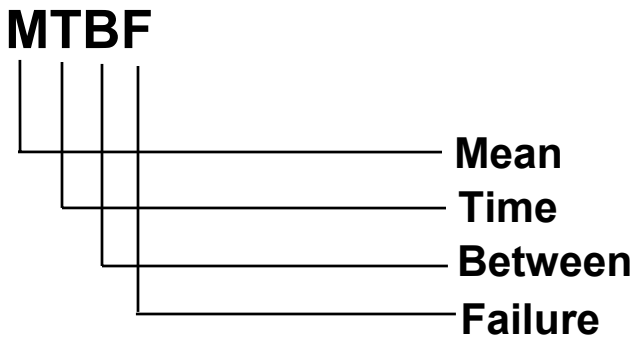
- Safety and Environment – What effect on failure does it have on people's safety and their environment
    - Rank A - If equipment poses explosion or risks in killing someone
    - Rank B - If equipment failure might adversely affect people's safety and environment
    - Rank C - If it does not pose any threat at all
- Quality – What effect on failure does it have on Product Quality
    - Rank A - Equipment failure had a major effect on quality
    - Rank B - Equipment failure produces variation on Product Quality
    - Rank C - Equipment failure have no effect on Product Quality
- Operations – What effect on failure does it have on Production
    - Rank A - Equipment failure had a major effect on production, no standby unit in place
    - Rank B - Equipment failure poses partial shutdown
    - Rank C - Equipment failure have no little or no effect on production
- Maintenance – Time and cost of repair
    - Rank A - Equipment failure takes 4 hrs or more fails 3x or more times per month
    - Rank B - Equipment failure takes less than 4 hrs fails less than 3x per month
    - Rank C - Equipment failure can be left unrepaired until a convenient time occurs

2.7 Select Pilot Machine and Backtrack Breakdown Data

A good indices for tracking Planned Maintenance activities are BDO (Breakdown Occurrences) and MTBF or Mean Time Between Failure.

Definition of MTBF

MTBF - reliability engineering term that means the average amount operating time between the Occurrence of breakdown that requires repair. The higher the equipment's MTBF the higher the equipment's reliability



Determine your 1st Pilot Machine which must belong to Rank A or worst machine in terms of breakdown. It is best that pilot machine have similar equipment types belonging to Rank A or B for Horizontal Replication purposes or fan-out of activities. After deciding which equipment will be piloted, backtrack data on breakdown by checking history logs and records, backtrack BDO (Breakdown Occurrences) for 3 to 6 months as this will be your benchmark and reference as well as measure of performance on your activities. It is important that the team monitor the data on Breakdown and provide a form on it's occurrence, here is a sample of Breakdown Report Form you can translate this to graph later on. Both BDO and MTBF are being tracked. And one good thing about this form is this one sheet of paper can be used for 1 whole year.

