The Fast Guide to OEE™

Presented by Vorne Industries

◆ ◆ ◆

Specialists in Visual Factory and Production Monitoring Systems

Table of Contents

FAST TRACK OEE FOR PRODUCTION PEOPLE ON THE MOVE 4
WHAT IS OEE? 4
FAST TRACK ROADMAP 5
OEE FACTORS 6
Where Do We Start? 6
Availability 6
Performance 6
Quality 6
Quick Review 7
SIX BIG LOSSES 8
Defining the Six Big Losses 8
Addressing the Six Big Losses 9
Breakdowns 9
Setup and Adjustments 9
Small Stops and Reduced Speed 9
Startup Rejects and Production Rejects 9
WORLD CLASS OEE 10
CALCULATING OEE 11
The Formulas 11
Availability 11
Performance 11
Quality 11
OEE 11
Example OEE Calculation 13
Example OEE Calculation 13
OEE FAQ 14
OEE GLOSSARY 17
VISUAL OEE™ 22
The Visual OEE™ Principle 22
Getting Started 23
Attacking the Six Big Losses 24
ABOUT VORNE 25
Who We Are 25
What We Do 25
Why We Do It 25
CONTACT US 26
NOTES: 27

Fast Track OEE for Production People on the Move

Does your production have bottlenecks that you're not aware of?
Could one machine be dragging down the entire facility?
Does your equipment have excess capacity that could be easily and inexpensively tapped?

There's been a long parade of manufacturing buzzwords and systems over the years. As you are all too aware, many have been little more than a waste of time, energy and money for you and your already overworked staff.

But Overall Equipment Effectiveness (OEE) is different. OEE truly reduces complex production problems into simple, intuitive presentation of information. It helps you systematically improve your process with easy-to-obtain measurements.

We invite you to spend a few minutes reading The Fast Guide to OEE™. It's a step by step tutorial that will help you instantly make more with what you've got.

What is OEE?

OEE is a "best practices" way to monitor and improve the effectiveness of your manufacturing processes (i.e. machines, manufacturing cells, assembly lines).

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 effectiveness of TPM and other initiatives by providing an overall framework for measuring production efficiency.

Fast Track Roadmap

We've broken it down into "six easy pieces" - Your *Fast Guide to OEE*™.

OEE Factors introduces Availability, Performance, and Quality…the metrics that you will use to measure your plant's efficiency and effectiveness. We provide a visual overview of the key productivity losses that occur in the typical manufacturing environment. We start with Plant Operating Time and end up at Fully Productive Time, showing the sources of productivity loss that occur in between.

Six Big Losses describes the most common causes for efficiency loss – almost always found in today's manufacturing environment. Six root causes of loss are presented, each directly related to an OEE Factor.

World Class OEE introduces the general OEE calculation and what is considered to be truly world class OEE. This is your goal!

Calculating OEE illustrates how the three OEE Factors are calculated and breaks them into the specific elements that are required to develop the OEE percentage. A real-world example is given to demonstrate the mechanics of a typical OEE calculation.

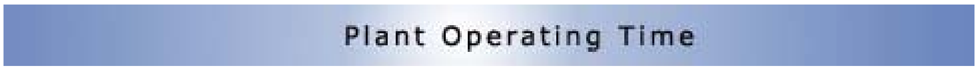
OEE FAQ presents commonly asked questions about OEE, with practical, real world answers and advice.

Visual OEE™ makes immediate improvements attainable! By bringing real-time data directly to the plant floor, Visual OEE™ is the proactive path to continuous improvement!

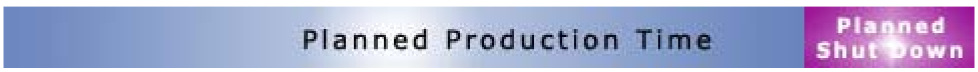
OEE Factors

Where Do We Start?

OEE analysis starts with **Plant Operating Time**; the amount of time your facility is open and available for equipment operation.



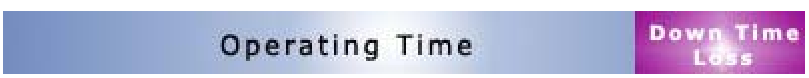
From **Plant Operating Time**, you subtract a category of time called **Planned Shut Down**, which includes all events that should be excluded from efficiency analysis because there was no intention of running production (e.g. breaks, lunch, scheduled maintenance, or periods where there is nothing to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



OEE begins with **Planned Production Time** and scrutinizes efficiency and productivity losses that occur, with the goal of reducing or eliminating these losses. There are three general categories of loss to consider - **Down Time Loss**, **Speed Loss** and **Quality Loss**.

