**OEE GLOSSARY**

- **Availability**: One of the three OEE Factors. Takes into account Down Time Loss (events that stop planned production for an appreciable amount of time).
- **Cycle Time**: The time to produce one piece.
- **Cycle Time Analysis**: Tool used to better understand issues that affect Performance.
- **Down Time Analysis**: Tool used to better understand issues that affect Availability.
- **Down Time Loss**: Production time lost to unplanned shutdowns.
- **Fully Productive Time**: Time remaining after ALL productivity losses are subtracted.
- **Ideal Cycle Time**: Theoretical minimum time to produce one piece.
- **Ideal Run Rate**: Theoretical maximum possible production rate.
- **Nameplate Capacity**: The design capacity of a machine or process.
- **Net Operating Time**: Time remaining after Down Time Losses and Speed Losses are subtracted.
- **OEE (Overall Equipment Effectiveness)**: Framework for measuring the efficiency and effectiveness of a process, by breaking it down into three constituent components (the OEE Factors).
- **OEE Factors**: The three constituent elements of OEE (Availability, Performance and Quality).
- **OEE Losses**: The three types of productivity loss associated with the three OEE Factors (Down Time Loss, Speed Loss, and Quality Loss).
- **Operating Time**: Time remaining after Down Time Losses are subtracted.
- **Performance**: One of the three OEE Factors. Takes into account Speed Loss factors that cause the process to operate at less than the maximum possible speed, when running.
- **Planned Production Time**: Total time that equipment is scheduled for production. This is the starting point for OEE analysis.
- **Planned Shut Down**: Time deliberately scheduled for no production.
- **Plant Operating Time**: The time the factory is open and available for equipment operation.
- **Quality**: One of the three OEE Factors. Takes into account Quality Loss (parts that do not meet quality requirements).
- **Quality Loss**: Production time lost to parts which do not meet quality requirements.
- **Reduced Speed**: Cycle where the process is truly running (as opposed to a Small Stop) but is slower than “expected”. One of the Six Big Losses.
- **Six Big Losses**: Six categories of productivity loss that are almost universally experienced in manufacturing: Breakdowns, Setup/Adjustments, Small Stops, Reduced Speed, Startup Rejections, and Production Rejections.
- **Small Stop**: A brief pause in production but not long enough to be tracked as Down Time. One of the Six Big Losses.
- **SMED (Single Minute Exchange of Dies)**: Program for reducing changeover time. Named after the goal of reducing changeover times to less than 10 minutes (representing time with one digit).
- **Speed Loss**: Production time lost to equipment running below maximum rated speed.
- **Takt Time**: Production rate needed to meet customer demand.
- **Visual OEE**: Plant floor real-time display of live OEE data for maximum team involvement.

**IMPROVING OEE**

**What is Visual OEE?** An extremely effective method of automating OEE data collection and bringing real-time OEE and other key metrics to the plant floor AND to managers and supervisors anywhere in your plant.

**How does it work?** XL is an amazingly simple and effective solution for improving plant floor productivity. It’s an off-the-shelf product that delivers real-time manufacturing visibility and performance management tools to your entire manufacturing team. And it’s an indispensable tool for lean manufacturing and real-time OEE.

![XL800 - Monitor over 100 process variables on the plant floor and over your network!](image)

**ACTIONABLE INFORMATION NOW**

Tired of seeing production data in stale and incomplete reports? XL is the answer! Accurate, complete, real-time data — viewable anywhere.

**Easy to implement**

Just install two sensors and enter your Ideal Cycle Time to start. Optionally, add your break schedule, Takt Time and Job/Shift Goal. In return XL provides over 100 different ways to view your production. It’s that simple!

**YOU PROVIDE**

- One Sensor
- Second Sensor
- Ideal Cycle Time
- Takt Time
- Job/Shift Goal
- Setup Switch
- Break Schedule

**XL PROVIDES**

- Availability: Total Pieces, Current Rate, Average Rate, Cycle Time, Last Cycle Time, Average Cycle Time, Run Time, Event Run Time, Down Time, Event Down Time
- Quality: Good/Reject Pieces, Good/Reject Percent, Good/Reject Current and Average Rate
- Performance, OEE: Standard Cycles and Time, Reduced Speed Cycles and Time, Small Stop Cycles and Time
- Target Count, Target Cycle, Takt Time, Piece/Time Variance, Efficiency
- Pieces to Deal, Percent of Goal
- Setup and Event Setup Time
- Standby and Event Standby Time, Break Countdown

Learn more at: www.vorne.com/xl

**WHAT IS OEE?**

OEE (Overall Equipment Effectiveness) is a “best practices” metric for monitoring and improving the efficiency of your manufacturing processes (i.e., machines, cells, assembly lines, etc.).