BACKTRACKING MACHINE BREAKDOWN HISTORY

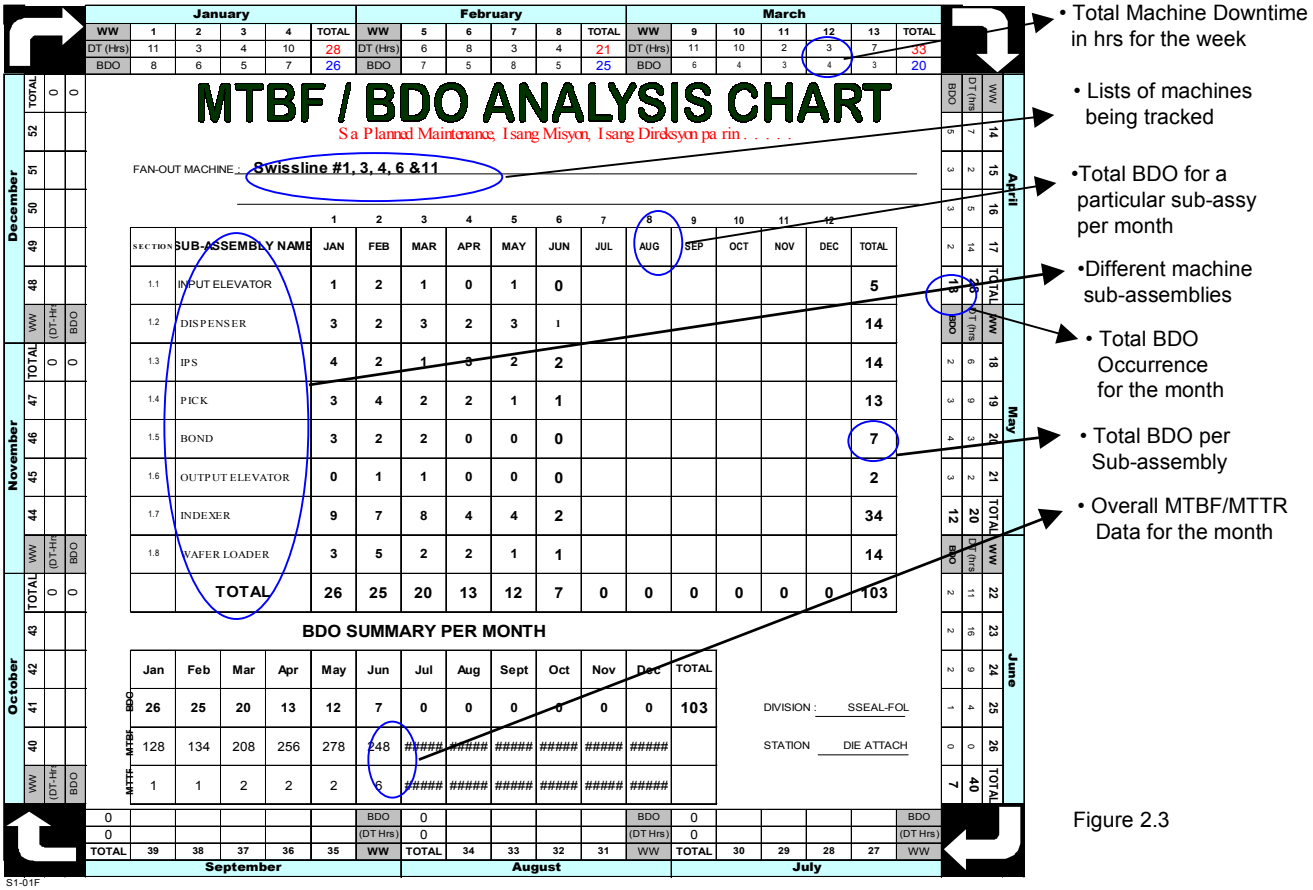


Figure 2.3

It is important that you divide your Pilot Machine into different major sub-assemblies and breakdown must determine what sub-assembly did it occur. This will tell you which is the worst sub-assembly in terms of breakdown so you can prioritize your Planned Maintenance Activities into that sub-assembly. Data listed above data must only include unplanned downtime caused by breakdowns.

MTBF – Mean Time Between Failure = $\frac{\text{(Operating Time – Machine Downtime) hrs}}{\text{Breakdown Occurrences}}$

MTTR – Mean Time To Repair = $\frac{\text{Machine Downtime in hrs}}{\text{Breakdown Occurrences}}$

Both MTBF and MTTR must be expressed in hours. Operating time refers to the time the equipment is operated and is different from available time which is the given time in a shift (8hrs), a day(24 hrs), a month. (720 hrs), Operating time can be equal to the available time if the equipment is running at full capacity or load. If equipment runs only at 80% capacity due to no inventory factor then,

Available time in 1 shift = 8 hrs
Operating time in 1 shift = 8 hrs x 0.8 = 6.4 hrs

Since the denominator of MTBF and MTTR is BDO or breakdown occurrences, if you achieve a zero breakdown for a given week, both MTBF and MTTR is zero since any number divided by zero is infinity, There are 2 choices to make if this is the case :

- 1st choice is to prolong your data from weekly to monthly, disadvantage is that MTBF and MTTR is usually expressed in graphical terms where MTBF the higher the value the more reliable the equipment is while MTTR the lower the value means that the time to repair the machine is fast. Monthly data may not be accurate since it is possible to achieve zero breakdowns in a given month then data for MTBF and MTTR will again be prolong again.
- 2nd The best way to cope with this situation is if case you achieve a BDO of zero then always assume a BDO of 1 any number divided by 1 will give you the numerator itself which means that in a given month you achieve a zero breakdown, then 720 divided by 1 will give you 720 hrs which means that the machine have a perfect uptime with zero breakdown. 720 hrs is the highest MTBF you can achieve for a given month of 30 days, for months with 31 days this shall be 744 days.

2.8 Determine Basic Training Requirements for Pilot Team

Planned Maintenance Facilitator in your plant must see to it that all members of the team are trained on Basic Requirement's needed to undergo each step/phase. It is best that these trainings be conducted in house and hiring a Planned Maintenance facilitator which specialized in this field. Here are what I think are the basic trainings on Planned Maintenance that the teams must complete as they advance to their next step/phase of implementation in their journey. These trainings does not include specialization trainings on their equipment as trainings may differ depending on the type of plant and equipments,

Phase 0 Training Requirements

- Planned Maintenance Overview (4 – 8 hrs)
  - Understanding The Need For A Planned Maintenance System
  - What Planned Maintenance Wants To Achieve
  - Summary of 4 Phases Of Planned Maintenance
  - Different Types of Maintenance Tasks
  - Why Do We Need Planned Maintenance ?
  - From Reactive to Pro-active Maintenance Tasks
  - Roles of Maintenance and Operations on Equipments
- Phase 0 – Preparatory Stage for Planned Maintenance (4 hrs)
  - Steps and activities needed for Planned Maintenance Preparatory Stage
  - Categorizing Breakdowns
  - Development of A Planned Maintenance Master Plan
  - Importance of Machine Ranking

Phase 1 Training Requirements

- Planned Maintenance Phase 1 Training (4 hrs)
  - Detailed Activities Needed To Perform Phase 1
  - Recommended forms to be used for Phase 1
  - What Phase 1 wants to accomplish
  - Understanding Basic Equipment's Condition and why Restoration is needed
  - Difference between Initial Cleaning performed by Autonomous Maintenance
- Poka-Yoke (Mistake Proofing For Zero Defects) (4 – 8 hrs)
  - Usually address problems caused by humans by providing solutions that are foolproof
- Why-Why Analysis (2 hrs)
  - Simple analytical approach on analyzing problem rootcauses
- 6 Equipment Big Losses (4 hrs)
  - Understanding equipments different types of losses
  - What must be included as breakdowns and what must be excluded

Phase 2 Training Requirements

- Phase 2 Training (4 hrs)
  - Lengthening Equipment Lifetime By Addressing Design Weaknesses
  - Detailed Activities and Recommended forms to be used
  - Audit Procedure for Phase 2 and System for Horizontal Replication
- P-M Analysis Training (4 hrs)
  - Problem Solving Technique for dealing with chronic problems
- Initial Flow Control Activities
  - MP Design Improvements

