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Eliminate Losses by Improving the Scope of General Maintenance in Production

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Abstract: I start with overall equipment effectiveness (OEE) as a key factor in measuring productivity and efficiency. In addition, I will examine the new movement in the automotive industry to use OEE as an indicator of strength. OEE is a hierarchy of indicators focused on how efficiently a manufacturing operation is used. The results are presented in a general form that allows comparison between production units in different departments, organizations, machines and industries.

Keywords: TPM, quality, management, safety, capacity, opportunity, available time, downtime, efficiency.

Improving the scope of maintenance in production is to bring OEE parameters closer to 100% and ultimately to eliminate delays and losses in the process.

OEE can be understood as:

- OEE is a measurement that determines the potential of the equipment.
- OEE detects and tracks loss.
- OEE identifies windows of opportunity.

And its main purpose:

- Increase productivity
- Price reduction
- Raise awareness of the need for machine performance
- Increase the service life of the equipment

The results of these objectives are as follows:

- Increase profits
- Gain (or maintain) a competitive advantage.
- Determine ownership of equipment
- Reduce costs

As a metric, OEE measures how effectively capital equipment is being used by identifying constraints and how constraints affect OEE. Efficiency is measured by multiplying CAPACITY and performance EFFICIENCY by the rate at which QUALITY products are produced.

Calculations are carried out as follows:

- OPPORTUNITY = ([Available Time - Downtime]/[Actual Available Time]) × 100 (Note that potential availability is always 24 hours or 1440 minutes)
- EFFICIENCY = ([ideal cycle time and common parts life]/[operating time]) × 100
- QUALITY = ([total parts worked - amount of defects]/[total parts worked]) × 100

OEE includes six key indicators

The six major losses in equipment or machinery are usually calculated by:

- Disruptions
- Installation/Configuration
- Idling/parking
- Slow down
- Inconsistent product
- Startup profitability

A global OEE is considered to be 85% or higher (see Table 1 later in this chapter for derivation of 85%).

The OEE measure is commonly used as a key performance indicator (KPI) in conjunction with lean manufacturing efforts to provide a measure of success. This can be best illustrated by briefly discussing the six indicators that comprise the system. The hierarchy consists of two top-level dimensions and four basic dimensions. OEE and total effective equipment performance (TEEP) are two closely related measures that report the overall utilization of facilities, time, and materials for manufacturing operations. These high-level metrics directly indicate the difference between actual and ideal performance [1].

OEE determines how well a generating unit performs relative to its intended capacity during scheduled periods of operation. TEEP, on the other hand, measures OEE performance against calendar hours, i.e. 24 hours per day, 365 days per year.

Table 1

<table>
<tr><th colspan="2">Overall Equipment Effectiveness (OEE)</th></tr>
<tr><td>Device ID:</td><td>Date:</td></tr>
<tr><td>Part ID:</td><td>Change:</td></tr>
<tr><td colspan="2">Uskunaning mavjudligi:
Availability of equipment:</td></tr>
<tr><td>A. Total available time</td><td>minute</td></tr>
<tr><td>B. Planned Downtime</td><td>minute</td></tr>
<tr><td>C. Scheduled Available Run Time (A-B)</td><td>minute</td></tr>
<tr><td>D. Unscheduled downtime (from downtime reports)</td><td></td></tr>
<tr><td colspan="2">➢ disruptions _______ total minutes _______ +
➢ installation and setup _____________ total minutes _______ +
➢ minor breakdowns ____________ total minutes _______ = ______ minutes</td></tr>
<tr><td>E. Running time (C-D)</td><td>_______ minute</td></tr>
<tr><td>F. Availability of Equipment (E/C)x100)</td><td>_________% [90%]</td></tr>
</table>

Performance:	
G. Total Parts Works (Good + Bad)	______ parts
H. Ideal cycle time	________ minute/part
I. Performance (HxG)x100)	________% [95%]
Quality level:	
J.Total Defects (Working + Nonconforming Product)	______ part
K. Quality level [(G-J)/G]x 100)	________% [99%]
Overall efficiency of the equipment:	
(F x I x K) x 100________% [85%]	

In addition to the previous measures, OEE (overall equipment effectiveness) and TEEP (total effective equipment performance) are four key metrics that provide an understanding of why and where performance gaps exist. 'pointer exists.

These are the following measurements:

Load: The portion of the TEEP metric that represents the percentage of total calendar time scheduled for operation.

