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STUDY OF METHODOLOGY OF OVERALL EQUIPMENT EFFICIENCY

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ABSTRACT

This research paper is mainly focused on study of methodology of overall equipment efficiency. It is an operations approach, should be based on a strong, systematic and consistent way of working combined with empowered shop floor teams who drive continuous progress in that standardized work. OEE data on machine performance is a key starting point for teams to understand there equipment losses and to establish improvement programs to eliminate them. OEE is the calculation of Availability, Performance, and Quality

We find that the implementation of OEE is typically based on the inspiration to use a basic reference measure for analyzing and comparing the utilization of resources at the plant. The use of OEE can also be transformed to a system for analyzing production data to identify potential areas of improvement, and supporting lean initiatives. Thus, characteristically, OEE typically advances from a base measure for efficiency as the initial purpose, to being a tool to improve Efficiency for analyzing data to support CI objectives via the identification and elimination of waste.

I. INTRODUCTION

In many industries, the efficiency of manufacturing equipment is of the utmost importance. Overall Equipment Efficiency (OEE) is gaining increasing interest as a key measure of considerable relevance for sustainable manufacturing. There is some research literature on OEE but it mostly deals with the technical aspects of OEE as a measure. There are very few case studies reported and when case studies are included, these typically have the role of merely illustrating a particular aspect of the measurement or definition of OEE. We identified a lack of literature concerning the implementation of OEE, i.e. how to introduce it in a plant or company, and how to use it for the continuing operations. We hope that this research contributes to the understanding of how to implement and use OEE in practice.

Overall Equipment Efficiency (OEE) is a metric that identifies the percentage of planned production time that is truly productive. An OEE score of 100% represents perfect production: manufacturing only good parts, as fast as possible, with no down time. In an ideal environment, all equipment would operate all the time at full capacity producing good quality product. In real life, however, this situation is almost non-existent. Put simply overall equipment efficiency, OEE, is a measure of what you actually made over what you could have made in theory over that timeframe. The difference between the ideal (theoretical) and actual situation is due to losses.

1.1What is OEE?

OEE is a "best practices" way to monitor and improve the efficiency of your manufacturing processes (i.e. machines, manufacturing cells, assembly lines). Developed in the mid 1990's. OEE is simple and practical.

It takes the most common and important sources of Manufacturing productivity loss, places them into three primary categories and distills them Into metrics that provide an excellent gauge for measuring where you are - and how you can improve!

OEE is frequently used as a key metric in TPM (Total Productive Maintenance) and Lean Manufacturing programs and gives you a consistent way to measure the efficiency plant.

Overall Equipment Efficiency (OEE) is a way to monitor and improve the efficiency of your manufacturing process. OEE has become an accepted management tool to measure and evaluate plant floor productivity.

OEE is calculated from three underlying factors: Availability, Performance, and Quality.

1.2 Problem Statement

- Lack of laziness of worker toward working.
- Improper material handling.
- Time consuming fixture setup.
- Unpredicted machine breakdown.
- Non –availability of c-class material.

1.3 Objectives

- To improve equipment reliability and maintainability.
- To cultivate the equipment-related expertise among operators.
- To maximize OEE, through total employee involvement.
- To create an enthusiastic work environment.
- To pick up the weakening in the production system those do not allow the company to achieve its full capacity and meet the set goals.
- To develop an ability in every worker to solve problem itself
- Motivate the worker to do given task.

II. LITERATURE REVIEW

The Literature Study was done in order to establish key concepts, related to OEE. The results of the literature The existing theory related to OEE was analyzed from secondary sources and related sources such as, Internet sites and web pages of different companies and organizations text books and other published material directly and indirectly related to the problem area, academic as well as organizational journals and newsletters relevant to the problems daily reports of companies erasure survey were used as a guideline to determine the impact and efficiency. Due to intense global competition, companies are striving to improve and optimize their productivity in order to stay competitive. This situation has led to the need for more rigorously defined productivity metrics that are able to take into account several important factors, such as equipment availability (breakdowns, set-ups and adjustments), performance (reduced speed, idling and minor stoppages), and quality (defects, rework and yield) (Dal et al 2000)

