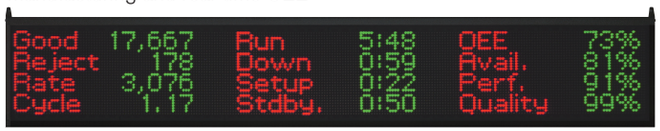
OEE GLOSSARY

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 Rejects, and Production Rejects.
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.

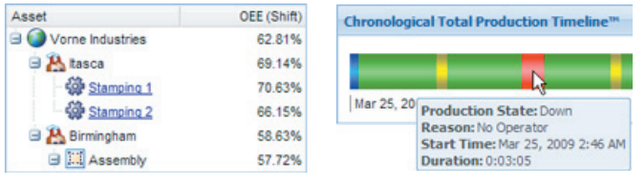
How does it work? XL is an amazingly simple and effective solution for improving plant floor productivity. It's an off-the-shelf product that delivers real-time manufacturing visibility and performance management tools to your entire manufacturing team. And it's an indispensible tool for lean manufacturing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



XL800 - Monitor over 100 process variables on the plant floor and over your network!

ACTIONABLE INFORMATION NOW

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



Every XL includes extensive production monitoring and analytics features - accessed directly from the XL device via web browser.

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	XL PROVIDES
One Sensor	**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
Second Sensor	**Quality**, Good/Reject Pieces, Good/Reject Percent, Good/Reject Current and Average Rate
Ideal Cycle Time	**Performance, OEE**, Standard Cycles and Time, Reduced Speed Cycles and Time, Small Stop Cycles and Time
Takt Time	Target Count, Target Cycle, Takt Timer, Piece/Time Variance, Efficiency
Job/Shift Goal	Pieces to Goal, Percent of Goal
Setup Switch	Setup and Event Setup Time
Break Schedule	Standby and Event Standby Time, Break Countdown

Learn more at: www.vorne.com/xl

OEE Pocket Guide

PRESENTED BY **Vorne™**

We Improve Manufacturing Productivity!™

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 takes 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.

OEE FACTOR	WORLD CLASS	YOUR OEE?
OEE	85.0%	___%
Availability	90.0%	___%
Performance	95.0%	___%
Quality	99.9%	___%

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!

OEE FACTORS

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 **Planned Production 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).

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:

Availability = Operating Time/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:

Performance = (Ideal Cycle Time x Total Pieces)/Operating Time

Ideal Cycle Time is the minimum cycle time that your process can be expected to achieve under optimal conditions, for a given part. Therefore, when it is multiplied by Total Pieces the result is Net Operating Time. Ideal Cycle Time is sometimes called Design Cycle Time, Theoretical Cycle Time or Nameplate Capacity.

Since Rate is the reciprocal of Cycle Time, Performance can also be calculated as:

Performance = (Total Pieces/Operating Time)/Ideal Run Rate

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:

Quality = Good Pieces / Total Pieces

OEE

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

OEE = Availability x Performance x Quality

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

OEE = Good Pieces x Ideal Cycle Time/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 Fully Productive Time (producing only good pieces, as fast as possible, with no down time).

It is very important to recognize that improving OEE should not be your sole objective. For example, very few companies would want to trade a 10% increase in Availability for an 8% decrease in Quality, even though this would represent a net improvement in OEE.

Working through real-world examples is a great way to improve your understanding of OEE calculations. **To download a free PDF worksheet and a spreadsheet template, visit: www.oee.com/tools**

THE SIX BIG LOSSES

One of the major goals of OEE and TPM programs is to reduce and/or eliminate what are called the Six Big Losses—the most common causes of efficiency loss in manufacturing. The following table lists the Six Big Losses, and shows how they relate to OEE Loss categories.

SIX BIG LOSS CATEGORY	OEE LOSS	EVENT EXAMPLES	NOTES
Breakdowns	Down Time Loss	• Tooling Failures • Unplanned Maintenance • Equipment Failure	There is flexibility on where to set the threshold between a Breakdown (Down Time Loss) and a Small Stop (Speed Loss).
Setup and Adjustments	Down Time Loss	• Setup/Changeover • Material Shortages • Operator Shortages • Warm-Up Time	One way to address this loss is through setup time reduction programs (e.g. SMED).
Small Stops	Speed Loss	• Obstructed Flow • Component Jams • Misfeeds • Sensor Blocked • Cleaning/Checking	Typically only includes stops that are under five minutes and that do not require maintenance personnel.
Reduced Speed	Speed Loss	• Rough Running • Under Nameplate Capacity • Equipment Wear • Operator Inefficiency	Anything that keeps the process from running at its theoretical maximum speed (a.k.a. Ideal Cycle Time) for a given product.
Startup Rejects	Quality Loss	• Scrap • Rework • In Process Damage • In Process Expiration • Incorrect Assembly	Rejects during warm-up, startup or other early production. May be due to improper setup, warm-up period, etc.
Production Rejects	Quality Loss	Same as Startup Rejects.	Rejects during steady-state production.

ADDRESSING THE SIX BIG LOSSES

Now that we know what the Six Big Losses are and some of the events that contribute to these losses, we can focus on ways to monitor and correct them.

For example, it is not only important to know how much Down Time your process is experiencing (and when) but also to attribute lost time to the specific source or reason for the loss (tabulated through Reason Codes). With Down Time and Reason Code data tabulated, root cause analysis can be applied, starting with the most severe loss categories.

Automating your data collection process is an important goal, as it will result 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.