AVAILABILITY: The OEE portion of the metric represents the percentage of scheduled time in which an operation can be completed. Often referred to as working time.

Efficiency: The OEE portion of the metric represents the operating speed of a workspace as a percentage of its intended speed.

Quality: The OEE metric represents good units produced as a percentage of total units started. It is usually called First Time Throughput (FTT).

The following sections provide a detailed presentation of each of the six OEE/TEEP metrics and examples of how to perform the calculations. Calculations are not particularly complicated, but it is necessary to pay attention to the standards used as a basis. In addition, these calculations are valid at the work area or part number level, but become more complex if elevated to general levels.

Indicator 1: OEE (Overall Equipment Effectiveness)

OEE breaks down the performance of a manufacturing unit into three distinct but measurable components: OPPORTUNITY, EFFECTIVENESS, and QUALITY. Each component refers to an aspect of the process that can be targeted for improvement. OEE can be applied to any individual work area or escalated to the Department or Plant level. This tool also allows you to get results for very specific analyzes such as a specific part number, Shift or any number of multiples.

No manufacturing process can operate at 100% OEE. Many manufacturers benchmark their industry to set a challenging target; 85% is not uncommon. Calculation formula for OEE

OEE = OPPORTUNITY × EFFECTIVENESS × QUALITY

Indicator 2: TEEP (Total Effective Equipment Performance)

OEE measures efficiency based on scheduled hours, but TEEP measures efficiency relative to calendar hours, i.e. 24 hours per day, 365 days per year. Thus, TEEP reports the "bottom line" use of assets [2].

Calculation formula for TEEP:

TEEP = Load × OEE

In other words, TEEP adds a fourth "Load" indicator. Therefore TEEP = Load × CAPACITY × EFFICIENCY × Quality

Indicator 3: The loading part of the TEEP indicator

The load portion of the TEEP indicator represents the percentage of time the operation is scheduled to be completed relative to the total calendar time available. The load factor is an accurate measure of Table performance and is designed to exclude the effect of how well an operation can perform. This calculation formula is:

Load = Scheduled Time/Calendar Time

Indicator 4: OPPORTUNITY.

The OPPORTUNITY portion of the OEE metric represents the percentage of scheduled time that an operation can be completed. Another way of saying this is that OPPORTUNITY is the percentage of time a machine is available to produce parts. CAPACITY is a pure measure of uptime, designed to exclude quality, productivity, and performance impacts.

Scheduled downtime events. This calculation formula is:

CAPACITY = Available Time/Scheduled Time

Indicator 5: EFFICIENCY.

The performance part of the OEE metric represents the machine's operating speed as a percentage of its intended speed. In other words, it is the actual speed of the car relative to the ideal speed of the car. Performance is a pure measure of speed designed to exclude the effects of quality and CAPACITY. EFFICIENCY CALCULATION FORMULA [3].

N=(Actual number of products produced)/(Number of products to be produced according to the plan)

Indicator 6: Quality.

The Quality portion of the OEE metric represents good units produced as a percentage of total units started. In other words, it is the percentage of the resulting parts within the specifications defined by the customer. A quality score is a pure measure of process profitability designed to exclude the effects of CAPACITY and productivity. Formula for calculating quality:

Quality = Good units/units started

Monitor and track time and other considerations.

Timing is important when dealing with OEE and TEEP. Especially when calculating OEE, the operator or machine engineer must be familiar with the time categories. These times should be monitored and monitored continuously. These time references are defined as runtime and downtime, which are detailed in the next two sections. In addition, ideal cycle time is also important, as are defects, quality cost, process line considerations, and process line quality.

The ideal cycle time is the fastest speed you can use before compromising quality. This is usually considered the theoretical cycle time. In a real sense, cycle time is equated to the total number of parts working in a given period.

Determining the cost of common defects and quality.

Total Defects is the total number of rejected, reworked, or scrapped parts produced during the period. Of course, the goal is to have zero defects.

The cost of quality is the cost of creating process defects and inefficiencies. In order to have a good quality costing system, the following guidelines may be useful:

- Identify data sources.
- Determine who collects the information.
- Specify who records the information.
- Determine how the data will be reported.
- Define who will calculate and produce the report.
- Announce results with funds achieved.

Process line accounting.