III. OEE FACTORS

3.1 Availability

Availability takes into account Down Time Loss, which includes any Events that stop planned production for an appreciable length of time (usually several minutes – long enough to log as a trackable Event). Examples include equipment failures, material shortages, and changeover time. Changeover time is included in OEE analysis, since it is a form of down time. While it may not be possible to eliminate changeover time, in most cases it can be reduced. The remaining available time is called Operating Time.

$$\text{Availability} = \text{Run Time} / \text{Total Time}$$

3.2 Performance

Performance takes into account Speed Loss, which includes any factors that cause the process to operate at less than the maximum possible speed, when running. Examples include machine wear, substandard materials, misfeeds, and operator inefficiency. The remaining available time is called Net Operating Time.

$$\text{Performance} = \text{Total Count} / \text{Target Counter}$$

3.3 Quality

Quality takes into account Quality Loss, which accounts for produced pieces that do not meet quality standards, including pieces that require rework. The remaining time is called Fully Productive Time. Our goal is to maximize Fully Productive Time.

$$\text{Quality} = \text{Good Count} / \text{Total Count}$$

By measuring the performance in each of these categories and multiplying the result will give you the OEE.

$$\text{OEE} = \text{Availability (A)} \times \text{Performance (P)} \times \text{Quality (Q)}$$

3.4 Loss Categories contribute to lowering the OEE

Loss Categories (Downtime, Speed, and Quality) of Simple OEE and examples of events that can occur in a production process of a machine to reduce productivity. These Loss Categories contribute to lowering the OEE.

Loss Category	OEE Metric	Loss Category Examples
Down Time Losses	Availability	1. Equipment Failures 2. Equipment Idle Time 3.Manufacturing Line Restraint 4. Machine Changeovers 5. Material Shortage
Speed Losses	Performance	1.Reduced Equipment Speed 2.Minor Equipment Stops 3.Level of Machine 4. Equipment Age 5. Tooling Wear
Quality Losses	Quality	1.Damage 2.Assembled Incorrectly 3.Rejects 4.Rework

Table No: 1. Loss Categories

The three primary components of loss within OEE are: Availability, Performance and Quality which were already defined. The primary drivers of business loss within these three OEE components are:

3.5 Equipment Breakdowns/Failure

A sudden and unexpected equipment breakdown or failure results in loss of production time. The cause of the malfunction may be technical as well as organizational (i.e. operational error, poor maintenance, etc.). OEE measures the way the breakdown manifests itself.

3.6 Equipment Idle Time

Setup and adjustment time where the equipment is idle. The equipment can be idle for many reasons (i.e. changeover, maintenance or work breaks). In the case of a changeover, the equipment usually has to be shut down for some time in order to change tools, dies, or other parts. SMED (Single Minute Exchange of Die) defines the changeover time as the time between the last good product of the previous series and the first good product of the new series. For the OEE, the changeover time is the time when the machine does not generate any products.

3.7 Manufacturing Line Restraint

Equipment idle time due to material supply and transport (conveyor) problems in a production line, or a series of linked manufacturing processes, is classified as manufacturing line restraint.

3.8 Machine changeover

This kind of losses are especially observe in the machine which perform more than one operation. It is the time consumed by machine while changing a setup for performing different operations on the same machine.

3.9 Material shortage

This loss may cause the complete stoppage of production and operations hence, it is very important that raw material required for processing should be available in adequate amount quantity.

3.10. Reduced Equipment Speed

Reduced speed is the difference between the actual set speed and the theoretical or design speed. There is often a considerable difference between what an operator believes is the equipment's maximum speed versus the theoretical maximum speed. In many cases, the production speed has been optimized in order to prevent other losses such as quality rejects and breakdowns. Losses due to reduced speed are, therefore, often ignored or underestimated.

3.11 Minor Equipment Stops

When equipment has short interruptions and does not deliver constant speed then a smooth flow of production does not occur. These minor stops manifest subsequent losses of speed and are generally caused by small problems, such as product units blocking sensors or getting stuck in conveyor belts. These frequent slowdowns can drastically diminish the efficiency of equipment.

3.12 Level of Machine

it is always important that the level of machine should be such that the control's of machine 's must be within reach of operator

3.13 Equipment age

The performance of almost everything declines with the age such as machine. Although a routine maintenance can keep the equipment working efficiently, but there a comes a point when the repairs are too expensive and it is less expensive to buy a replacement.

