A guide to OEE

The current hot topic and project activity being initiated in many manufacturing companies right now, or being talked about in the manufacturing press, is the subject of OEE.

What is OEE?

OEE stands for Overall Equipment Effectiveness. Essentially, it is a single figure that signifies the utilisation of a machine. This can be at a job level, shift level, overall plant or enterprise level.

Why measure OEE?

You have typically made a large investment in a piece of capital machinery and, in theory, it could run 24 hours a day for seven days a week at its optimum speed. If it did this you would gain the maximum value from the investment.

In reality there are a number of elements that can affect the value gained from the investment. For instance you may not run it 24/7. You therefore may wish only to measure OEE for when you are operating the machine. You may, or may not wish to include scheduled maintenance within your OEE figure for instance.

Three main factors make up the OEE calculation

They are; **Availability, Performance and Quality**. These are expressed as a percentage and then the three factors are multiplied together to give you a single OEE figure – again expressed as a percentage.

The point of the final calculation is that it gives you a single figure to measure and compare your OEE. Therefore you may, on a single machine perhaps, compare the OEE between jobs. This will allow you to see which jobs run well and which ones don't. You can then take corrective action.

You may compare shifts – and gain an insight to whether one shift performs better than another – again you can investigate the underlying reasons and take action to improve the OEE.

You may compare machines within, or across several plants. You may even compare different manufacturing plants where you make similar product and understand underlying reasons why one may have a better OEE than another, and then take corrective action.

Ultimately you can, if the data is available, compare your OEE to that of your competitors or industry best and put plans in place to reach the best in class. Like best practice initiatives you may look at industries that have similar characteristics to your own and then try to emulate practices that improve your OEE to the levels they sustain.

Let's take a look at each factor in turn.

Availability

The calculation for availability is simply the actual production time, including set up, out of the planned production time. Time that is lost due to downtime through machine failure, lack of input materials, lack of operator(s), as a series of examples, will be set against the calculation.

Therefore the actual consumed time divided by the available time will give you a figure, expressed as a percentage that is a factor that contributes to the overall OEE calculation. See overleaf…

Availability example:

$$\frac{\text{Actual production time}}{\text{Planned production time}} = \text{Availability}$$

$$\frac{\text{Actual production time}}{\text{Planned production time}} = \frac{\text{7.2 hours}}{\text{8.0 hours}} = \text{Availability } 90.0\%$$

Performance

Our next factor, performance, is in theory very simple. It is the actual achieved run rate against the ideal run rate for the machine. Often the machine ideal or optimum run rate may be the figure published by the machine manufacturer. However, we all know that the ideal run rate may be affected by the situation of the machine, heat, cold product running through etc. Purists would say you still refer to the published run rate whilst others may suggest that expected performance may necessarily be degraded by the nature of the product going through it.

In a situation where the same product, with no expected variability, passing through the machine, such as a line in a bottling plant, we would expect the ideal run rate to remain constant and therefore variances may easily be identified.

However, if we take another example, such as a machine used in packaging carton manufacture, then the machine performance can be degraded by the size of the input product or the number of slots and folds or the quality of the material. In this situation you may wish to measure the performance against the degraded expected run time rather than, or maybe as well as, the ideal run rate.

So our next example is:

$$\frac{\text{Actual run rate}}{\text{Ideal run rate}} = \text{Performance}$$

$$\frac{\text{Actual run rate}}{\text{Ideal run rate}} = \frac{\text{1900}}{\text{2000}} = \text{Performance } 95.0\%$$

Quality

So the final factor on the overall OEE calculation is quality. This is simply a measure of good product divided by the total product (for the job, shift, day, week etc). An element for discussion here is whether you expected set up waste within your figures.

This factor is then:

$$\frac{\text{Good product}}{\text{Total product}} = \text{Quality}$$

$$\frac{\text{Good product}}{\text{Total product}} = \frac{\text{957}}{\text{1000}} = \text{Quality } 95.7\%$$

OEE figure

We now simply multiply the figures together.

