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The Role of Eight Pillars of Total Productive Maintenance-TPM Pillars Analysis

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ABSTRACT

TPM is one method to improve manufacturing performance through an emphasis on maintenance that involves everyone in the organization. Research on the application of TPM and its relevance to the manufacturing performance has been performed quite a lot. However, to the best of our knowledge, a study that deliberates how the application of 8 pillars TPM (especially in developing countries) is still hard to find. This paper attempts to evaluate in more detail about how the 8 pillars of TPM are applied in Indonesia and their impact on manufacturing performance.

Main findings

The level of motivation of the team was positively associated with a change in operational performance, and the implementation of TPM had a positive impact on performance, and the role of eight pillar in TPM.

Keywords -Total productive maintenance, DTL = Downtime Loss, SL = Speed Loss, QL = Quality Loss.

1. INTRODUCTION

With the constraints of intense competition internationally, manufacturing sector is under pressure to offer high levels of performance and dedication. To handle the ever-changing client needs, manufacturing organization choose to embrace strategic changes in management techniques, production process and technology, supplier attitudes and customer behavior. Lean manufacturing concepts have been extensively applied by manufacturing organization to make these changes and gain competitive advantage. It also has stressed the re-examination of the function of enhanced maintenance management towards boosting the organization's competitiveness . One technique to increasing the performance of the maintenance tasks is by applying Total Productive Maintenance (TPM) strategy . It is essential in contemporary manufacturing for enterprises to be successful organization, and it needs to be backed by both effective and efficient maintenance programmed, which is TPM .

RESEARCH METHOD

This is an exploratory case study that used a measurement of motivation with two teams of employees who participated in the implementation of TPM, comparing it to measures of operational performance. Unstructured interviews and nonparticipant observation were also used for data collection.

LITERATURE REVIEW

The literature review discusses the Total Productive Maintenance system and workforce motivation, focusing on TPM implementation, on the role of motivation in the performance of workers, and on the conceptual model and hypotheses that are proposed in this study.

What is Total Productive Maintenance (TPM)?

Total productive maintenance is a complete system for maintenance of equipment that aims at achieving an optimal production environment devoid of defects, downtime, stoppages and accidents. One distinct advantage of total productive maintenance is that it empowers the shop floor to work in a concerted manner to ensure that machines are functioning at their optimal performance. In fact, in a lean production setup that is practicing TPM, you find it difficult to distinguish between normal operators and maintenance staff. This is because they all are proactively involved in the maintenance of machines which leads to increased productivity, lower costs, improve quality and extended machine lifespan.

Hypotheses and conceptual model
Based on the literature review, two hypotheses are defined that underlie this study, which refer to the case of the researched company:

H1: "A higher level of motivation of the team is associated with a positive change in operational performance after the implementation of a TPM program and his eight pillar."

H2: "The operational performance of production lines is positively impacted after the implementation of a TPM program and his eight pillar."

Finding
This study analyzed the role of the motivation and his eight pillar of the teams of two production lines of an industrial company in the operational performance obtained with the implementation of TPM. Evidence was found of the impact of the TPM program on operational performance. Among the research hypotheses, there is evidence supporting the hypotheses (in this case study): H1: A higher level of motivation and his eight pillar is associated with a positive change in operational performance; and H2: The implementation of the TPM program and his eight pillar has a positive effect on operational performance. Thus, it is important that companies have working practices and conditions that foster the motivation of their employees, and such practices were identified in the literature review. As was previously explained, the focus of this study is on the role of motivation in the implementation process, and not on the day-to-day operations of companies using TPM. This constitutes an additional contribution of the research.