3.14 Tooling Wear

tool wear describes gradual failure of welding tip due to regular operation. Every welding tip is subjected continuous wear due that it may loose its accuracy and shape thus, it may result into poor quality of weld. General effects of tool wear are as follows

- Poor quality of product
- Nugget failure
- Dislocation of weld
- Improper spot on the product
- May lead to tip failure
- May cause to change in tool geometry

All above mentioned effects can be reduced by using lubricants and coolants while operation. Thus it reduces tool wear.

3.15 Scrap

Scrap are those product units that do not meet the quality specifications even if they can be sold as "sub-spec." The objective of every manufacturing operation is to have "zero defects" and thereby manufacture quality products the first time. A specific type of quality loss is the start-up loss. This loss is defined by:

- Instability in production when the equipment is started up causing the initial product units to not meet quality specifications
- Production at the end of a production run is not stable and the products no longer meet quality specifications

Product units which are no longer counted as part of the production order and, consequently, are considered a loss These are usually hidden losses and are often considered to be unavoidable. However, the magnitude of these business losses can be significant.

3.16 Rework

Reworked product units do not meet the quality specifications the first time through the process, but can be reprocessed into good products. Reworking products may not seem to be a loss because the product unit can still be sold at the normal price. However, the product unit was not right the first time and is therefore a registered as quality loss just like scrap.

IV. METHODOLOGY

Performance optimization systems that combine Business Intelligence, Operational Intelligence and Human Intelligence via data collection (from all levels of the enterprise) facilitate very accurate analyses of OEE. The first step in creating actionable intelligence that drives profitability is to collect data from automation equipment and manual labor in the manufacturing process. The closer to real-time that data is collected and synthesized into actionable intelligence, the quicker the corrective steps can be taken to drive out variability and waste, thereby maximizing operating income.

- **Equipment Breakdowns/Failures :**
  - Eliminating unscheduled downtime is critical to improving OEE. Other OEE Factors cannot be addressed if the process is halted. It is important to know how much downtime your process is experiencing and when it happens. It is also important to be able to attribute the lost time to the specific source or reason for the loss (i.e. Reason Codes). If Downtime Loss and Reason Code data are tracked, then Pareto Charts can be created that correlate the significant few process variables that drive the downtime events.
- **Equipment Idle Time (Setup and Adjustments) :**
  - Equipment Idle Time is generally measured as the time between the last good products units produced before setup to the first consistent good units produced after setup. This often includes substantial adjustment time in order to consistently produce product units that meet quality standards. Tracking setup

time is critical to reducing this loss, together with an active program to reduce this time, such as the SMED (Single Minute Exchange of Dies) program.

- **Minor Equipment Stops and Reduced Speed :**
  - Minor Stops and Reduced Speed are the most difficult of the "Six Big Losses" to monitor and record. Cycle. Time Analysis should be utilized to quantify and track these loss types. In most processes that record data for Cycle Time Analysis there must be automation. By comparing all completed cycles to the Ideal Cycle Time and filtering the data through a Minor Stop Threshold and Reduced Speed Threshold the errant cycles are categorized for analysis. The reason for analyzing Minor Stops separately from Reduced Speed is that the root causes are typically very different.
- **Startup Rejects and Production Rejects :**
  - Startup Rejects and Production Rejects are differentiated, since the root causes are frequently different between startup and steady-state production. Production units that require rework of any kind should be considered rejects. Tracking the timing of reject events during a shift can highlight potential causes and/or trends. Six Sigma drives the goal of achieving a defect rate of less than 3.4 defects per million "opportunities" and is used to focus attention on a goal of achieving "near perfect" quality.
  - These metrics help gauge your plant's efficiency and efficiency and categorize these key productivity losses that occur within the manufacturing process. OEE empowers manufacturing companies to improve their processes and in turn ensure quality, consistency, and productivity measured at the bottom line.
- By definition, OEE is the calculation of Availability, Performance, and Quality.

V. CONCLUSION

It is the basic need for a company to improve the production rate and quality of the products. In order to achieve this, the Overall Equipment Efficiency was improved with low machine breakdown, less idling and minor stops time, less quality defects, reduced accident in plants, increased the productivity rate, optimized process parameters, worker involvement, improved profits through cost saving method, increased customer satisfaction and increasing sales. The Overall Equipment Efficiency through the implementation of availability, better utilization of resources, high quality products and also raised employee morale and confidence. From above study we have concluded that by minimizing the production losses we can improve the OEE.

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