Availability	X	Performance	X	Quality	=	OEE
90%	X	95%	X	95.7%	=	81.8%

We now have a figure that we can try and improve!

How we improve this figure, in theory, is relatively simple. In terms of Availability you can look at activities that reduce unplanned downtime – this may be putting engineers on call, making sure you have critical spares, making sure that input product (raw materials) don't run out, making sure that the operator is 'available'.

Performance may be addressed, dependent perhaps on the machine and industry, by good maintenance routines to maintain speed, or in a degraded environment, redesign of product if necessary to achieve the planned or ideal run speed.

Quality of course can be addressed, perhaps, by improved maintenance routines or improved quality of raw materials, amongst others.

There will be debate within your organisation about what should actually be within the overall factors – and there are flexible interpretations of this.

The problem

You may think that agreeing about an OEE initiative and the measures is a complex task – and depending on your organisation it may well be. However, I would suggest that it is the smaller of the challenges you will face.

Collecting the data from operators on the performance factor is not always a reliable measure. If you decide to settle on manual data collection there is an inherent problem in that manual forms are often filled in at the end of shift and may not reflect the truth of what is happening. This is not because there is an inherent dishonesty in machine operators. The problem is that 'remembering' what happened in terms of set up time, run time and downtime including the reasons is subject to the 'witness effect'. By this I mean that you may get several witnesses to a crime but it is unlikely that they will all describe the suspect precisely and the same!

The longer the time between the event and the recording the greater the inaccuracy. Some companies may insist that the data is recorded at the end of the job or at the end of the shift. Some even at the end of the week. This method will entirely compromise the factor that contributes to the OEE figure.

It is likely that the figure will be overstated and your OEE will be higher than it genuinely is. There will also be a danger that the figures recorded will also be the 'target' figures. By this I mean that if you allow 20 minutes to set-up a machine the operator may always take 20 minutes, or record 20 minutes, even if it is less. Does it matter? Of course – if you are not finding out the truth you may not be revealing the hidden capacity that may be utilised to improve the performance (and the OEE) of your investment. Some may suggest that collecting data manually as the events happen may be the answer- but the reality is that any manual method would actually also impair the OEE figure simply through the act of collecting it.

The answer….

Is that the recording of all the factors needs to be either automatic, or as unobtrusive, as possible.

This can be addressed by the implementation of such a product as Plantnode from Shoplogix. Simply it measures through a 'heartbeat' sensor if the machine is running or not and at what speed. In the event of the machine stopping the operator simply has to record the reason for the stop through a scan of a barcode. This ease of use will give you 'machine truth'. This is the starting point to not only implementing OEE measurement but gaining the power to improve it.

Plantnode, which is a self contained device, can report what is happening at the machine in near real-time. It gives you instant insight to the machine performance at a job, shift and machine level.

A critical element of Plantnode is a LED text display that is located near the machine to provide feedback on performance to the operator. The nature of the feedback relating to current production rate, if the machine is running or idle, the current OEE and other vital signs gives them the information required to help them run the machine in a more efficient manner. Most operators welcome the objective measurement and feedback from the LED and that motivates them to achieve greater efficiencies.

Importantly, the user interface for the person managing the plant is very intuitive and reveals through meaningful representation of the data what can be improved.

Conclusion

Understanding the theory of OEE is a relatively simple task. Furthermore improving your OEE figure can again be easy. The problem is with collecting accurate data so you know what to act upon.

OEE is an important measure of efficiency and improvements in OEE have a direct positive affect on the bottom line – you are getting a greater return on your investment (ROI) by understanding it and improving it.

It will also give you valid comparative measurement across your own plant, across sites and potentially against your competitors.

For more information about how data collection can be achieved to give you 'machine truth' visit our website http://www.neustro.com/plantnode_Options.aspx