Phase 3 Training Requirements

- Phase 3 Training – RCM2 Methodology (3 days)
  - Basic Understanding on Different Failure Patterns
  - RCM Information Worksheet
  - How to Use The RCM Decision Diagram
  - Developing Equipments Maintenance Tasks
- Predictive Maintenance Overview (4 hrs)
  - When To Use Condition Based Maintenance Techniques and Common Types of CBM Techniques

Phase 4 Training Requirements

- Vibration Monitoring Techniques – Seek Outside Specialization Courses
- Thermography Monitoring Techniques – Seek Outside Specialization Courses
- Lube Oil Analysis / Tribology – Seek Outside Specialization Courses
- Others as seen on your maintenance tasks

Trainings is an essential factor that is required for the success of Planned Maintenance. As each team completes each step/phase in the Planned Maintenance implementation, their skills are enhance and they gain more knowledge and indebt understanding on the daily needs of their equipments. One factor that is often overlooked in the process of maintenance is the use of the right maintenance task, putting everything on time based inspection and preventive maintenance schedules. There are lots of industries

that do not use condition-based maintenance, and there are many maintenance people who have never heard this concept, since they are too busy dealing with repairs and failures. Invest the time needed for these trainings, these are investments your company needs and when each had been applied, whatever time and money you have spend in them will be return to you 10 to 100x fold. Although one caution the maintenance manager must make is that as each of the team members upgrade their skills, they will be more marketable to other industries and even abroad, hence, it is best that whatever learning they learn must be applied to your company, having a contract or including these in their yearly performance appraisal will be a good option.

Summary

Phase 0 is the foundation of building a solid Planned Maintenance structure, aim at completing this initial stage and determine a timeframe of completion. These are the basic activities needed for you to start a strategic maintenance program.

Not all equipment's will undergo each step/phase of Planned Maintenance but rather only those which are classified and rank as A and B. The aim of Phase 0 is to plan ahead your activities on Planned Maintenance, create a Timeframe of completion. It will take 1 to 2 months to complete this stage. Once the planning had been achieved, your next step is to proceed to the details step/phase activities of Planned Maintenance.

Phase 0 Activities : Understanding The Need For A Planned Maintenance System

Activity	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1. Building Your Planned Maintenance Organizational Structure								
2. Planned Maintenance Kick-Off								
3. Define Roles and Responsibilities								
4. Set-Up Vision/Mission								
5. Develop PM Master Plan								
6. Conduct Machine Inventory and Rank Equipments								
7. Select Pilot Machine and Backtrack MTBF/BDO Data								
8. Define Basic Training Modules per Phase of Implementation								

Table 2.1

Chapter 3

3 Phase 1 : Stabilize MTBF Through Restoration

3 Phase 1 : Stabilize MTBF Through Restoration

A machine that had been left unattended suffers from accelerated deterioration, it is both the responsibility of operators and maintenance to establish basic equipment condition on their equipment. Whatever program that you undertake once Basic Equipment Condition had not been established, then it is hopeless to pursue such a program. Maintenance department often have no time to perform Planned Maintenance because they are busy dealing with their day to day failures. It is impossible to established Planned Maintenance in this situation. Oftentimes due to the equipment running continuously non-stop for 24 hrs a day, 7 days a week, these simple basic condition had been neglected.

- Dust, dirt and abrasion
- Poor working environmental condition
- Severe leaks and contamination
- Corroded pipes and internal part of machines
- Not calibrated and non-working gauges
- Non-functional parts or Function Reduction Breakdown of parts such as sensors
- Corrosion of metal parts and cracks
- Missing bolts and nuts due to assembly and disassembly and so on