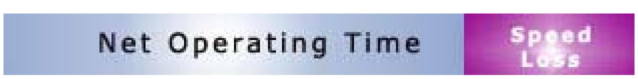
Availability

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**.



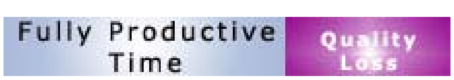
Performance

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**.



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.**



Quick Review

Now that you have taken a look at how the factors that contribute to OEE Losses are developed we can quickly review the key points.

OEE Loss	OEE Factor
Planned Shutdown	Not part of the OEE calculation.
Down Time Loss	• *Availability* is the ratio of Operating Time to Planned Production Time (Operating Time is Planned Production Time less Down Time Loss). • Calculated as the ratio of Operating Time to Planned Production Time. • 100% *Availability* means the process has been running without any recorded stops.
Speed Loss	• *Performance* is the ratio of Net Operating Time to Operating Time (Net Operating Time is Operating Time less Speed Loss). • Calculated as the ratio of Ideal Cycle Time to Actual Cycle Time, or alternately the ratio of Actual Run Rate to Ideal Run Rate. • 100% *Performance* means the process has been consistently running at its theoretical maximum speed.
Quality Loss	• *Quality* is the ratio of Fully Productive Time to Net Operating Time (Fully Productive Time is Net Operating Time less Quality Loss). • Calculated as the ratio of Good Pieces to Total Pieces. • 100% *Quality* means there have been no reject or rework pieces.

As you can see, the core concepts of OEE are quite simple and really help to focus on the underlying causes of productivity loss. We can delve even deeper into productivity losses by understanding the Six Big Losses.

Six Big Losses

Defining the Six Big Losses

One of the major goals of TPM and OEE 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 the OEE Loss categories.

Six Big Loss Category	OEE Loss Category	Event Examples	Comment
Breakdowns	Down Time Loss	• Tooling Failures • Unplanned Maintenance • General Breakdowns • 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 • Major Adjustments • Warm-Up Time	This loss is often addressed through setup time reduction programs.
Small Stops	Speed Loss	• Obstructed Product Flow • Component Jams • Misfeeds • Sensor Blocked • Delivery 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 • Under Design Capacity • Equipment Wear • Operator Inefficiency	Anything that keeps the process from running at its theoretical maximum speed (a.k.a. Ideal Run Rate or Nameplate Capacity).
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	• Scrap • Rework • In-Process Damage • In-Process Expiration • Incorrect Assembly	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. Categorizing data makes loss analysis much easier, and a key goal should be fast and efficient data collection, with data put it to use throughout the day and in real-time.

Breakdowns

Eliminating unplanned **Down Time** is critical to improving OEE. Other OEE Factors cannot be addressed if the process is down. It is not only important to know how much Down Time your process is experiencing (and when) but also to be able to attribute the 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** is applied starting with the most severe loss categories.

Setup and Adjustments

Setup and Adjustment time is generally measured as the time between the last good part produced before Setup to the first consistent good parts produced after Setup. This often includes substantial adjustment and/or warm-up time in order to consistently produce parts that meet quality standards.

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

Many companies use creative methods of reducing Setup Time including assembling changeover carts with all tools and supplies necessary for the changeover in one place, pinned or marked settings so that coarse adjustments are no longer necessary, and use of prefabricated setup gauges.

Small Stops and Reduced Speed

Small Stops and Reduced Speed are the most difficult of the Six Big Losses to monitor and record. **Cycle Time Analysis** should be utilized to pinpoint these loss types. In most processes recording data for Cycle Time Analysis needs to be automated since cycles are quick and repetitive events that do not leave adequate time for manual data-logging.

By comparing all completed cycles to the **Ideal Cycle Time** and filtering the data through a **Small Stop Threshold** and **Reduced Speed Threshold** the errant cycles can be automatically categorized for analysis. The reason for analyzing Small Stops separately from Reduced Speed is that the root causes are typically very different, as can be seen from the Event Examples in the previous table.

Startup Rejects and Production Rejects

Startup Rejects and Production Rejects are differentiated, since often the root causes are different between startup and steady-state production. Parts that require rework of any kind should be considered rejects. Tracking when rejects occur during a shift and/or job run can help pinpoint potential causes, and in many cases patterns will be discovered.

Often a **Six Sigma** program, where a common metric is achieving a defect rate of less than 3.4 defects per million “opportunities”, is used to focus attention on a goal of achieving ”near perfect” quality.