The major contribution of this study is therefore to combine human behavior with operations issues, in line with the growing importance of the human factor in current studies in the field of operations, which demonstrates the importance of people management. The behavior of workers and teams is necessary to inform adjustments or abandonment of pre-existing practices, creation of new practices, and especially the monitoring of management practices and their results according to the realities specific to each production site. The main limitation of this study is the low external validity, as it is a case study that cannot be generalized. Future quantitative studies with a survey design, collecting data from several companies, and using normalized and control variables, are necessary for increasing the external validity of the evidence shown here. In addition, the periods of analysis (of data collection and interval between them) should have been longer. However, this was not possible because of the recency of the changes and due to limitations of the study design itself. The fact that team motivation was measured only at one moment in time, i.e., after the implementation of TPM, is another limitation.

TPM – Total Productive Maintenance Pillars
Developed in the early 50s, Total Productive Maintenance is a program for increasing efficiency of machines and processes which stands on eight pillars with 5S as its foundation.

TPM 5S Foundation
5S is considered the foundation of the lean TPM program because without it the initiative will founder under the weight of disorganization, indiscipline and inefficiency. It is important because it results in a clean, visually organized workplace that is self-maintaining. 5S consists of five basic steps:

Sorting all the items in the workplace and removing everything that is not necessary and does not contribute to the creation of value for the customer. Setting in Order everything that remains in an organized manner such that find items and raw materials is easy. This reduces waiting and searching time in the process enhancing the flow of value throughout the value chain. Shining (Cleaning) is a way of making any abnormalities visible as well ensuring that quality of the final product is of a high standard. It has been observed that a clean and organized workplace has a positive effect on worker morale, not to mention that it also ingrains a sense discipline – all of which has an impact on overall productivity. Standardizing ensures that the improvements made are documented for posterity as well as serving as a basis for further improvements and training.

Sustaining the improvements through scheduled audits is a way of stabilizing the system by ensuring the agreed standards are been followed. Audits also serve as a measure of the effectiveness of the established standards – feedback that can be used to determine whether the standards need further revision or improvement.

The 5S program sets the pace for the introduction of Total Productive Maintenance and must be fully mature before any attempts are made to implement other aspects of the system. As a stand-alone component, 5S is very effective in improving the organizational metrics and has been shown to increase aspects such as productivity and quality.

For example, if the workplace is clean and organized, tools used in maintenance are easily located – this has a positive effect on machine uptime.

The Eight TPM Pillars

Once a high degree of stability is established using the 5S program, an organization can start implementing the total productive maintenance in earnest. Total productive maintenance has eight pillars that are aimed at proactively establishing reliability of machines. One point that has to be made here is that people are centre of this system and must be continuously trained to identify and eliminate waste. It is a system that is based on a clear set of principles and structures and should not be interpreted to be a set of tools or techniques to be applied haphazardly.

TPM Pillar 1: Autonomous Maintenance (Jishu Hozen)

Jishu Hozen or Autonomous Maintenance places the responsibility of basic maintenance activities on the hands of the operators and leaves the maintenance staff with more time to attend to more complex maintenance tasks. Maintenance activities that are carried out by shop floor workers include basic cleaning of machines, lubricating, oiling, and tightening of nuts and bolts, inspection, diagnosis of potential problems and other actions that increase the productive life of machines or equipment.

By carrying out these maintenance activities, the workers become more responsible towards their work and downtime is reduced because there is no need of waiting for maintenance staff as they can correct simple problems that may occur from time to time. Maintenance staff on the other hand will be more concerned with issues that require a higher technical ability such as replacement and servicing of internal parts. They will also carry out scheduled or planned maintenance which means production will not be interrupted unnecessarily.

Autonomous maintenance has benefits to both the workers and the organization as a whole:

- Operators become more responsible and concerned about the condition of equipment they use on a daily basis
- Skill levels of workers increase as they gain an understanding of the general working of equipment thus achieving the multi-skilling objective of a lean organization
- Machines operate at their optimal level because basic maintenance such as cleaning and lubrication is carried out more regularly
- Problems are identified and corrected before they go out of control leading to major breakdown of equipment.
- Engineering staff are freed-up to carry out higher-level maintenance activities on sensitive and critical equipment thus reducing the overall system downtime.