3.1 Understanding The Concept Of Machine Deterioration

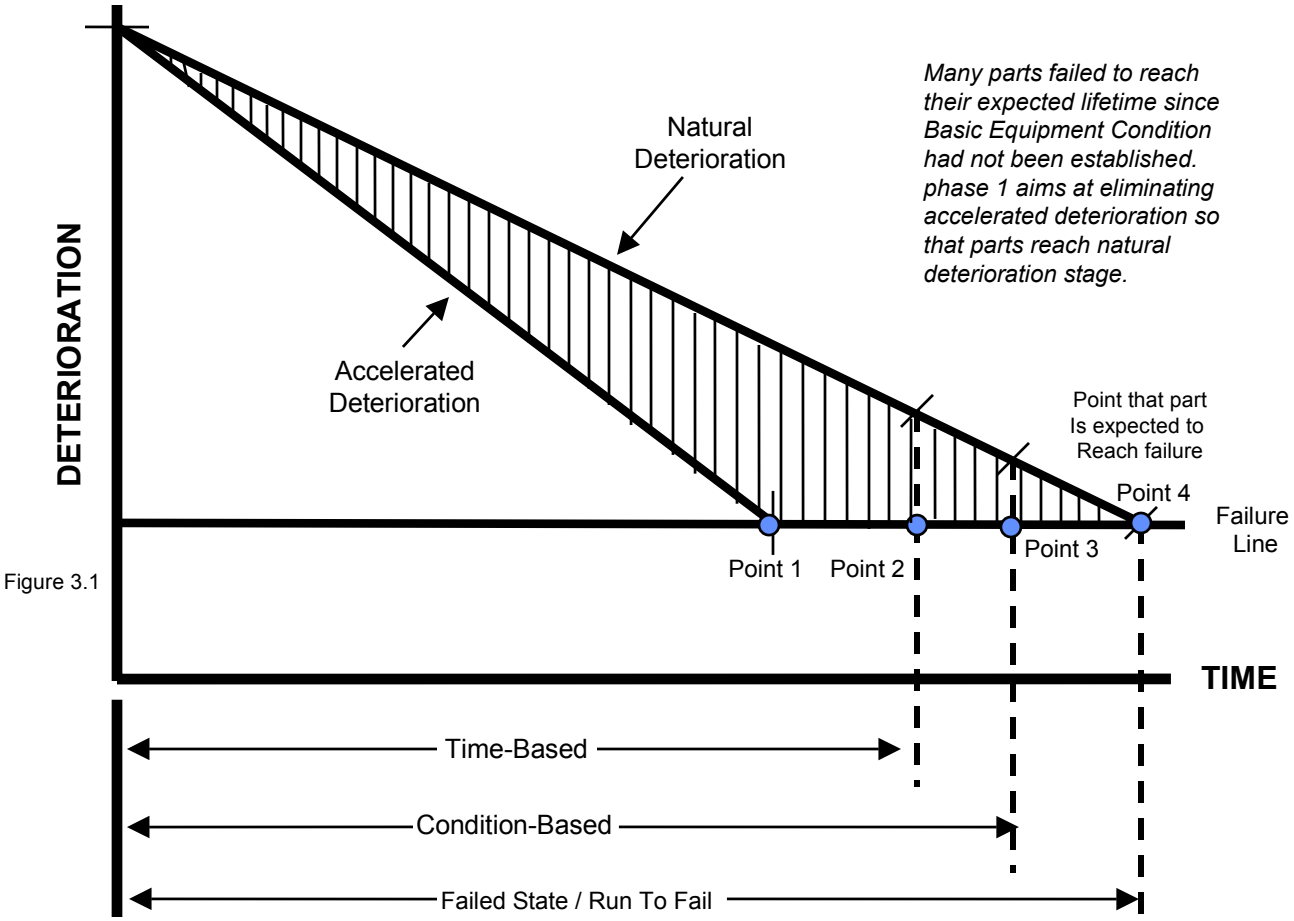


Figure 3.1

3 Phase 1 : Stabilize MTBF Through Restoration

In figure 1, a part or spare is expected to wear out at a specific point in time which in this figure is referred to as Natural Deterioration, but due to neglect in Basic Equipment Condition, the part or spare fails even before reaching its life, which is Accelerated Deterioration. The difference between point 1 to point 3 is the amount of time you could have saved. This is the objective of Phase 1, bring all parts to natural deterioration and avoid failures caused by accelerated deterioration, and once it had been restored all measures must be done to prevent recurrence of the same problem.

3.2 Difference Between Restoration and Improvement

Our basic goal in Phase 1 is to eliminate accelerated deterioration by bringing the equipment back to It's original condition. Restoration is simply replacing the parts and not modifying it, we shall leave the Subject of modification in later phases/step in Planned Maintenance. What is important in this Phase is That parts with deteriorations are replace, therefore when we speak of restoration we simply mean,

- Establishing Basic Equipment Condition means eliminating the causes of accelerated deterioration
- Machine is divided into different sub-assemblies and audited on its current condition
- Basic Equipment that must be established must not be broad, if possible should be specific by indicating numbers and parameters
- For the Autonomous Maintenance Basic Equipment of the machine means it is well cleaned, lubricated and tightened
- Any activities performed to bring back the equipment to it's original condition

On the other hand, modification or improvement means changing sometime out from the original specification of the parts or spare, this is usually done when machine suffers from design weaknesses

- These are improvements, modification or countermeasure done after analyzing its root cause to ensure that deterioration had been eliminated and prevention of recurrence. Example : Oil Leak : Analysis on grade of oil to stand temperature increase or change in a higher resistance oil seal while a restoration task involved means replacing the seal with the same type.

3.3 Perform Initial Cleaning

While Autonomous Maintenance perform initial cleaning and Tag the abnormalities, the PM team likewise is not exempted from this step, the main difference between the initial cleaning performed by operators and maintenance is AM teams focus on the exterior part of the machine, while the PM group perform their initial cleaning on the interior part of the machine, accumulated dirt, dust, rust, corrosion, leaks will be the focus of the PM Team's restoration activities. PM team must lists all deteriorations uncovered during their initial cleaning stage and correct them one by one.

Note for Autonomous Team : While most of the deteriorations include peeled off paint, Do not spend the time to repaint the machine which most of the times is included in their abnormality tasks is not highly recommended, instead, Autonomous Maintenance teams must focus on prevention and what cause the peeled off paint.