World Class OEE

OEE is essentially the ratio of Fully Productive Time to Planned Production Time (refer to the **OEE Factors** section for a graphic representation). In practice, however, OEE is calculated as the product of its three contributing factors:

OEE = Availability x Performance x Quality

This type of calculation makes OEE a severe test. For example, if all three contributing factors are 90.0%, the OEE would be 72.9%. In practice, the generally accepted World-Class goals for each factor are quite different from each other, as is shown in the table below.

OEE Factor	World Class
Availability	90.0%
Performance	95.0%
Quality	99.9%
OEE	85.0%

Of course, every manufacturing plant is different. For example, if your plant has an active Six Sigma quality program, you may not be satisfied with a first-run quality rate of 99.9%.

Worldwide studies indicate that the average OEE rate in manufacturing plants is 60%. As you can see from the above table, a World Class OEE is considered to be 85% or better. Clearly, there is room for improvement in most manufacturing plants! How about yours?

Calculating OEE

The Formulas

As described in World Class OEE, the OEE calculation is based on the three OEE Factors, Availability, Performance, and Quality. Here's how each of these factors is calculated.

Availability

Availability takes into account **Down Time Loss**, and is calculated as:

Availability = *Operating Time / Planned Production Time*

Performance

Performance takes into account **Speed Loss**, and is calculated as:

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

Ideal Cycle Time is the minimum cycle time that your process can be expected to achieve in optimal circumstances. It is sometimes called *Design Cycle Time*, *Theoretical Cycle Time or Nameplate Capacity*.

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

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

Performance is capped at 100%, to ensure that if an error is made in specifying the *Ideal Cycle Time* or *Ideal Run Rate* the effect on OEE will be limited.

Quality

Quality takes into account **Quality Loss**, and is calculated as:

Quality = *Good Pieces / Total Pieces*

OEE

OEE takes into account all three **OEE Factors**, and is calculated as:

OEE = *Availability x Performance x Quality*

It is very important to recognize that improving OEE is not the only objective. Take a look at the following data for two production shifts.

OEE Factor	Shift 1	Shift 2
Availability	90.0%	95.0%
Performance	95.0%	95.0%
Quality	99.5%	96.0%
OEE	**85.1%**	**86.6%**

Superficially, it may appear that the second shift is performing better than the first, since its OEE is higher. Very few companies, however, would want to trade a 5.0% increase in Availability for a 3.5% decline in Quality!

The beauty of OEE is not that it gives you one magic number; it's that it gives you three numbers, which are all useful individually as your situation changes from day to day. And it helps you visualize performance in simple terms – a very practical simplification.

Example OEE Calculation

The table below contains hypothetical shift data, to be used for a complete OEE calculation, starting with the calculation of the OEE Factors of *Availability, Performance, and Quality.* Note that the same units of measurement (in this case minutes and pieces) are consistently used throughout the calculations.

Item	Data
Shift Length	8 hours = 480 min.
Short Breaks	2 @ 15 min. = 30 min.
Meal Break	1 @ 30 min. = 30 min.
Down Time	47 minutes
Ideal Run Rate	60 pieces per minute
Total Pieces	19,271 pieces
Reject Pieces	423 pieces

Planned Production Time = [Shift Length - Breaks] = [480 - 60]= **420 minutes**

Operating Time = [Planned Production Time - Down Time] = [420 - 47] = **373 minutes**

Good Pieces = [Total Pieces - Reject Pieces] = [19,271 - 423] = **18,848 pieces**

Availability	=	*Operating Time / Planned Production Time*
	=	373 minutes / 420 minutes
	=	0.8881 (88.81%)

Performance	=	*(Total Pieces / Operating Time) / Ideal Run Rate*
	=	(19,271 pieces / 373 minutes) / 60 pieces per minute
	=	0.8611 (86.11%)

Quality	=	*Good Pieces / Total Pieces*
	=	18,848 / 19,271 pieces
	=	0.9780 (97.80%)

OEE	=	*Availability x Performance x Quality*
	=	0.8881 x 0.8611 x 0.9780
	=	0.7479 (74.79%)

OEE FAQ

Do you define everything in units of parts and units of time?

The answer depends on what's most intuitive for you and your operators. Down Time Loss is usually described in units of hours or minutes. Speed Loss is most often defined in terms such as pieces per hour (rate) or seconds per piece (cycle time). Quality Loss is typically looked at as a ratio of rejects to total production. Other quantity related measurements like pounds, kilos or meters may also be used. All of these eventually are converted (normalized) to a percentage that shows actual vs. potential.

Is OEE data subject to misinterpretation?

