

Idhammar Whitepaper – What is OEE?

The concept and calculation of overall equipment effectiveness

ABSTRACT

WITH THE CONSTANT PRESSURES OF GLOBAL COMPETITION driving profit margins ever lower, manufacturers are forced to look for creative ways to maximise the efficiency of existing plant and minimise additional investment. In this climate OEE, Overall Equipment Effectiveness, has become a hot topic and is now widely recognised as a powerful tool to identify previously hidden manufacturing losses.

In its most basic form, the OEE metric provides a simple way to “keep score” of manufacturing performance. However, the true power of OEE lies in the ability to use it as a change-enabler, or tool for continuous improvement and lean manufacturing initiatives. This paper will show how small improvements in OEE can have a larger impact on profitability.

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Also available for download from www.idhammarsystems.com/resource_library:

- The Benefits of OEE Systems - making every second of production count
- The Business Case for OEE Systems - the operational and financial ROI
- Implementing OEE Systems - delivering on the promise
- OEE, the Great Energy Saver- reducing consumption with OEE Systems



The context for OEE: Lean Manufacturing and TPM



LEAN MANUFACTURING started as the Toyota Production System (TPS), developed by the Toyota Motor Car Company in the 1950s. In basic terms it is a unified, comprehensive set of philosophies, tools, and techniques for improving and optimising discrete manufacturing processes in order to maximise customer value and eliminate waste. There are three key principles in lean manufacturing:

1. Recognising and listening to the voice of the customer

This allows organisations to identify what the customer perceives as added value. It also encourages organisations to conduct value stream mapping to analyse the flow of materials and information required to deliver a product or service.

2. A relentless focus on continuous improvement

In Japanese this is known as *Kaizen*, continuously looking for ways to improve production processes. It can also be referred to as *Operational Excellence*; a philosophy of leadership, teamwork and problem solving resulting in continuous improvement throughout the organisation by focusing on the needs of the customer, empowering employees, and optimising existing activities in the process.

Measuring performance against standard (or performance to standard), is a good way of bench-marking production levels against competitors or industry averages, however as a measurement system it lacks ambition. If production teams are generally meeting their target performance rates, complacency may creep in and continuous improvement is paid lip-service only. A major focus of “lean” is to empower workers, and make production decisions at the lowest level possible in order to fine-tune process improvements.

3. Identifying and eliminating waste from everywhere

This is a process which involves using empirical methods to determine where waste is occurring across the entire production process. This includes reducing inventory stockpiles (known as Kanban), quality defects, idle time, over-production, over-processing, energy consumption, motion, and transportation.

Total Productive Maintenance (TPM) seeks to engage all levels and functions in an organisation to maximise the overall effectiveness of production equipment. Whereas maintenance departments are the traditional centre of preventive maintenance programmes, TPM seeks to involve all departments and levels, from the plant-floor to senior executives, to ensure effective equipment operation.

Lean Manufacturing and TPM require metrics to both identify areas of inefficiency and to provide a way of benchmarking improvements. There are many different approaches to measuring manufacturing efficiency and generally most companies will have some measures already in place. Many now argue that none of these are as comprehensive as the Overall Equipment Effectiveness (OEE) score which should be considered as a fundamental KPI (key performance indicator).



How does measuring OEE support Lean Manufacturing?

OEE PROVIDES A WAY TO MEASURE THE EFFECTIVENESS of manufacturing operations from a single piece of equipment to an entire manufacturing plant or several manufacturing plants in a group. In doing so OEE provides a complete picture of where productive manufacturing time and money is being lost and uncovers the true, hidden capability of the factory. It becomes the key manufacturing decision support tool for continuous improvement programmes.

Calculating OEE and the 1% Effect

THE OEE MEASUREMENT IS MADE UP OF THREE ELEMENTS, each expressed as a percentage and accounting for a different kind of waste in the manufacturing process:

Availability: the time the plant was actually available for production compared to the manufacturing requirements. Losses in this area are due to major breakdowns or extended set up time.

Performance: the rate that actual units are produced compared to the designed output. Losses would be due to slow running speed and minor stoppages and adjustments.

Quality: a measure of good quality, saleable product, minus any waste. Losses for this element would be damaged rejects or products needing re-work.