Thorough cleaning means taking equipment apart to clean internal parts that you have never been exposed before, this kind of cleaning naturally leads you to discovering deteriorations on the equipment. overtime you will learn the correct way to inspect equipment for deteriorations and distinguish them from normal conditions. By performing initial cleaning we address the following :

On the Equipment

- Dirt and dust on equipment
- Equipment leaks on hydraulic fluid and lubricants
- Overflowing oil pans
- Cutting debris scattered beneath the equipment
- Layers of oil mist on motors
- Strange noise on motors, overheated motors
- Too much vibration on some equipment parts
- Clogged drains and pipes
- Unharness wires and octopus wiring connections
- Oil leaks on floor and machine compartments
- Dirty and disorganized dies and fixtures
- Broken and missing gauges
- Rust and corrosion on equipment parts and pipings
- Worn out or overused parts and spares
- Malfunctioning parts in which equipment still runs
- Dirty and dead sensors

Maintenance Room Area

- Disorganized maintenance bays
- Slippery floors and cabwebs on the ceilings
- Improper storage of spares
- No fix location of tools
- Disorganized files and bulletin boards not updated
- Disorganized spares cabinet, no proper labeling

Many breakdowns occur because of lack maintenance are too busy dealing with the failures themselves. performing basic restoration on equipments can dramatically reduced breakdowns by as much as 50% and in some industries even more. Most industries make it a habit to clean their equipments and workplace when they know that there will be an audit by one of their customers or one of your Top Boss schedules the operation for a visit. Planned Maintenance must not be done this way to satisfy others, in fact basic operating conditions such as maintenance the equipment clean is done to satisfy the user of the equipment. That's is correct, we perform maintenance so as to satisfy the requirements of the user. Often times negligence on these basic factors happens because people perceived breakdowns as normal and as part of their routines. They are custom to perform repair and fixes on equipments as part of their basic job. Performing Planned Maintenance requires a change in direction, a change in the way people think, a change in the way people act, unless these changes are accepted by all levels of organization in the maintenance department, and are willing to perform the necessary steps required for such a change can spell the difference of success in such an implementation.

Restoration plays a crucial factor in Planned Maintenance, and Top Management must support this activity as there are cost factors involved in such undertaking. Imagine you have been approved of a loan and you purchase a second hand car, you try to inspect and perform initial cleaning on your 2nd hand car and perform restoration on these items so that you feel more confident driving your car. Same thing goes with your equipment which had been running non-stop to cope up with output measures.

There are functional reduction breakdowns that need to be analyzed and restored, often times this does not affect the operation of the equipment however they serve a function in particular. Spend the Time to correct and restore these basic functions through Phase 1 of Planned Maintenance.

3.4 Detailed Drawing of Equipment's Sub-Assembly

It is highly recommended that a drawing of the major sub-assemblies be done by the maintenance Group. There are two purposes of doing this, first so that we can place a mark on where each Breakdown occurs for easy reference by all maintenance involved and secondly, this serves as your Training materials later on for teaching the Autonomous Maintenance group once they are in place. Imagine the level of knowledge an operator may have once maintenance teach them these drawings. These can aid as a communication in pinpointing the exact location of the failure which occurs frequently

Operators knowing the parts of his equipment can facilitate easy communication during what problems had occurred in their equipment, and later on, you can teach operators to perform some basic minor repairs, having you more time to focus on improving more sever failures.

3.5 Analyze Deteriorations and Prevent Recurrence Of the Failure

After completing your lists of deteriorations, teams meet and discuss each deterioration uncovered and perform a simple why-why analysis on why each deterioration that had occurred and single out counter-measures to prevent recurrence of the problem. Most of these deteriorations had been neglected and As the meeting progress, basic equipment condition of the equipment is taking place. Maintenance Now understand why these deteriorations occurred in the first place, and what effect does it have on their equipment, although some parts restored may have no relation to breakdown and are considered as functional failure reduction, they may contribute to some problems of the equipment.

3.6 Document Evidence Before and After

Since we are implying a TPM concept of implementation on Planned Maintenance, a before and after picture is required, these serve as your document on completing each restoration activity and can serve as teaching aid to other teams and operator performing autonomous maintenance. A Digital Camera will be useful in this tasks. The goal of the team is to correct all the deteriorations uncovered during their Initial cleaning stage.