Without a doubt! The two shift example in the Calculating OEE section is a great example. OEE tells you nothing about how much your resources actually cost in dollars, what the easiest improvement actually is, or how much it will cost you to make that improvement. What you should look for in OEE is losses and bottlenecks that can be eliminated for a cost/benefit that makes sense. OEE data is only meaningful in the context of your situation and your efforts to improve it.

How do you determine the Ideal Cycle Time or Ideal Run Rate of a machine or process?

The simple answer is the Nameplate Capacity – the stated capacity given by the manufacturer or engineer. But like the speedometer in your car, this number may only be an approximation and may vary considerably with machine age and other circumstances. Ideally you should experiment, take measurements and come up with your own number.

How do you define whether a machine is "producing"?

If the machine is producing anything at all, the production clock is running. Even if a machine is not producing, if production is planned, the production clock is running.

How do you minimize number crunching, spreadsheets and reports and make OEE truly simple?

Data isn't very useful if you don't see it until tomorrow, or at next week's production meeting. The printout in the manager's office isn't nearly as helpful as having real-time data, with visual cues, already digested into a form that is useful to you and your operators. Automate the OEE data collection and calculation process, and spend your time dealing with the issues that impact productivity here and now.

What period of time do you use for an OEE calculation?

You can choose any period you want. Most commonly it's based on the working cycle of the factory, i.e. one shift (8 hours or 480 minutes). Other time frames include one day, one job, or even continuous monitoring.

Is it possible to have processes that exceed 100%?

No. If you obtain readings greater than 100%, then at some point of the process you are not defining something correctly. It means that you were underestimating the capacity of a process when you input your parameters. This is most often an issue with Performance, when the Ideal Cycle Time or Ideal Run Rate have not been correctly characterized.

If you have a series of machines or stages in a cell with different capacities, which stage do you base your Ideal Cycle Time (or Ideal Run Rate) on?

Typically, when a cell is "balanced", meaning that the Nameplate Capacity of all contributing machines, stations, or stages is designed to produce at reasonably close to the same rate, the fastest stage (not the slowest), should be your target. This forces you to recognize all other bottlenecks and strive to improve them.

In cases where a cell is not balanced, some analysis should be performed. Probably the best way to begin is to look at the cell in aggregate to determine if any of the associated stages have a Nameplate Capacity that far exceeds the others. These stages are typically known as "accumulator/buffers", or may be the result of a piece of equipment not originally designed for use in the particular cell but later added, and should be disregarded when calculating the Ideal Cycle Time for the cell.

How do I calculate OEE for my entire plant?

This is a very interesting question that touches on a tricky and somewhat controversial topic (as discussed below). But first, here are two reasonable options for calculating Plant OEE:

Calculate Plant OEE Using a Straight Average
Calculate Plant OEE Using a Weighted Average

Calculate Plant OEE Using a Straight Average – The simplest method of calculating Plant OEE is to average the OEE scores of all production assets (i.e. add together the OEE scores of all production assets and then divide that result by the number of production assets).

In a plant with three production assets the calculation would be:

$(OEE_1 + OEE_2 + OEE_3) / 3$

Calculate Plant OEE Using a Weighted Average – An improved (albeit more complex) method of calculating Plant OEE is to calculate a weighted average of the OEE scores of all production assets. A weighted average "weights" the OEE score of each production asset to take into account its relative importance. The weight can be any factor that assigns relative importance; however, it is recommended to assign weights based on the value added by the production asset. Doing so, helps keep the focus on improvements that add the most value – to the bottom line.

In a plant with three production assets, the calculation would be:

$$((OEE_1 \times Weight_1) + (OEE_2 \times Weight_2) + (OEE_3 \times Weight_3)) / (Weight_1 + Weight_2 + Weight_3)$$

Calculating Plant OEE can be very useful for monitoring trends (such as whether a given plant is improving OEE over time) or as a rough gauge of where a given plant lies in the OEE benchmarking spectrum. However, one should be very cautious about using OEE to compare different plants, or even to compare different production assets. Unless production assets are running identical products on identical equipment under identical conditions, comparing their OEE metrics is somewhat akin to comparing apples to oranges.

Do OEE benchmarks, i.e. Theoretical Capacity, ever change?

Yes, but only if the process is improved in some tangible and measurable way.

Can OEE become a political football?

Yes, to the extent that it is misinterpreted and to the extent that it is used for political purposes rather than to genuinely work towards sustainable improved productivity. Of course that's true of all numbers and measurements. The important thing is to keep the core objective in mind – to produce more quality product with less waste and fewer headaches. Therefore you should be very clear about exactly what you want and make sure you are measuring it. Then you can create incentives for operators to deliver that result.