By carrying out the simple activities in this TPM pillar, capital investments are drastically reduced because the organization has reliable equipment and does not have to replace machines as often. This is because the lifespan of machines is drastically increased as forced deterioration is checked through constant monitoring and maintenance.

TPM Pillar 2: Planned Maintenance

Planned maintenance is the scheduling of maintenance activities based on observed behaviour of machines such as failure rates and breakdowns. By scheduling these activities around such metrics, the cycle of breakdowns and failure is broken thus contributing to a longer service life of machines.

Because there is a specific time for maintaining equipment, production is rarely interrupted as these activities are scheduled around the time when they are idle or are producing very little. In fact, production functions can build up some inventory to allow for the planned maintenance to be carried out as they have prior information of when these activities are scheduled.

This is in contrast to reactive maintenance that waits for problems to occur which has a negative impact on productivity due to machine downtime. Production will never be sure when they will be able to get back to work because the problems are not clear and technicians will just be doing exploratory work to find causes.

There are many obvious benefits of taking the planned maintenance approach as compared to being reactive when technical issues arise:

- By constantly scheduling maintenance activities, the number of breakdowns gradually decrease and this then increases the capacity for productive activities.
- Production functions can continue with their activities uninterrupted because they know exactly when maintenance will take place.
- Maintenance is done when the production floor is not very busy.
- Capital investments in machinery are reduced as the equipment is utilized to its fullest potential.
- Expensive machine parts do not have to be kept in inventory as there is better control of the various categories of parts.

Pillar 3: Quality Maintenance
This TPM pillar addresses the issue of quality by ensuring equipment is able to detect and prevent errors during production. By detecting errors, processes become reliable enough to produce the right specification the first time.

The quality aspect of maintenance is very important because it helps in preventing defects from moving down the value chain which only leads to a lot of rework.

Using lean tools such autonomation (jidoka) and andon, machines detect and report any abnormal conditions, thereby releasing the operators from the tedious monitoring that is common in non-lean operations.

The quality maintenance pillar of TPM also ingrains in the workforce the habit of finding the root cause of problems instead of rushing to solutions that are not permanent. This is done through tools such as 5 Whys root-cause-analysis and Ishakawa diagrams which are structured ways of getting to the real reasons why problems occur.

Quality maintenance offers a number of advantages including:

- Targeted improvement activities address quality issues that arise from time to time in the workplace by coming up with permanent countermeasures
- Defects are minimized or completely eliminated
- Cost of poor quality is reduced by getting quality right the first time. This happens because errors are caught before they move down the value stream which reduces the amount of rework that has to be done to correct them

Pillar 4: Focused Improvement (Kobetsu Kaizen)
In this pillar, cross-functional teams are assembled with the main working on problematic equipment and coming up with improvement suggestions.

The use of cross-functional teams is important so as to have a large and varied number of employees involved so as to bring in different experience as well as viewpoints to the table.

These teams are better placed to come up with solutions to the issues that arise concerning crucial machines. The kaizen projects for maintenance also serve as training sessions on the total productive maintenance tool which results in the organization having a large pool of skilled personnel. Once a focused improvement team for maintenance has been identified and trained, they choose at least one piece of equipment as a pilot for their activities. Problems relating to the equipment are identified and improvement goals set in a three to five day in-house kaizen event. During the events, the participants map the current state of affairs as a baseline performance measure on which they will compare any future performance after improvement.

The teams work together to make sure that any solutions that they come up with are implemented and any follow-up activities are completed within the agreed timelines. The focused improvement pillar of TPM is therefore advantageous as quick gains are made which helps in promoting the lean methodology to workers who may not have bought in to the program. The organization is able to build-up a large base of employees that are conversant with the right tools for solving problems and getting to the root cause.

