The Productivity Factory (TPF)

Improving production efficiency

OEE: Overall Equipment Effectiveness

Overall Equipment Efficiency (OEE)

OEE is a simple way of measuring and improving the utilization of the machines in your plant. OEE is commonly used in Total Productive Maintenance (TPM) programs. Ideally, your factory would operate 100% of the time at 100% capacity and with 100% good parts. In reality, however, this rarely occurs. OEE provides a measure of the difference between the ideal and what is actually happening on your shop floor.

The OEE index has been developed by the JIPM (Japan Institute for Plant Maintenance). It is one of the pillars within the TPM method. (see Attachment #1) The method distinguishes 6 loss types, and 3 categories: availability, speed losses and quality rate. The method's strength is that it makes the losses more transparent, and from experience we know that a good analysis provides a very good "picture" of the actual situation, which helps ***to determine both short and longer term improvement activities****, including quantified benefits from each of the improvements.*

Gross Available hours
Gross Available hours (#days/year: 365, 24 hours/day, 7 days/week)

Planned Downtime
For example: vacation, holidays, not 168 hours/week, not enough load.

1. Breakdowns/Machine failures
Downtime because of machine failures

2. Setup and adjustment
For example between product types, including "warm-up time" after the actual changeover. Changeover time should be included here, and should not be included in the planned downtime. Changeover time can be reduced by applying the SMED System. (SMED: see Attachment #2)

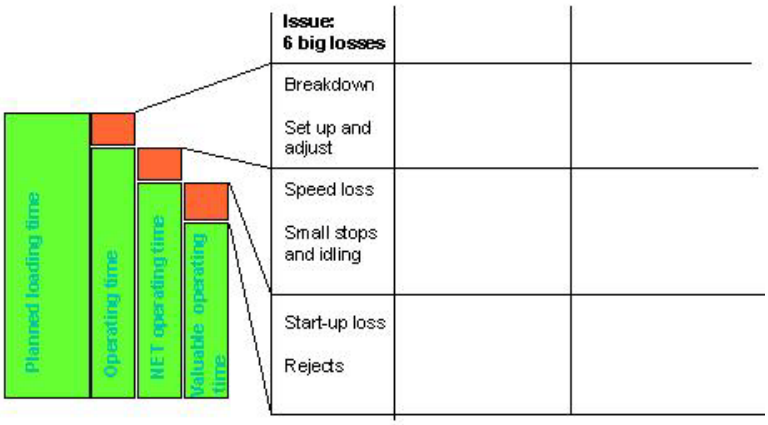
3. Small stops
When these have not been causes by logistics. Small stops are typically shorter than 5-10 minutes. Small stops are typically minor adjustments, for example cleaning etc. This in contrast with machine failures, where you will usually need maintenance personnel to solve it.

4. Speed losses
Speed losses are caused when a machine runs more slowly than its optimal/maximum speed.

5. Rejects during production
This includes all rejects and repairs during normal production, so after running in/warm-up phenomena.

6. Rejects during running in/ warm-up
This includes all rejects and repair during startup/running in/ warm-up.

Schematically it can be represented as follows:



The calculation of the OEE index is as follows:

Availability = (Planned production time - Unscheduled Downtime)/Planned production time
The *Production time* = Planned production time - Downtime

The **Performance** = Cycle time x number of products processed/ Production time
Now remains the *Net Production time* (= time products are produced)

The **Yield (Quality Rate)** = (# processed products - # rejected products)/(# processed products)

The **OEE-index** = Availability x Performance x Yield

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Attachment #1

TPM: Total Productivity Management /

Total Productive Maintenance / Lean Manufacturing

When we realize that in many factories, the valuable operating time is less than 50% of the gross available hours per year, it is obvious that our assets are not sweating. Part of this is caused by scheduled downtime, which includes holidays, no production planned due to limited load, spare capacity to cope with volume flexibility etc. The other part is caused by the fact that we do not produce fully efficiently. The reasons for this can be categorized into six big losses. These losses can be influenced during development and production.

Why Total Productivity Management (TPM)?

Total Productivity Management (TPM) is becoming an industrial standard and it is an approach to optimise the effectiveness of production means in a structured manner.

TPM focuses on improving the Planned Loading Time. The gap (losses) between 100% and actual efficiency can be categorized into 3 categories:

- Availability
- Performance
- Yield (Quality Rate)

Availability losses:

Breakdowns and changeovers indicate situations where the line is not running while it should be.

Performance losses:

Speed losses and small stops/idling/empty positions indicate the line is running, but is not providing the quantity it should.

Yield losses:

Additionally, when the line producing products, there are losses due to rejects and start-up quality losses.

These losses lead to the Overall Equipment Effectiveness (OEE) indicator, which tells you how efficiently you produce when you have planned to produce. TPM helps you to improve your OEE by providing a structure to quantify these losses, and by subsequently giving priority to the most important ones. TPM provides concepts and tools to achieve both short and longer-term improvements.

Attachment #2

Single Minute Exchange of Dies (SMED)

"Reduce your setup and adjustment times from hours to minutes"

These modern times of rapidly increasing diversity and smaller batch sizes, setup time reduction is of crucial importance for the profitability of many companies. For example, bottling industries sometimes spend more than 20% of their planned production time on changeovers. Fortunately, these setup and changeover times can be reduced significantly when the SMED system is applied. The SMED system has a proven track record in many types of industries. You may wonder: "Is it magic, or something everybody can apply?" Fortunately everybody can apply the SMED system to reduce their setup times, and there is nothing magic about it!

Single Minute Exchange of Dies (SMED) is ***the approach*** to reduce output and quality losses due to changeovers. The method has been developed in Japan by Shigeo Shingo, and has proven its effectiveness in many companies by reducing changeover times from hours to minutes. Analyzing the changeover process, combined with a stronger sense of teamwork and ownership lead to significant reductions in setup and changeover times.
And the funny thing is, it is fun to do it!!

The analysis consists of the following 4 phases:
1. mixed phase
2. separated phase
3. transferred phase
4. improved phase

The method's strength is the systematic approach to analyze what is actually done and how time is spent during the changeover activity. Through the analysis, a better understanding is gained on how to do certain activities, when the line is running. Also it is determined, what can be done to reduce the "fine tuning" activities after the actual changeover.

”Changeover Losses” is one of the 6 big losses that have been defined within the TPM method.