

IMPLEMENTATION OF TOTAL PRODUCTIVE MAINTENANCE TO ACHIEVE SUSTAINABLE IMPROVEMENT

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Abstrak

Dalam dunia industry, khususnya perusahaan manufaktur dalam banyak kasus membutuhkan penanganan kerja yang dilakukan menggunakan alat alat berat untuk mendukung produktivitas kinerja perusahaan. Hal ini membutuhkan perencanaan program yang bagus dalam menangani perawatan peralatan mesin mesin tersebut sehingga dapat berjalan sesuai fungsinya. TPM atau dikenal dengan total productive maintenance atau perawatan produktif total adalah suatu system perawatan dan pemberdayaan peningkatan integritas produksi , keamanan dan system mutu melalui peralatan mesin, peralatan perlengkapan, process dan pekerja yang menambah nilai dari suatu bisnis di perusahaan.

Total productive maintenance (TPM) merupakan suatu bagian dari manajemen system perusahaan dalam menjaga bagian perawatan dalam mencapai peningkatan secara berkesinambungan untuk memperoleh performansi yang baik. Dengan mengimplementasikan konsep dari TPM dengan perencanaan pada perawatan yang harus dapat dicapai dan kemampuan kerja dari mesin secara kontinu, mengoptimasi biaya perawatan , mengurangi inventori, meningkatkan kehandalan, dan kemampuan kerja dari mesin.

Kata kunci —*tpm, kemampuan kerja, berkesinambungan, perawatan, peningkatan*

Abstract

In industries, especially in manufacture's case almost use many heavy equipment to support their productivity. It need a good programed to keep handle maintaining the equipment so it can be working as it function. The TPM or total productive maintenance is a system of maintaining and improving the integrity of production, safety and quality systems through the machines, equipment, processes, and employees that add business value to an organization.

Total productive maintenance or TPM is the part of quality management system of company to protecting the maintenance division to achieve sustainable improvement getting a good performance. By implementation TPM concept with planned maintenance it could be achieve and sustain availability of machines, optimum maintenance cost , reduce spares inventory, improve reliability and maintainability of machines.

Keywords—*tpm, availability, sustainable, maintenance, improvement*

1. PREFACE

In industries, especially in manufacture's case almost use many heavy equipment to support their productivity. It need a good program to keep handle maintaining the equipment so it can be working as it function. What the TPM is? The TPM or total productive maintenance is a system of maintaining and improving the integrity of production, safety and quality systems through the machines, equipment, processes, and employees that add business value to an organization. That is a good solution which was getting operators involved in maintaining their own equipment, and emphasizing proactive and preventive maintenance will lay a foundation for improved production (fewer breakdowns, stops, and defects). TPM was introduced to achieve the following objectives. The important ones are :

- 1) Avoid wastage in a quickly changing economic environment.
- 2) Producing goods without reducing product quality.
- 3) Reduce cost.
- 4) Produce a low batch quantity at the earliest possible time.
- 5) Goods send to the customers must be non defective.

The implementation of a TPM program creates a shared responsibility for equipment that encourages greater involvement by workers. In the right environment this can be very effective in improving productivity (increasing up time, reducing cycle times, and eliminating defects). Because of the topic the writer was trying to discuss the research about Implementation of Total productive maintenance (TPM) to achieve sustainable improvement. This main topics almost same about TPM ever researched by Herman Signh Rajput, Pratesh Jayaswal in their journal at IJMERE talk about A total productive maintenance (TPM) approach to improve overall equipment efficiency.

2. METHOD

Total Productive Maintenance (TPM) was developed by Seiichi Nakajima based on experience of the practical application of maintenance best practice in Japan between

1950 and 1970. This experience led to the recognition that a leadership mindset engaging front line teams in small group improvement activity is an essential element of effective operation. The outcome from his work was the application of the TPM process in 1971. One of the first companies to gain from this was Nippondenso, a company that created parts for Toyota. They became the first winner of the PM prize. An internationally accepted TPM benchmark developed by the JIPM Seiichi Nakajima is therefore regarded as the father of TPM. The classic TPM process he developed consisting of 5 principles was later enhanced by the JIPM to incorporate many of the lessons of Lean Manufacturing and is referred to as Company Wide TPM which consists of 8 principles/pillar.