Pillar 5: Early Equipment Maintenance
The fifth TPM pillar of Early Management uses the experience gathered from previous maintenance improvement activities to ensure that new machinery reaches its optimal performance much early than usual. Working with a myriad of stake-holders including suppliers, the company is able to hit the ground running with highly reliable and productive equipment.

Such an approach has a positive impact on profitability of the company as maintenance costs are dramatically reduced. The productivity as well as output quality of the machines is also guaranteed from the very first day when the equipment is commissioned.

Using the input from the people who use these machines on a daily basis, suppliers of the equipment can improve the maintainability and operability in the next iteration of their products. Among the factors that should be considered when designing new equipment include:

- Ease of cleaning and inspection.
- Ease of lubrication.
- Accessibility of equipment parts.

- Improving operability of machines through ergonomically placing controls in such a way that they are comfortable to use by operators.
- Making it easier for changeover to take place through simplification of procedures or eliminating the unnecessary ones.
- Feedback mechanisms that prevent out-of-spec situations as well as clear indications of the correct specifications for quality products.

Increased safety features

- Though the machines may be designed and manufactured with all the above considerations in mind, it is still possible that there will be bugs that will need to be removed before full commissioning.

- Early management is a system that addresses these concerns and uses input from the staff who will be using the equipment before installation.

Pillar 6: Education and Training

This pillar is concerned with filling the knowledge gap that exists in an organization when it comes to total productive maintenance. Lack of knowledge in the tools can stand in the way of proper implementation leading to mediocre results at best and failure at worst. Without proper training, tools such as TPM can be misunderstood by the staff which can result in disastrous results for the company. Ensuring that employees are trained gives the organization a reliable pool of knowledgeable staff that can drive the initiative competently.

TPM education and training pillar is a company-wide initiative that does not leave out any employee cadre. In fact, all levels in the organization – from the operators to senior managers – get involved in the TPM training as well projects. Through training, operators' skills levels are raised to the point where they are able to carry-out basic maintenance activities that were previously the preserve of maintenance staff. The technical staff are then taught higher level skills such as preventive maintenance and analytical skills to help become more proactive to problem solving.

At the managerial level, managers also learn the TPM skills so as to become competent mentors to their juniors as well as be involved in coaching programs.

Pillar 7: Health, Safety & Environment

That workers must be able to perform their functions in a safe environment devoid of health risks cannot be gainsaid. The health, safety and environment pillar of total productive maintenance ensures that all workers are provided with an environment that is safe and that all conditions that are harmful to their well-being are eliminated. While the goal of any organization is to produce value for the customer in an efficient and productive manner, this should be done in a way that is does not put to risk the safety of workers. It is therefore important that any solutions which are put in place should consider the well-being of the worker above all else.

When workers are in a safe environment, their attitude towards work changes dramatically with a resultant increase in important metrics such as productivity. This is because injuries or fatalities reduce when there is a concerted effort to make the workplace an accident-free environment. The cross-functional teams will work towards making machines safe to use by the operators by putting in place such features as guards, works standards, use of personal protective equipment and first-aid kits in the work-area. Each of these measures are aimed at improving the safety of the machines so as to have a more productive work-force.

Pillar 8: TPM in Office Functions

Taking TPM to the administrative functions is the next logical step in the total productive maintenance program so as to have the whole organization speaking from the same page. As these are supportive functions, making them understand and apply the principles of lean in their own operations makes it easy for them to provide efficient service to the main value-creating processes.

In addition, spreading the initiative into other functions removes the silo mentality and encourages horizontal cooperation within the workforce. The organization will also benefit by having a larger pool of workers who understand the principles of TPM and can easily be called upon to play a positive role in its implementation.

The TPM principles can also be applied as stand-alone techniques to improve the efficiency of these supportive functions. For example, if the administrative functions are able to improve their order processing procedures, then material will get to the shop-floor in a flawless manner which will have a positive effect on the workflow.