In any maintenance environment, process consideration should be an important part of evaluating "zero defects." Typical considerations are:

- Maintain reliability of all equipment by focusing on limiting machines.
- Faster production depends on limiting machines.
- Rules for collecting technological material between machines.
- The process must be compatible with stop or stop.
- The constraint machine is missing or blocked downstream.

Process line quality issues.

When evaluating a machine or equipment, you should also be aware of the quality issues presented in the operating cycle. Common problems

The following should be looked for and evaluated:

- Upstream defects are not serious unless they are starving.
- Defects at bottleneck or downstream points are more serious because they affect production volume.
- Whether all quality defects should be recorded (eg upstream affects cost; downstream affects cost and production).

To define what OEE is, you need to understand and measure its components, which are described in the following sections [4].

Equipment CAPACITY measurement.

OPPORTUNITY focuses on features and repairs. As mentioned above, AVAILABILITY is a measure of the degree to which machinery or equipment is in a serviceable and reliable condition at any given time; specifically, the percentage of time that machinery or equipment can operate when needed. OPPORTUNITY depends on reliability and maintenance (R&M) and it combines R&M in one dimension. In addition, it is affected by the scheduled maintenance schedule for a particular machine or equipment. In fact, one of the main objectives of a planned maintenance schedule is to maximize the availability of the machine or equipment. It is essential to ensure that machines and equipment are designed to the highest level of R&M to maximize OPPORTUNITY [5].

The following areas affect OPPORTUNITY: distortion loss, adjustment and adjustment loss, etc.

When calculating this figure, it is assumed that maintenance starts as soon as the failure is reported. And so,

CAPACITY= Mean Time Between Failures(MTBF) / [(Mean Time Between Failures(MTBF))+(Mean Time To Repair (MTTR))]

Measure the equipment setup time. As you know, machines don't always run perfectly the first time. It will take them some time to get up to speed and produce quality parts. The time required to achieve this optimal production (sustainable production) is the fixed time. At this stage, companies face inconsistent product, rework and delays.

Measuring equipment performance.

Performance is a parameter that depends on the speed of the mechanism. This research is so however, the performance degradation due to speed is of interest. There are two ways to reduce performance due to loss of speed:

1. Decreasing speed of operation: These are losses due to defects when the machine or equipment is operated below the recommended speed. The reason for this low speed is that operators are not sure of the level of quality produced at normal speed [6].

2. Minor stoppages: These are minor interruptions that occur during the production process and are usually not recorded. As a result, you have to include them as part of the performance losses that reduce the production of the product. Because of the erratic behavior of the machines or equipment at hand, automating them will be very difficult until you solve the small stops. A typical OEE form is shown in Table 1.

OEE measurement is intended to be used as a tool to track machine improvement progress. The main definitions are as follows:

- Total Available Time = The amount of time the equipment can operate during a shift, assuming no planned or unplanned outages [7].
- Planned Downtime = Time the equipment is down due to scheduled activities such as meetings, breaks, lunches, etc.
- Unplanned Downtime = Time the equipment is down due to malfunctions, adjustments, adjustments, etc.
- Ideal cycle time = Best achieved cycle time, can be design cycle time or estimate.

A typical first-time transfer form is shown in Table 2. First time throughput = C1 × C2 × C3 × C4 × C5 × C6, where C1, C2, …, C6 are quality indicators. A typical "get it right the first time" format is shown in Table 2

Table 2. Usually the first transfer form.

Part Number: Date:		Part Name: Change:	
Process # Description	A. In-process parts	B. (Nonconforming product + in-line processing + off-line processing)	C: Quality level: [(A-B)/A]
1.			
2.			
3.			
4.			

Conclusion. To be sure, OEE is a process tool. There is no doubt about it. However, certain elements can be used as a useful reference (for example, can be used as a benchmark for performance and capacity). For this it must be done properly. In the past year or so, the application of OEE in the automotive industry has taken a new turn. Considered as an indicator for measuring and evaluating capabilities. If used correctly, it has the potential to aid in this process.

As mentioned above, 100% efficiency cannot be achieved in the long run due to maintenance, downtime and adjustments. The guideline is that 85% is the true "worldwide" value for "conventional" machines (see Table 1). This means that the installation, for example, of 99% of products is "Right within specifications the first time"; operation at a speed of 95% of the theoretical maximum speed; and that it actually works 90% of the time (99% quality × 95% speed × 90% uptime = 85% efficiency).

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