OEE = Availability x Performance x Quality.

Measuring OEE can be done simply by capturing five basic pieces of information and then using spreadsheets to calculate the OEE.

1. **Planned Production Time** – the intended time in which production is planned.
2. **Down Time** – time that the process is not running during planned production.
3. **Ideal Cycle Time** – the theoretical minimum needed to produce a single piece.
4. **Total Pieces** – the total produced during the planned production time.
5. **Good Pieces** – the total product produced that meet quality standards.

Calculating OEE – an example

Imagine a factory where a particular production line experiences 2.5 hours down time during 10 hours of planned production; this gives us an availability figure of 7.5/10 hours or 75%. At the same time the line, capable of a cycle time of 1000 pieces an hour is only producing 700 pieces, giving us a performance rate of 70%. Supposing that 30 of those 700 pieces are faulty, the resulting quality element is 96%.

Separately we may not regard each element as too significant, but calculated together they result in an OEE of 50%, or half of what should be expected and giving rise to 50% of potential improvements.

Availability	Only 7.5 out of 10 hours	75%
Performance	Slow running – 700/1000 pieces an hour	70%
Quality	Is good, only 30 rejects	96%
OEE Score	Availability (75) x Performance (70) x Quality (96)	50%

Working further on this example we would then need to address the two weaker elements; the major breakdowns which appear to result in low availability, and the causes of the poor performance rate. We must however take care not to reduce the high quality in our efforts to improve slow running.

It will be useful to add at this point, (at least to reassure manufacturing engineers), that accurate performance measurement with OEE should also be used to uncover the issues behind each loss. Significant interruptions to production are just as likely to be the result of waiting for raw materials or changeovers as equipment breakdown. Frequently People or Process issues are quicker and cheaper to resolve than equipment re-designs.

Beyond Spreadsheets



Using the previous example, let's illustrate the savings which could be made with just a 1% improvement to the OEE score - from 50% to 51%:

- Planned production time is 10 hours
- Planned output is 1000 units per hour
- Notional Selling Price per unit is €5

A 1% improvement will generate €50 per hour in additional notional revenue for the company, or looked at from a different perspective, it will reduce the loss due to waste by €50 per hour. That's €1,200 for the entire 24 hour shift, and €312,000 over a year operating a 24 hour, five day per week shift system. Now just imagine what the company would achieve with a 10% improvement, the realistic figure we expect to see in the first three months of introducing an OEE system.

Beyond spreadsheets

COMPANIES THAT RECOGNISE THE VALUE OF OEE usually begin with a simple spreadsheet for each production line which enables staff to understand how OEE works and to generate the graphs required by production offices. However this approach is limited to a superficial level due to the following issues:

Data handling – data handling becomes more complex and time consuming the more intricate the process and the greater the number of lines/plants/sites involved

Manual reporting – spreadsheet-based reporting is yet another step in the process to manage and requires more time to complete. Errors can also easily creep in.

Limited functionality – there is no easy way to analyse the detail behind the data.

Organisations who are serious about continuous improvement and lean manufacturing quickly out-grow their spreadsheets. To make the most of OEE, powerful dedicated OEE software applications, such as Idhammar's OEE System are available.

In Summary

TRACKING OEE SCORES AND USING THEM TO DRIVE PROCESS IMPROVEMENTS is a vital step towards world-class lean manufacturing for organisations of all sizes and industries. Dedicated OEE systems provide the rich functionality necessary to expose exactly what percentage of production time is value added, and to reveal the causes of lost productivity. Even increasing the OEE score by 1% leads to dramatic savings and turns lost production time into a positive contribution to profit.

Moreover, it is widely recognised that significant manufacturing performance improvement is driven from the shop-floor up and supported by a top-down management ethos of engagement. Organisations that benefit most from lean manufacturing are using OEE to inform, train and motivate their workforce. The clear, visible data that OEE systems provide galvanises action, eliminates guesswork and finger-pointing and provides the basis for team-based problem solving at all levels of the organisation. (For more information please refer to the next Idhammar Whitepaper in the series: *The Benefits of OEE Systems* available on the website).

To find out more about Idhammar's OEE Systems and how we can contribute to your world class manufacturing programmes,

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