If suppliers are paid on time, they will have the ability to provide the services that they have been contracted to give without any problem. As we conclude with this pillar, it is important to note that each has its role in the greater scheme of things and should be employed at the appropriate time. While each TPM pillar has can be applied as a stand-alone

component, the aim should be to sequentially implement each of the pillars so as to have get the full benefits of a complete system.

The Role of OEE in Total Productive Maintenance
OEE is a supportive metric that measures how productive a process is against the expected productivity of that process and is a strong component of the TPM program that must be measured at regular intervals.

It is composed of three important metrics that tie in well with the overall objectives of a TPM program as set-out in the introductory part of this article.

The three components of overall equipment effectiveness metric are:

Availability- which is a measure of the percentage of time that a piece of equipment or a process is available for productive work. The goal of this metric to ensure that there are no break-downs and downtime beyond the already planned downtime.

Performance measures how well a process performed against the set targets and exposes any speed losses that may arise during the running of a production process.

Quality is a measure of the percentage of good parts that come out of a process against all the parts produced. It is concerned with the defect-rate and the ability of a process to produce good quality the first time without the need for rework.

OEE is an important metric as it ties-in well with the objectives of a TPM program that aims at having zero-defects, zero-breakdowns and zero-stops in the production process. A more detailed account of the OEE metric can be found in our page on overall equipment effectiveness.

The tracking of OEE is important because by doing so, one will be able to tell whether the TPM program is working as intended as well as the effect of any improvement activities.

Collection of OEE data is therefore an integral part of the TPM program and can be done either manually or automatically.

Each data collection technique has its advantages but one will notice that an automated OEE data collection strategy can provide even greater benefits.

For example, for processes with extremely short cycles, it would be better to employ automatic data collection mechanisms such as computerized metering. This will free up the operator to do their main task as well improve on the accuracy of the data collection activity.

Six Big Losses of Production
In addition to the losses described in the OEE metric, production units experience six common losses which reduce the productivity of an organization.

By addressing these losses, a total productive maintenance program results in increased productivity through reduction of wasteful conditions within processes.

The following table shows the six big losses, their relation to OEE and typical examples in a production facility:

Six Big Losses Summary

Six Big Losses	OEE Loss Classification	Examples	Remarks
Machine Breakdowns	DTL	Fan belt breakage, tool failures,motor breakdown	Must be clearly defined so as not to confuse with small stops
Setup Loss and Minor Adjustments	DTL	Product change-over, staff shortage, material shortage	SMED is used for reducing the effects of this loss
Minor Stoppages	SL	Inspection, jams, adjustments, blocked	Very short stops (-5mins) not

Six Big Losses	OEE Loss Classification	Examples	Remarks
		sensing devices,	requiring technical intervention
Slow Running	SL	Poor settings and alignment	Factors that prevent the design capacity/speed from been achieved
Start-up Errors	QL	scrap and rework	Occur before the process starts in earnest
Product Defects	QL	scrap and rework	Occur during the running of the process

TPM Implementation Steps
Having considered the important components of a TPM program, it is now time to discuss how to implement them in a cohesive manner across all functions of an organization.

This step by step implementation is important if there are to be any tangible gains to be had from the program and each step should be implemented sequentially for maximum effect.

TPM Step one – Piloting
The first step in implementing the program should start with the identification of a pilot area. The importance of this approach is that the program will gain more acceptance and momentum when staff realize the benefits that accrue from its implementation. Several considerations must be taken into account when choosing the pilot area and these include:

Is it easy to get the "low hanging fruit"? Getting quick gains helps in achieving buy-in from staff who may be reluctant to implement the program because of fear of the unknown. Choosing a simple machine will be good as a starting point as any mistake during the learning process will not lead to any significant damage to the system.

The effect of the improvement on the system will not be as strong as using critical equipment and you will not be able to use the TPM methodology to the fullest. Though this may appear as a disadvantage, it is the safest approach given the critical nature of capital equipment to the organization.