If there are several interpretations for the cause of a problem, where do you start?

Always look for the simplest and most direct explanation (the root cause). Obviously there are exceptions, but here's what's important – rather than ponder and discuss 50 different causes, start with the most straightforward hypothesis and test it. Use a process of elimination until you are certain you have reached the root cause of the problem.

Should preventative maintenance Down Time be allowed to penalize an OEE calculation?

If the preventative maintenance happens during Planned Production Time (rather than during Planned Shut Down) then it is interfering with production and should be counted. This does not mean that you should not do preventative maintenance at that time; it only means that over time, OEE will tell you whether this maintenance results in less overall Down Time, because of fewer "surprises," or more Down Time, because of the lost productivity while maintenance is done. This is an example of how OEE can give you solid answers to complex questions by attaching them to simple measurements.

Should reworked pieces be counted as Good or Reject in the OEE calculation?

In OEE, any part that doesn't come out right the first time is a Reject Piece. It's a production issue that needs to be addressed. Your strategy for improving original part quality vs. reworking reject parts is a separate management and financial issue.

How can reworked pieces counted in an OEE calculation?

Reworked pieces are typically looked at as a completely independent OEE process. It is taken into consideration that time and materials were used in the first pass run that resulted in a part or product that did not meet quality standards but where a part of some value exists. Where the original Ideal Cycle Time may have been 180 seconds, a rework Ideal Cycle Time may be only 26 seconds, for example.

If a process can run during scheduled breaks, then is that break time factored into equipment availability?

A personnel break is not necessarily the same as a process break. If the process is expected to be running (i.e. producing anything at all) then regardless of whoever is or isn't eating lunch, OEE considers the time to be part of planned production. On the other hand, in a multiple operator non-automated process, a different Ideal Run Rate may be applicable during the break.

How does OEE relate to the management function of “enabling” operators?

The true value of OEE is in helping you and your operators make systematic improvements. Therefore everything you do with OEE, including the visual display of OEE data, should be designed with operators in mind and stated in whatever terms they most easily understand.

OEE Glossary

Term	Definition	Implication
Actual Cycle Time	The actual time to produce one piece. In OEE, calculated as Operating Time divided by Total Pieces.	Used in calculating OEE Performance. A variation of the calculation uses Actual Run Rate instead.
Actual Run Rate	The actual rate of production, when it is running. In OEE, calculated as Total Pieces divided by Operating Time.	Used in calculating OEE Performance. A variation of the calculation uses Actual Cycle Time instead.
Adjustment Time	Productive time lost while tweaking equipment. See Setup and Adjustments.	Can be a significant loss factor, and in many factories is not directly measured.
Andon	Indicator above production line to signal production conditions.	Often uses green/yellow/red colors to indicate status.
Availability	One of the three OEE Factors. Takes into account Down Time Loss (events that stop planned production for an appreciable amount of time).	Must be measured in an OEE program, usually by recording the duration of Down Time Events.
Best Practice	Methods that are considered “state of the art” by the most respected in an industry.	Successful companies use different methods than unsuccessful companies.
Breakdowns	Lost time due to equipment failure. One of the Six Big Losses.	Contributes to OEE Down Time Loss (reduces OEE Availability).
Changeover Time	Lost time due to swapping of equipment, connections or materials. See Setup and Adjustments.	A prime candidate for improvement for most companies.
Cycle Time	The time to produce one piece.	Inverse of Run Rate.
Cycle Time Analysis	Tool used to better understand issues that affect Performance.	Important to automate logging of Cycle Times for later analysis.
Design Cycle Time	See Ideal Cycle Time.	See Ideal Cycle Time.
Down Time Loss	Production time lost to unplanned shutdowns.	One of the three OEE Losses (reduces OEE Availability). Major focus area for improvement.
Event	In OEE, a production loss which must be categorized.	OEE’s purpose is to clarify the nature and effect of Events.
Fully Productive Time	Actual productive time after ALL losses are subtracted.	What OEE measures – the true bottom line of your facility's efficiency.