3.7 Standardization of Documents

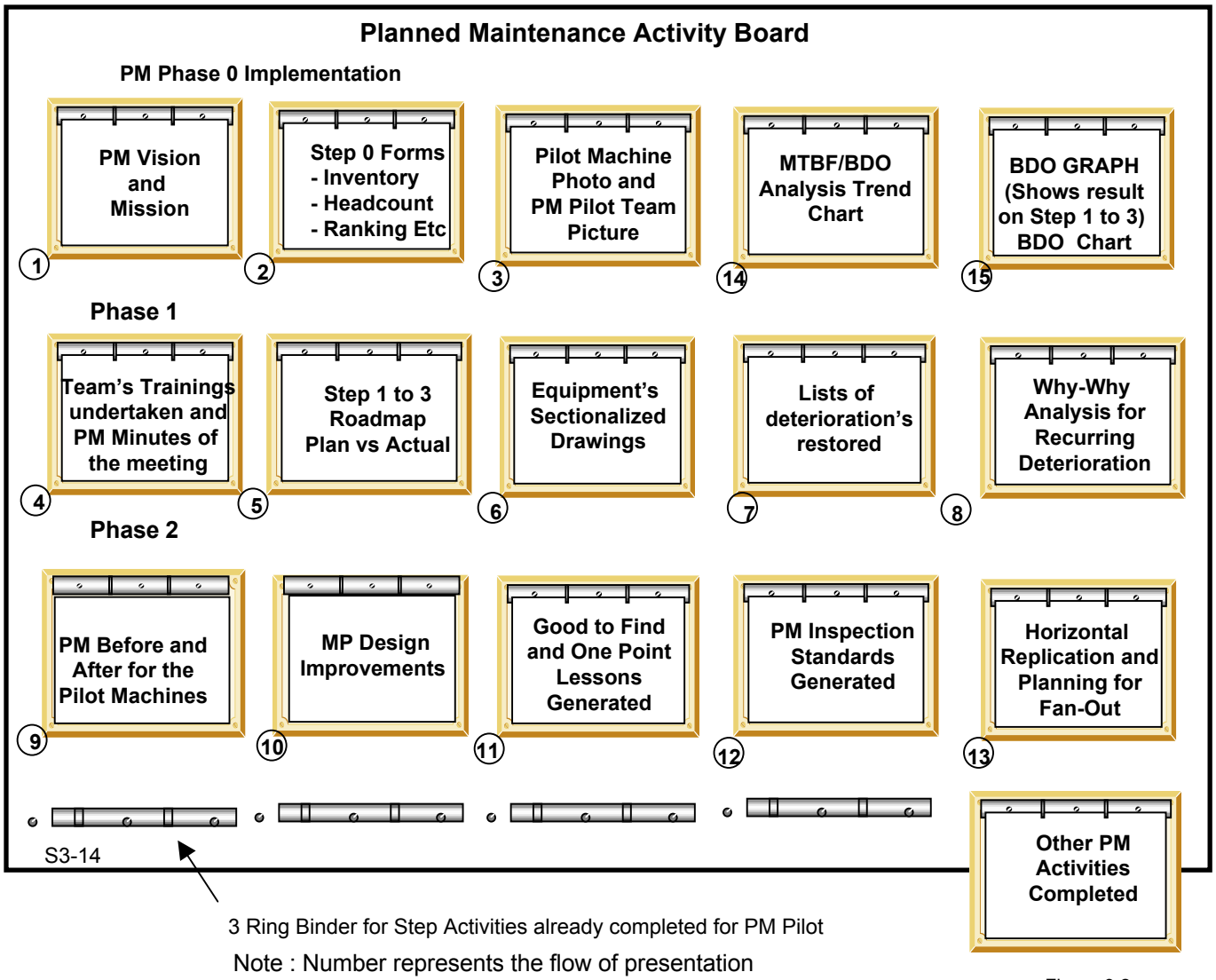
Standardization of documentation is an activity in Phase 1 where each deterioration uncovered is being crossed checked in to your existing Preventive Maintenance Checklists if a suitable task is performed and why such tasked had been overlooked. If no standards had been made then a temporary inspection standard is performed and a tentative revision of your PM checklist must be done. Objective of this activity is to include all deteriorations that are uncovered, with a timely inspection and frequency which must be made specially when he consequences of the failure is severe. The standards listed here are tentative standards and must be performed on the specified date provided, also indicated in this activity is who is the best responsible person to perform this inspection whether maintenance or operators.

If the responsibility is to be performed by the operators of the equipment, it is very important to educate and train the operator through visual aids such as OPL (One-Point Lesson) or GTF (Good to Find) forms so that operator understands why they need to perform such tasks. If Autonomous Maintenance is not performed regularly or no activity exists, operators think that this is an added burden to them and find maintenance passing the job to them, these must be explained to them carefully since they are the once closest to the machine 90% of the time.

3.8 Planned Maintenance Activity Board

Although JIPM Consultants require both the Autonomous and Planned Maintenance to have their own activity board in place. Activity boards is used to highlight the activities of the teams and their progress, important factor here is the Breakdown Trend where after completion of restoration a drop in breakdown is evident. Not only does this serve to highlight the teams progress, but it serve as reference to all maintenance and operators that by seriously performance the basics of Planned Maintenance, breakdowns are reduced dramatically. The goal of Planned Maintenance is to minimize Unplanned Breakdowns.

Teams must update their activity boards regularly and monitor the trend of their graphs. These will serve as evidence of their accomplishment in successfully completing their Phase 1 activities on their Pilot Equipment.



3 Ring Binder for Step Activities already completed for PM Pilot

Note : Number represents the flow of presentation
Recommended 4 ft by 8 ft White board

Figure 3.2

3.9 Performing The Planned Maintenance Audit

Audits are done to check that the team comply with the activities performed in doing Planned Maintenance. This is initially done by the TPM Facilitator together with the Maintenance Managers, while after exposing the Maintenance Managers to such activities, they must own the audit themselves, since they are directly responsible for the equipments. The Planned Maintenance Facilitator briefs the Maintenance Manager on what to look for regarding audit, likewise the reason why they are the best candidate to perform the Audit themselves. The Planned Maintenance Audit composed of 2 parts :

Room Audit or Activity Board Audit

Team present their activities to the auditors, referring to figure 3.2 on page 22 each number corresponds to the sequence of activities they are going to present from Phase 0 to Phase 1 activities. Pilot team explains in details of their accomplishment. Team must be brief and precise in their presentation and this usually take around from 30 min to 45 min. Complete lists of Phase 1 audit is included in the appendix. These are the maintenance indices that must take place if the team are ready for the audit

- BDO (Breakdown Occurrence Trend) – The Lower the better
- MTBF (Mean Time Between Failure Trend) – The Higher the better

The objective of the audit taking place and the auditor being their Maintenance Manager, is to see to it that the team takes pride in their success on improving the breakdown rate of their equipment. If this was possibly done on their pilot and worst equipment, then it can be done on all Rank A and B machines.

Equipment Audit

After the room or activity board audit, both PM auditor and the team proceed with the equipment and auditor checks the validity of the documents with respect to the actual condition of the equipment. They also looked for other unwanted factors and may include them in their pending requirements if found. managers performing the audit asked the teams the benefits of performing Planned Maintenance and how they are going to sustain whatever activities they had performed specially on restoration so as not to let the equipment deteriorate and left unattended again. It is important that standards set forth must be performed as this will serve as their sustenance measures, otherwise if these will be just for show-off purposes, a couple of months work will bring back again the equipment to the stage where they had started. Do not skip this very important factor, sustaining equipment must be done at all measures.