Another approach will be to pilot the TPM project on a bottleneck or highly critical equipment. While this approach will have a significant effect on the process if it succeeds, there is the risk that it can cause disruption of the normal processes if done in the wrong way.

Choosing the pilot equipment for the TPM project should therefore be a balance between the perceived benefits and the cost of failure. It is always better to start with less critical equipment and then move to the more critical machines as the teams mature and gain competence in the TPM methodology.

To get more acceptance across the organization, it is best practice to begin the TPM journey with the widest base of employees. This gives it the necessary momentum to sustain it into the future as well as to build the right culture that eventually becomes the DNA of the organization.

TPM Step Two – Restore Equipment Back to Basic Condition

Machines and equipment are returned to their basic condition through a thorough 5S program coupled with autonomous maintenance as discussed above. In the 5S project, both operators and technical staff work together to clean and organize the machines by taking into consideration the following points:

Record the current state of the machines by noting any abnormalities such as dust, exposed wires, oily surfaces and poorly organized work area. It is good practice to take "before" photos of the work area as it is so as to serve as a comparison with the state after improvement.

Remove any unwanted material from within the vicinity of the machines and put them away in a "red tag" area for decisions to be made on their disposal at a later date.

Use visual shadow boards to store the remaining tools, spares and other parts so as to provide an organized way of knowing where everything is or should be. Yellow marking can also be used to mark the position of machines so that it will be easy to know when they are moved.

Carryout thorough cleaning of machines and surrounding spaces so as to get rid of dirt and expose any abnormalities that may be hidden from sight.

Record the new state of the machines using photos and use it for training purposes as well as for selling the benefits of the program to present and future staff.

Create one-point-lessons for training purpose as well as checklist so as to ensure that the new standards are followed by members of staff.

Audit the machines and work area regularly to get a clear picture on whether the agreed standards are being adhered to by the workers. The audits also help you get enough feedback on what needs to be changed or improved upon – an important principle of kaizen continuous improvement methodology.

Once the 5S program has been carried-out satisfactorily, the operators and maintenance staff will then begin an autonomous maintenance project.

There should be an agreement as to the technical tasks that can be safely transferred to the operators and if there is need for basic training to bring them up to speed, it should be done before the start of autonomous maintenance.

An autonomous maintenance program will achieve a lot if done correctly and normally takes the following format:

- Create a machine map with inspection points clearly indicated for ease of reference.
- Make obscure inspection points more visible by using transparent covers where possible (safety and functionality should be considered).
- Visualize the ideal settings of gauges and meters by marking the machines – for example, a pressure gauge can be marked green to show the acceptable reading and red to indicate out-of-spec conditions.
- Mark the lubrication points and make the lubricating of machines easier through adjustments such as extension of oiling nozzles. This will reduce the downtime associated with such activities as they can now be done with minimal interruption of the production process.
- Put in place standards for reporting of abnormalities by the operators and encourage a culture of always addressing problems before they get out of control.
- Create autonomous maintenance standards and checklists that will be used by the operators to check for most important tasks that need to done on machines such as lubrication and inspection points.

TPM Step Three – OEE Tracking
On completion of the preparatory steps of 5S and autonomous maintenance, the next logical step is to track the Overall Equipment Effectiveness. This data collection is important so as to identify the biggest causes of downtime on critical machines.

- Downtime can be caused by a variety of reasons and it is important for these reasons to be accurately categorized which will help in pinpointing which are the ones that need to be urgently addressed.
- While it is quite straight-forward to know which are the causes of downtime, sometimes it will not be easy for operators to immediately or allocate a cause to a breakdown.
- In this case, operators can introduce a new category of “not known” to their causes for downtime. This is makes it easy for operators to record data that they are not sure about instead of leaving the data collection form blank.
- Data collection must be done over decently long period of time (at least a month) for it to be meaningful enough to be analyzed and for decisions to be made based on the data.
- Accuracy is also an important factor during data collection and all efforts should be made to ensure that all shifts give real data.
- To achieve this, there has to real time review of data with the aim of correcting any inaccuracies that may arise during its collection.