OEE is simple, practical and powerful. It captures the most common sources of manufacturing productivity losses and places them into three categories: Availability, Performance and Quality. In doing so, it distills complex production data into simple understandable metrics that provide a gauge for measuring true manufacturing efficiency. It also forms the foundation for tools that help to improve productivity.

**Availability** measures productivity losses from down time (events that stop planned production for an appreciable amount of time).

**Performance** measures losses from slow cycles (factors that cause the process to operate at less than the maximum possible speed).

**Quality** measures losses from manufactured parts that do not meet quality requirements. Together these three factors combine into one OEE score—a single number that provides a complete measure of manufacturing efficiency and effectiveness.

OEE provides a consistent, proven way to measure the effectiveness of lean manufacturing initiatives, TPM (Total Productive Maintenance) programs and other productivity initiatives.

**WORLD CLASS OEE**

World Class OEE for discrete manufacturing plants is generally considered to be 85% or better.

<table>
<thead>
<tr>
<th>OEE FACTOR</th>
<th>WORLD CLASS</th>
<th>YOUR OEE?</th>
</tr>
</thead>
<tbody>
<tr>
<td>OEE</td>
<td>85.0%</td>
<td>_____%</td>
</tr>
<tr>
<td>Availability</td>
<td>90.0%</td>
<td>_____%</td>
</tr>
<tr>
<td>Performance</td>
<td>95.0%</td>
<td>_____%</td>
</tr>
<tr>
<td>Quality</td>
<td>99.9%</td>
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Studies indicate that the average OEE score for discrete manufacturing plants is approximately 60%. Clearly, there is significant room for improvement in most manufacturing plants. Imagine what a 40% improvement (increasing OEE from 60% to 85%) in productivity could do for your competitiveness and profitability!
We start with **Plant Operating Time**, which is the amount of time your facility is open and available for equipment operation.

From Plant Operating Time, we subtract **Planned Shut Down**, which includes all events that should be excluded from efficiency analysis because there is no intention of running production (e.g., breaks, scheduled maintenance, periods where there is nothing to produce). The remaining time is called **Operating Time**.

**Availability**

Availability takes into account **Down Time Loss**, which includes all events that stop planned production for an appreciable length of time (usually several minutes). 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 is usually not possible to eliminate changeover time, in most cases it can be reduced (the basis of SMED programs). The remaining time is called **Operating Time**. Availability is the ratio of Operating Time to Planned Production Time.

**Performance**

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

**Quality**

Quality takes into account **Quality Loss**, which factors out produced pieces that do not meet quality standards, including pieces that require rework. The remaining time is called **Fully Productive Time**. Quality is the ratio of Fully Productive Time to Net Operating Time.

**OEE**

OEE takes into account all three factors, and is simply the ratio of Fully Productive Time to Planned Production Time. In other words, it represents the percentage of production time spent making good pieces (no quality loss), as fast as possible (no speed loss), without interruption (no down time loss).

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**Calculating OEE**

In practice, Availability, Performance, Quality and OEE are calculated from production data gathered from your manufacturing process. Here’s how.

### Availability

Availability is the ratio of Operating Time (which is simply Planned Production Time less Down Time) to Planned Production Time, and accounts for Down Time Loss. It is calculated as:

\[
\text{Availability} = \frac{\text{Operating Time}}{\text{Planned Production Time}}
\]

### Performance

Performance is the ratio of Net Operating Time to Operating Time, and accounts for Speed Loss. In practice it is calculated as:

\[
\text{Performance} = \frac{\text{Ideal Cycle Time} \times \text{Total Pieces}}{\text{Operating Time}}
\]

### Quality

Quality is the ratio of Fully Productive Time (time for Good Pieces) to Net Operating Time (time for Total Pieces). In practice it is calculated as:

\[
\text{Quality} = \frac{\text{Good Pieces}}{\text{Total Pieces}}
\]

### OEE

OEE is the ratio of Fully Productive Time to Planned Production Time. In practice it is calculated as:

\[
\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality}
\]

If you substitute in the equations for Availability, Performance, and Quality, and then reduce them to their simplest terms, the result is:

\[
\text{OEE} = \frac{\text{Good Pieces} \times \text{Ideal Cycle Time}}{\text{Planned Production Time}}
\]

This is also an entirely correct way to calculate OEE, and with a bit of reflection you will realize that multiplying Good Pieces by Ideal Cycle Time results in much more timely and accurate information—information that gives managers and operators the ability to react quickly to any problems that arise. It is also important to give your operators goals that provide real-time feedback on how they are doing compared to your established standards.