After several question and answer on the part of the team and the PM Auditors, the audit is concluded And the team are graded for their performance, if the team had attain the standards and requirements Set forth in their Phase 1 activities, then they deserve a passing mark which is usually a rating of 85% or higher. If many items that must be addressed are found by the auditors, team may achieve a remark of unconditionally passed unless otherwise all pending requirements are settled on the date both agreed by the auditor and the team. Phase 1 audit compose of the following :

- Preparatory Stage – Completion of Phase 0 activities, how pilot machine is selected, training completion
- Understanding of Current Condition
- Restoration Activities and Completion
- Rootcause Analysis and Countermeasure to prevent recurrence of the problem
- Evidence of Before and After Restoration – Trend in BDO and MTBF
- Documentation and Sustaining Measures

3.10 Horizontal Replication or Fan-Out Activities

Depending on the number of equipments to be replicated or fan-out, the original Phase 1 team members break themselves into several groups and perform Phase 1 activities to similar equipments. Since the original member had already gain some experience in performing Phase 1 activities, he/she is responsible In coaching new members on the activities to be performed.

Figure 3.3

3.11 Summarizing Phase 1 Activities

Activity	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1.Categorize and Track Down BDO of Pilot Machine								
2. Perform Initial Cleaning on Pilot								
3. List all deteriorations uncovered and perform restoration								
4. Sectionalize the machine into different sub-assemblies and draw								
5. Analyze deteriorations and prepare Why-why Analysis								
6. Set countermeasures for preventing recurrence of the problem								
7. Select worst sub-assembly and perform restoration on equipment								
8. Perform Steps 5 to 7 on other sub-assemblies								
9. Document Evidence on Before and After Restoration								
10. Classify Top Deteriorations and prepare GTF or OPL								

Table 3.1a

Continuation . . .

Activity	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
11. Update MTBF/BDO Trend Chart for Pilot Machine								
12. Summarize lists of deteriorations for possible replication								
13. Prepare Tentative Inspection Standards and Update Checklists								
14. Post all documents on Activity Board and update regularly								
15. Final Checking on completeness of Activity and Documentation								
16. Proceed with Phase 1 Audit								

Table 3.1b

Phase 1 Activities for Horizontally Replicated or Fan-Out Equipments

Activity	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1. Group the machine by batches and backtrack BDO Data								
2. Divide the original team and add 2 new members per batch								
3. Perform Initial Cleaning and lists deteriorations uncovered								
4. Check Pilot's Horizontal Replication and add new deteriorations found								
5. Perform Restoration on Fan-Out or Replicated Machines								
6. Update MTBF trend for Fan-Out after completing restoration								
7. Perform Inspection Standards and add lists on Pilot Standards								
8. Documentation and Posting on Pilot's Activity Board								

Table 3.2

3.12 Phase 1 Completion

Phase 1 activities usually takes around 3 to 4 months to complete, and once this is done according to the step activities provided, unplanned breakdowns can be dramatically reduced as high as 80 %, and we have just perform the basics. Model equipment chosen must belong to the Rank A category and fan-out or similar equipments must belong to both Rank A and B category.

Once breakdowns had been reduced on the 1st Pilot Equipment and their corresponding fan-out, carry on the activities to other Rank A equipments and perform the same activities as you did in your 1st pilot which can compose of different team. And update timeframe of completion on your Master Plan.

As each equipment had completely undergone Phase 1 activities, a reduction in breakdown is achieved. Breakdowns which can stop and hurt your operations, and a change of mindset had undergone for the team and the way they treat and maintain their equipments. Their skills had been upgraded since they study and analyze each deterioration and why it occurred in their equipments, and this is an important change in their daily tasks, what is important is that these becomes a habit. The team that had undergone these activities realized that the most important part of their job is not how many failures or breakdowns they had repaired for a given day, but how these breakdowns can be eliminated by a thorough analysis of the failure that occurred.

Phase 1 is not only about improving the equipment, but it is also about improving the way operators and maintenance think about their equipment. Just as each person needs love and care, equipments are not exempted, if properly operated and maintained, they will deliver to perform the task required of them.

It is a good gesture for the maintenance manager to provide simple and inexpensive recognition to the Team since they are proud of their accomplishments. A certificate of achievement can be provided by HRD with your recommendation, or a simple lunch with the team may do. This is important in letting them know you are acknowledging their efforts and improve your relationship.

The team that comprises the 1st pilot will serve as a model of success to every new team that will be doing the same activities, they will be benchmarked and consulted by other teams in their activities on Planned Maintenance. As more and more teams are created, more and more breakdowns are reduced, maintenance skills are upgraded.

With the completion of the 1st Pilot Equipment on it's Phase 1 activities, team can prepare to advance to Phase 2 and must attend necessary training requirements provided by the PM Facilitator.

Chapter 4

Phase 2 : Lengthening Equipment Lifetime

4 Phase 2 : Lengthening Equipment Lifetime

4.1 Equipment Design Weaknesses

After completing Phase 1, it is important that Basic Equipment Condition must be maintained. Maintenance teams observed a reduction in unplanned breakdowns but still we need to observed what Part or spare is often replaced or worn out easily. Even if this is what is expected on the timely replacement of the said part. Our objective in Phase 2 is to identify what parts needs to be improved in terms of lifespan. Once the spare part with inherent design weakness had been identified, the team Analyze and study the part and what need to be change, factors such as changing it's dimension, material change, or completely redesigning the part in order to increase it's lifespan. Figure below Details what we want to achieve in Phase 2 of Planned Maintenance.