Table 1 Pillar 5S

Japanese term	English	Equivalent S term
Seiri	Organization	Sort
Seiton	Tidiness	Systematize
Seiso	Cleaning	Sweep
Seiketsu	Standardization	Standardize
Shitsuke	Discipline	Self-discipline

Source : writer, 2019

The five elements at the TPM starts consists the list below:

- 1) Seiri - Sort (eliminate anything that is not truly needed in the work area)
- 2) Seiton – Set in order (organize the remaining items, The items should be placed back after usage at the same place.).
- 3) Seiso – Shine the workplace (clean and inspect the work area)
- 4) Seiketsu - Standardization (create standards for performing the above three activities), Employees has to discuss together and decide on standards for keeping the work place / Machines / pathways neat and clean.
- 5) Shitsuke – Self discipline (self-discipline among the employees of the organization. This includes wearing badges, following work procedures, punctuality, dedication to the organization etc).

The eight pillars of TPM are mostly focused on proactive and preventive

techniques for improving equipment reliability:

- 1) Autonomous Maintenance (Jishu hozen)
- 2) Focused Improvement
- 3) Planned Maintenance

- 4) Quality management
- 5) Early Equipment management
- 6) Training and Education
- 7) TPM in Administration
- 8) Safety Health Environmental conditions



Picture 1 The traditional model consists of a 5S foundation
Source : www.leanproduction.com/tpm

The first pillar autonomous maintenance is about places responsibility for routine maintenance, such as cleaning, lubricating, and inspection, in the hands of operators. In focused improvement, it has small groups of employees work together proactively to achieve regular, incremental improvements in equipment operation.

The planned maintenance is schedules maintenance tasks based on predicted and /or measures failure rates. It significantly reduces instances of unplanned stop time. The quality maintenance is acting to handle design error detection and prevention into production processes. It applying root of cause analysis to eliminate recurring sources of quality defects. The Early equipment management as directs practical knowledge and understanding of manufacturing equipment gained through TPM towards improving the design of new equipment.

Training and Education is about fill the knowledge gaps necessary to achieve TPM goals. Applies to operators, maintenance personnel and managers. Administrative & office TPM is applying TPM techniques to administrative functions. The Safety Health Environmental conditions is maintain a safe and healthy working environment.

Total quality management (TQM) and total productive maintenance (TPM) are considered as the key operational activities

of the quality management system. In order for TPM to be effective, the full support of the total workforce is required. The main objective of TPM is to increase the Overall Equipment Effectiveness (OEE) of plant equipment.

OEE (Overall Equipment Effectiveness) is a metric that identifies the percentage of planned production time that is truly productive. OEE was developed to support TPM initiatives by accurately progress to achieve a perfect production.

Table 2 Score of OEE

OEE Score	The meaning
100%	Perfect production
85%	World class for discrete manufactures
60%	Fairly typical for discrete manufactures
40%	Not uncommon for manufacturers without TPM and /or lean programs

Source: Writer, 2019



Picture 2 OEE score

Source : <https://www.leanproduction.com>

OEE score calculated :

$$OEE = \frac{(\text{Good Count} \times \text{Ideal Cycle Time})}{\text{Planned Production Time}}$$

Or

Availability X Performance X Rate of Quality

$$\frac{\text{Rate of Quality calculating ,} \\ (\text{Process} - \text{defect})}{\text{Process}} \times 100\%$$

Define terms:

- Good Count (pieces that are manufactured without any defects).
- Ideal Cycle Time (the theoretical fastest possible time to manufacture one piece)
- Planned Production Time (the total time that the production asset is scheduled for production).
- Fully Productive Time (producing only good pieces, as fast as possible, with no stop time).

The preferred way to calculate OEE is mathematically equivalent to the simple formula described above, but provides a much richer understanding of waste in the manufacturing process by breaking it down into three loss factors: Availability Loss, Performance Loss, Quality Loss.

Availability takes into account Availability Loss, which includes all events that stop planned production for an appreciable length of time (typically several minutes or longer). Availability Loss includes Unplanned Stops (such as equipment failures and material shortages), and Planned Stops (such as changeover time). Availability formula :

$$\frac{\text{loading time}}{\text{Loading time} - \text{downtime}} \times 100\%$$

Performance takes into account Performance Loss, which includes all factors that cause the production asset to operate at less than the maximum possible speed when running (including Slow Cycles and Small Stops). Ideal Cycle Time is the theoretical fastest possible time to manufacture one piece. Quality takes into account Quality Loss, which factors out manufactured pieces that do not meet quality standards, including pieces that are later reworked. Performance or

performance efficiency.

$$\frac{\text{Processes amount}}{\text{Operating time}} \times 100\%$$

In heavy equipment the performance of equipment has counted for mechanical availability, utility and efficiency for machine.