TPM Step Four – Reduce Major Losses
Using the Kaizen pillar of TPM, major losses are tackled in a systematic process based on the data already collected in the data-collection step.

Addressing the major losses based on the data involves:

Selecting a cross-functional team from a wide section of the workforce and should comprise of all cadres including operators, technical staff as well supervisors. Another consideration when assembling a cross-functional team is the level of experience and expertise of the team members.
Data analysis of the major losses as collected from the OEE data. This analysis should look at the main reasons for the losses using tools such as pare to diagrams which rank the causes according to the degree of occurrence.

- Root cause analysis of why the losses occurred in the first place. This is done by asking why five or more times until you get to the true cause of the problem. It is only after a thorough root cause analysis has been done should countermeasures be suggested and implemented.
- Implementation of suggested solutions within a specified time frame.
- Verify effectiveness of the implemented solutions through audits.

TPM Step Five – Planned Maintenance
Planned maintenance is a very advanced part of the TPM implementation journey because it happens only after other components have matured enough to be left on their own and any benefits accruing from the programs have been exhausted.

At the heart of this TPM step is to understand the machine parts the wear out the most and reasons for this wearing out. Countermeasures to these causes are then put in place and this includes the use of parts that do not wear out as quickly as the ones replaced.

Documentation of the frequency of failure for machine parts must also be carried out so as to have a clear picture of all the parts that need replacement and how regularly they need replacement.

With both the data on the frequency of wearing out and that of failure, a schedule for replacement of these parts is created. This will include the purchasing of the parts in advance and scheduling the downtime in such a way that it has the least effect on production processes.

Replacement data should be collected on an on-going basis to fine-tune the part replacement schedule. This fine-tuning should also take into consideration the parts that require replacement off-schedule and analysis should be done to find out whether there are any emerging issues with the equipment that had not been recognized earlier.

Other TPM Actions

- The other pillars of TPM will be implemented depending on the situation that the organization is facing at the moment and do not necessary have to be implemented all at once.
- For example, early equipment management applies to situations where there has been purchase of new equipment.
- Similarly, a quality maintenance project will be more likely to be implemented when there are major customer issues concerning quality.
- It would also be initiated when there are major deviations of the agreed quality standards within the facility.
- In the same vein, the TPM in the office and Safety, Health & Environment programs will be implemented when there are serious issues concerning them.
- If the accidents within the workplace are way above the standards, there will be more focus on creating safe working conditions.
- These additional steps should be taken one at a time depending on priority and urgency because it not about only implementing a set of programs but it is based more on necessity.

CONCLUSION

Sustaining the TPM Initiative
Like any other effort, maintaining the project is the most challenging component, requiring a high degree of discipline and frequent monitoring of the development of the project. The most critical component in the success of Total Productive Maintenance is the buy-in of workers, without whom the effort would have a false start. Gaining the full involvement of workers is a multi-facetted technique that involves educating them of the strategic goals of the business, promoting the proper behaviors and fostering idea development from the shop floor.

Starting with low hanging fruit will offer the employees the confidence to move along with the company on its TPM journey since the outcomes of the programmed are evident to everybody from the outset. Using challenging pilot regions which are certain to fail may discourage the workers from engaging in a whole-hearted way. Top management engagement and enthusiasm in the TPM effort also assists in maintaining it via the allocation of the required resources

needed for it to succeed. Management engagement also provides a clear message to the employees on the priority the firm takes on the effort.

Making the system part of the organizational culture also entails the being innovative and consistently updating the approach to impart a feeling of freshness. This avoids a lazy and complacent mindset from creeping in when workers start losing interest due to boredom.

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