Term	Definition	Implication
Good Pieces	Produced pieces that meet quality standards (without rework).	Used in calculating OEE Quality.
Ideal Cycle Time	Theoretical minimum time to produce one piece. The inverse of Ideal Run Rate.	Used in calculating OEE Performance. A variation of the calculation uses Ideal Run Rate instead.
Ideal Run Rate	Theoretical maximum production rate. The inverse of Ideal Cycle Time.	Used in calculating OEE Performance. A variation of the calculation uses Ideal Cycle Time instead.
Lean Manufacturing	Quality philosophy that strives to minimize consumption of resources that add no value to the finished product.	OEE can be a key tool and metric in Lean Manufacturing programs.
Nameplate Capacity	The design capacity of a machine or process.	Used to determine Ideal Cycle Time or Ideal Run Rate.
Net Operating Time	True productive time before product quality losses are subtracted.	Equipment time losses normally are much larger than defect losses.
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 helps you see and measure a problem so you can fix it, and provides a standardized method of benchmarking progress.
OEE Factors	The three constituent elements of OEE (Availability, Performance, and Quality).	Often it is more important to focus on the three OEE Factors than the consolidated OEE metric.
OEE Losses	The three types of productivity loss associated with the three OEE Factors (Down Time Loss, Speed Loss, and Quality Loss).	The goal is to relentlessly work towards eliminating OEE Losses.
Operating Time	Productive time available after Down Time Losses are subtracted.	Operating Time increases as Down Time Losses are reduced.
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).	Must be measured in an OEE program, usually by comparing Actual Cycle Time (or Actual Run Rate) to Ideal Cycle Time (or Ideal Run Rate).
Planned Production Time	Total time that equipment is expected to produce.	Benchmark that OEE is measured against.

Term	Definition	Implication
Planned Shut Down	Deliberate unproductive time.	Excluded from OEE calculations.
Plant OEE	Consolidated OEE calculation as applied to an entire plant.	There are different methods of calculating Plant OEE. Pick the one that makes sense for your company.
Plant Operating Time	The time the factory is open and capable of equipment operation.	Planned Shut Down is subtracted from Plant Operating Time to reach the OEE start point – Planned Production Time.
Process	A sequence of activities that starts with some type of input (e.g. raw materials) and ends with some type of output (e.g. a product).	OEE can be used across a wide range of different processes, although it is most often associated with discrete manufacturing.
Production Rejects	Rejects produced during steady-state production. One of the Six Big Losses.	Contributes to OEE Quality Loss (reduces OEE Quality).
Quality	One of the three OEE Factors. Takes into account Quality Loss (parts which do not meet quality requirements).	Must be measured in an OEE program, usually by tracking Reject Pieces.
Quality Loss	Percentage of pieces which do not meet quality requirements.	One of the three OEE Losses (reduces OEE Quality). OEE views defects in terms of lost time.
Reason Code	An identification number or classification applied to an Event subcategory. Used to tabulate statistics regarding Events.	Makes it much easier to get a handle on losses, especially Down Time.
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.	Contributes to OEE Speed Loss (reduces OEE Performance).
Reduced Speed Threshold	A dividing point between a standard cycle, and one which is considered “slow” (a Reduced Speed cycle).	Setting a Reduced Speed Threshold can be used in Cycle Time Analysis to automatically identify Reduced Speed cycles.
Reject Pieces	Produced pieces that do not meet quality standards.	Used in calculating OEE Quality.
Rework Pieces	A subset of Reject Pieces, that can be reworked into Good Pieces.	OEE does not make a distinction between pieces that can be reworked and pieces that are scrapped.