3. ANALISYS

Total productive maintenance objectives are zero defects, zero breakdown, zero accidents in all functional areas in manufacture. Second, it will involve people in all levels of organization and at different teams to reduce defects and Self Maintenance. Some major losses in organization like Failure losses (Breakdown loss), Setup / adjustment losses, Cutting blade loss, Start up loss, Minor stoppage / Idling loss. Speed loss - operating at low speeds. Defect / rework loss, Scheduled downtime loss. They are losses that impede equipment efficiency.

The losses that impede human work efficiency are Management loss, Operating motion loss, Line organization loss, Logistic loss, Measurement and adjustment loss. Loses in effective use of production resources like energy loss, Die, jig and tool breakage loss and yield loss. The objectives to have trouble free machines and equipment producing defect free products for total customer satisfaction. The breaks maintenance down which was defined earlier are preventive maintenance, breakdown maintenance, corrective maintenance. The steps are

- ✓ Equipment evaluation and recoding present condition..
- ✓ Restore deterioration and improve weakness.
- ✓ Building up about information management system.
- ✓ Prepare time based information system, choose the equipment, parts, members and map out plan.
- ✓ Prepare predictive maintenance system (diagnostic techniques)
- ✓ Evaluation.

Data of Drill Equipment in two months
Schedule time = 500 hours
Maintenance = 16 hours

Table 3 data of drill equipment Tamrock DP1500

items	hours
schedule	500
Maintenance	16
Idle	30
Start	243511
Stop	243731
Run	273
Operation Delay	0
Operation(Drill)	273

Source : writer, 2018

Counting the performance of drill equipment,

$$\text{Machine availability} = \frac{\text{Availability}}{\text{Time Schedule}} \times 100\%$$

$$\text{Machine availability} = 0.606 \text{ or } 0.61 \times 100\% = 60.6\%$$

$$\text{Utility} = \frac{\text{operation time}}{\text{Available time}} \times 100\%$$

$$\text{Utility} = 55\%$$

$$\text{Efficiency} = (\text{drill time} / \text{operation}) 100\%$$

Efficiency from the data result is 100%

From the data we have know if the performance of the drill equipment is could be handle and be able to productive the company . The interaction between the production target and unit production it can become a decision the adding equipment which must using with a kind of material specification and the rate of easiness operation and also the maintenance.

The greatest challenges at some company is how to achieve sustainable improvement. This includes both a) achieving short-term success and b) maintaining that success over the long-term. There are four techniques for achieving sustainable improvement.

1. Engaging Employees
2. Succeeding Early
3. Providing Active Leadership

4. Evolving the Initiative

A powerful technique for engaging employees is creating a shared vision of the future “improved” state of the company – and clearly outlining how it will benefit employees. It will create a strong, broad-ranging motivation to succeed. Another powerful technique is recognizing and rewarding desired behavior.

Succeeding Early, by way of contrast, if an initiative is perceived as having been tried and failed, it will be much harder to successfully implement that initiative in the future. Active leadership combats the natural tendency of employees to drift back into old patterns of behavior and old ways of working.

The last , Evolving the initiative, The goal is to keep the initiative fresh and interesting. Evolving the initiative also helps to ensure that it thrives over the long-term by constantly adapting it to a changing environment.

4. CONCLUSION

Total productive maintenance or TPM is the part of quality management system of company to protecting the maintenance division to achieve sustainable improvement getting a good performance. By implementation TPM concept with planned maintenance it could be achieve and sustain availability of machines, optimum maintenance cost , reduce spares inventory, improve reliability and maintainability of machines.

When quality management activities set up equipment conditions that minimize quality defect so the condition are checked and measured in time series to measure values are within standard values with preventing defects. In most problems by TPM, to improve the equipment will be well supported by operators , solving the problems he will strengthen support for the project. The Teams often gravitate to selecting the Most Problematic equipment.

This, however, is rarely the best choice (unless it happens to also be the Constraint. When creating a wide base of support for the TPM project, make sure to include the full spectrum of associated employees (operators, maintenance

personnel, and managers) in the selection process, and work hard to create a consensus within the group as to the equipment selection choice.

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