4.2 From Natural To Extending Equipment's Parts Lifespan

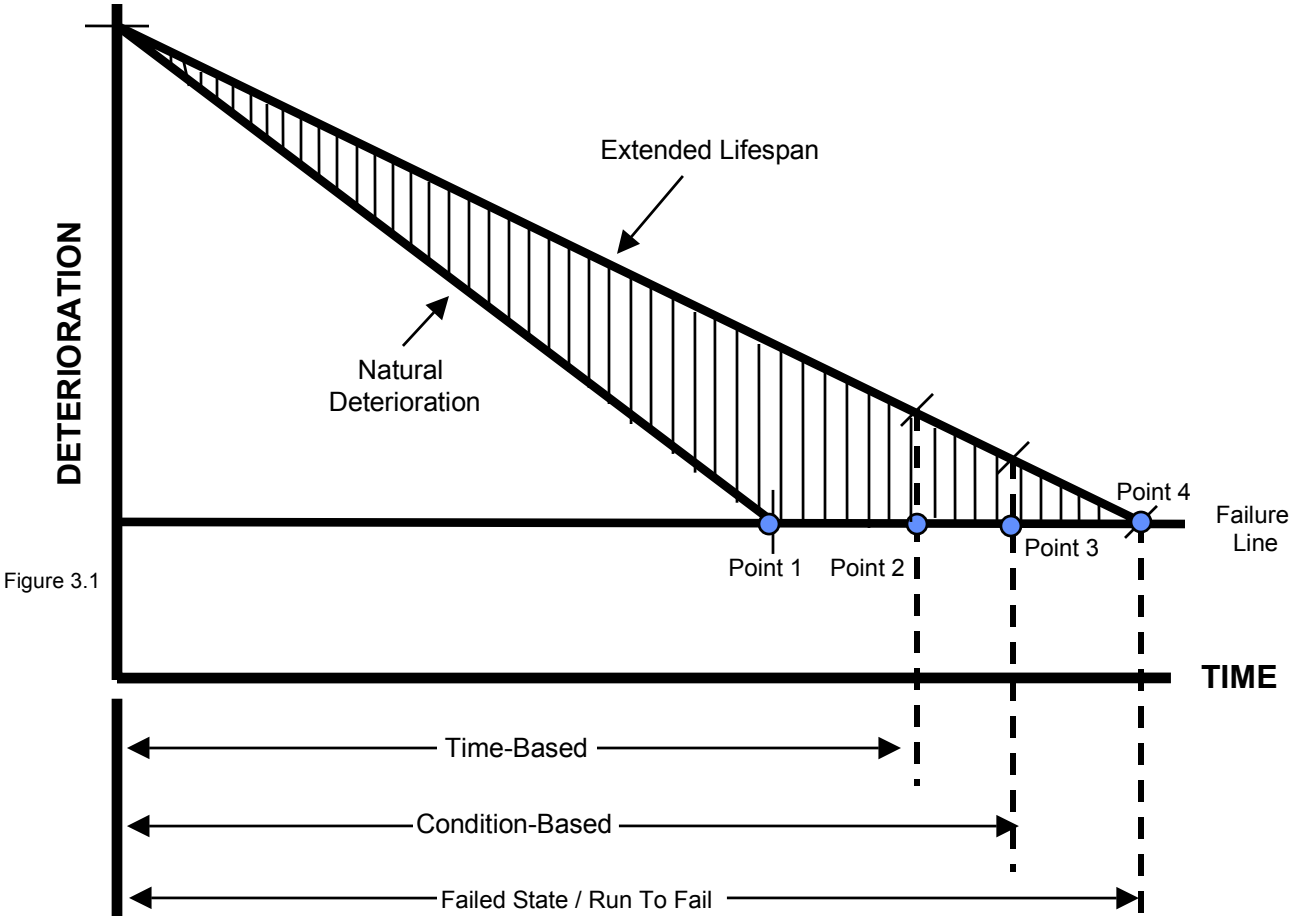


Figure 3.1

Phase 1 **Stabilize MTBF**	**ADDRESS BASIC PROBLEMS**  **TASKFORCE RESTORATION TEAM**	**RESPONSIBILITIES** • Equipment Inventory • Equipment Ranking • Pilot Machine Selection • Conduct Initial Cleaning • Basic Restoration • Reduce Breakdowns • Improve MTBF • Horizontal Replication
Phase 2 - 3 **Determine the Maintenance tasks required**	**PM SYSTEMS**  **RCM MAINTENANCE TEAM**	**RESPONSIBILITIES** • Conduct an RCM approach on determining the correct maintenance tasks for the worst equipment • To compose of maintenance personnel with the most comprehensive experience of the equipments
Phase 4 **Lengthen Equipment Life & address difficult minor stoppages**	**PM IMPROVEMENTS**  **PM KAIZEN TEAM**	**RESPONSIBILITIES** • Address Design Weakness • Improve Set-Up Time • Improve Difficult Minor Stops and other equipment

Although JIPM procedures teach that each Step or Phase be done in sequence and on the same machine with the same team involved. Whatever course of action in your maintenance organization you will undergo, take note that it shall be the responsibility of the maintenance manager to consistently review the process each team undergoes