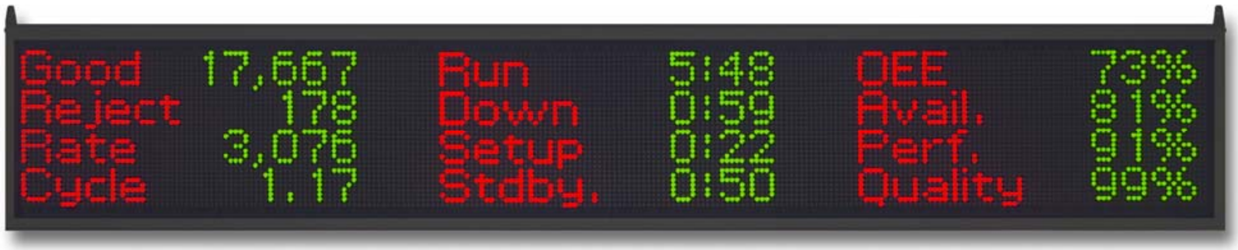
Term	Definition	Implication
Root Cause Analysis	A method of resolving a non-conformance, by tracing back from the end failure to its original (root) cause.	The basic tool for understanding and eliminating the sources of productivity losses.
Run Rate	The production rate when actually producing (running).	Inverse of Cycle Time.
Setup and Adjustments	Time lost configuring equipment. One of the Six Big Losses. See also Adjustment Time and Changeover Time.	Contributes to OEE Down Time Loss (reduces OEE Availability). Tracking Setup Time is critical to reducing this loss.
Six Big Losses	Six categories of productivity losses that are almost universally experienced in manufacturing: Breakdowns, Setup and Adjustments, Small Stops, Reduced Speed, Startup Rejects, and Production Rejects.	Drill down into the three OEE Factors, and you will reach the Six Big Losses. Measure your process with OEE, and improve your process by addressing the Six Big Losses.
Six Sigma	Systematic quality program that strives to limit defects to six standard deviations from the mean. One of the major focuses of Six Sigma is to reduce process variation.	In most companies, Quality Loss will be by far the smallest of the OEE Losses. A Six Sigma or equivalent program may be necessary to maintain focus on quality improvements.
Small Stop	A brief pause in production, but not long enough to be tracked as Down Time. One of the Six Big Losses.	Contributes to OEE Speed Loss (reduces OEE Performance).
Small Stop Threshold	A dividing point between a Reduced Speed cycle, and one which is considered a Small Stop.	Setting a Small Stop Threshold can be used in Cycle Time Analysis to automatically identify Small Stop cycles.
SMED (Single Minute Exchange of Dies)	Program for reducing setup time. Named after the goal of reducing setup times to under ten minutes (representing time with one digit).	Often a part of programs to improve OEE Availability.
Speed Loss	Production time lost to equipment running below maximum rated speed.	One of the three OEE Losses (reduces OEE Performance). Usually the most difficult of the OEE Losses to analyze.
Startup Rejects	Rejects produced while equipment is adjusted for production. One of the Six Big Losses.	Contributes to OEE Quality Loss (reduces OEE Quality).

Term	Definition	Implication
Takt Time	Production rate needed to meet customer demand.	Where sales and business planning meets the factory floor.
Theoretical Cycle Time	See Ideal Cycle Time.	See Ideal Cycle Time.
Total Pieces	Total of all produced pieces.	Used in calculating OEE Quality.
TPM (Total Productive Maintenance)	Maintenance system covering the life of all equipment: planning, manufacturing, maintenance and improving performance.	OEE is a metric for defining equipment effectiveness in a TPM program.
Visual OEE™	Plant floor real-time display of live OEE data for maximum team involvement.	Visual OEE™ displays make improvement everyone's job.
World Class OEE	90.0% Availability 95.0% Performance 99.9% Quality 85.0% OEE	A composite OEE number means very little without the total context.

Visual OEE™

"How can I collect and display useful OEE data without reams of paper and a platoon of Industrial Engineers?"

The answer is: Visual OEE™



Visual OEE™ Display

Dimensions 13.8" x 74.0" (2" tall characters shown)

Have you ever driven a car with a speedometer that didn't work? Imagine for a moment that you couldn't tell how fast (or slow) you were going. A factory without a display of production metrics is like a car without a speedometer! You might know where you're going, but you have no idea when you'll get there.

Real-time display of production metrics enables your operators and maintenance personnel to quickly respond to issues that would otherwise disrupt and reduce your plant's productivity. Visual metrics serve as a gauge when making adjustments that lead to incremental improvements, and provide real-time right-now motivation to everyone on the plant floor.

The Visual OEE™ Principle

The #1 barrier between you and greater productivity is performance data you can't see when you need it. Performance data needs to be available in real-time to everyone – operators, maintenance personnel, supervisors, managers – everyone.

OEE information in tomorrow's report is not nearly as useful as instantaneous reporting of OEE metrics in real-time. Image the productivity improvements that can be achieved by seeing real-time data developed directly from your machine or manufacturing cell.

Visual OEE™ displays are a simple, effective way to:

- Empower your operators and maintenance personnel to understand and quickly respond to production problems (the Six Big Losses)
- Monitor plant floor activity in real-time from anywhere in the plant
- Automate the information gathering process – leaving you more time for analysis and improvement, and your operators more time to effectively operate equipment.
- **Realize immediate improvements in productivity**

Getting Started

It's easy to get started with **Visual OEE™**:

Install two sensors, a switch and your break schedule
Supply your Ideal Cycle Time, Takt Time (optional), and Goal Count (optional)

In return the Visual OEE™ display provides over **100 different ways** to view your production in real time – from anywhere in your plant. It's that simple!

You Provide…	You Get…
One Sensor	• **OEE Availability** • Total Pieces • Current and Average Rate for Total Pieces • Cycle Time, Last Cycle Time, Average Cycle Time • Run Time, Percent Run Time, Event Run Time • Down Time, Percent Down Time, Event Down Time • Plant Operating Time
Second Sensor	• **OEE Quality** • Good Pieces, Percent Good Pieces • Reject Pieces, Percent Reject Pieces • Current and Average Rate for Good or Reject Pieces
Setup Switch	• Setup Pieces • Setup Time, Percent Setup Time, Event Setup Time
Break Schedule	• Standby Time, Percent Standby Time, Event Standby Time • Planned Production Time • Remaining Time (for breaks)
Ideal Cycle Time	• **OEE Performance** • **OEE** • Standard Cycles and Time • Reduced Speed Cycles and Time • Small Stop Cycles and Time • Target Cycle
Takt Time	• Target Count • Takt Timer • Efficiency • Count Variance • Time Variance
Goal Count	• Pieces To Goal • Percent Towards Goal

Attacking the Six Big Losses

The cornerstone of **Visual OEE™** is providing your employees the tools they need to aggressively attack the **Six Big Losses**. If you can display the underlying data in real-time, in one stroke you have empowered your operators and maintenance staff to understand how they can improve their OEE numbers – and most importantly – your plant productivity. In any fast-paced manufacturing environment, it is of paramount importance that operators spend their time effectively operating equipment – not manually recording data.

The following table shows the **Six Big Losses**, the associated **OEE Factors** and how **Visual OEE™** provides real-time metrics and a powerful set of analytical tools to help everyone see how efficiently, effectively and consistently a production line or work cell is operating.

Six Big Losses	OEE Factor	Visual OEE™
Breakdowns	*Availability*	• **Availability** • Down Time (cumulative and event) • Real-time production mode indication • Reason Code tracking and analysis • Statistics and metrics are real-time automated • Operators can focus on getting equipment running
Setup and Adjustments	*Availability*	• Setup Time (cumulative and event) • Set goals for Setup Time reduction programs
Small Stops	*Performance*	• **Performance** • Average Cycle Time • Small Stops (occurrences and time) • Configurable Small Stop Threshold • Cycle Time Trace records every cycle • Identify when and how time is lost to Small Stops
Reduced Speed	*Performance*	• Reduced Speed (occurrences and time) • Configurable Reduced Speed Threshold • Cycle Time Trace records every cycle • Identify Reduced Speed patterns
Startup Rejects	*Quality*	• Reject Pieces (during Startup) • Percent Reject Pieces (during Startup)
Production Rejects	*Quality*	• **Quality** • Reject Pieces (during Production) • Percent Reject Pieces (during Production)

About Vorne

Who We Are

We are Vorne Industries Inc., a company that has been working hard for over 30 years to bring you the best, field-proven industrial automation products available, period. During this time our company has evolved to meet and anticipate your ever-changing needs by LISTENING to you and by responding with well-engineered, well thought-out solutions to your real world problems.

We are NOT a distributor - we are *the* manufacturer of our own tightly-focused, innovative product designs. We have complete control over quality assurance, lead-time, support and pricing.

Since inception, our company has been focused on improving the bottom line of companies just like yours by delivering valuable, real-time information to all levels of your enterprise when it is most useful - RIGHT NOW!

What We Do

At Vorne Industries we love what we do and it shows! Vorne products are used around the world, at thousands of companies and in a wide range of applications, to assist those looking to improve their company's efficiency and ultimately their bottom line.

We take great pride in providing superior "productivity enhancing" products and support at all levels – before, during and after the sale. As a matter of fact, more than 70% of our business is from repeat customers and referrals.

Should you need technical support, you speak directly to an engineer - not a trainee reading from a product manual. Our people have helped us to build a solid culture of quality and a genuine commitment to exceeding your expectations each and every time.

Why We Do It

Over the years we have had literally *tens of thousands* of conversations with people just like you. We use the knowledge that we have gained through our application experience with our customers, in conjunction with extensive research in various manufacturing-related fields, to provide above and beyond value and a solid product at a great price.

We *enjoy* presenting powerful tools like OEE to people just like you who are concerned with the productivity of their operation.

The fact is, whatever your goal - increasing productivity, reducing down time, enhancing communication - Vorne message and production monitoring displays are an outstanding choice.

Call 888-DISPLAYS (888-347-7529) or visit us at www.vorne.com to see how Vorne can help your ideas come to light.

Contact Us

Corporate Address:

1445 Industrial Drive
Itasca, IL 60143-1849 USA

Sales, Customer Service and Technical Support:

888-DISPLAYS or +1 (630) 875-3600

Fax Support:

+1 (630) 875-3609

Main Web Site:

www.vorne.com

OEE Web Site:

www.oee.com

Notes: