



WHITEPAPER

OEE Guide

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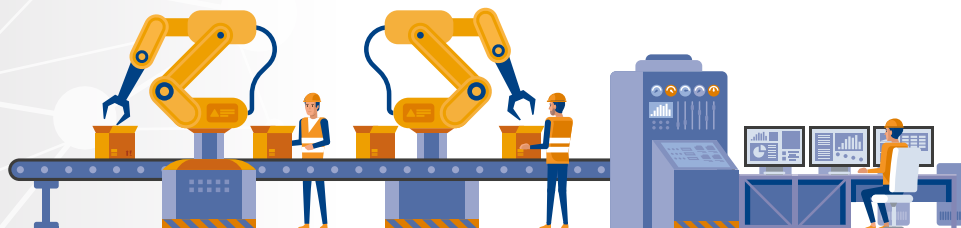
The OEE (Overall Equipment Effectiveness) key figure evaluates productivity in production companies. It can be recorded automatically with relatively little effort and enables real-time monitoring of productivity. The transparency created in this way makes it possible to react quickly to deviations.

CONCLUSION:

With the help of OEE the productivity of a company can be increased without great costs. More output per time unit while operating costs remain the same, less stress in production due to the reduction of disruptions – OEE can thus contribute significantly to increasing margins. Reason enough to take a closer look at the topic of OEE.

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Measuring Instead of Estimating – Gut Feeling Is Deceptive

Time and costs are the decisive factors for the success of a manufacturing company. However, many entrepreneurs are barely aware of the optimization potential that still exists in their production. If they were aware of the margins they are losing as a result, they would immediately address the issue of production optimization as a top priority.

The reason for this inaction, which is hard to understand, is a lack of transparency in production. The figures available in production often do not allow any conclusions to be drawn about the existing potential. And „as long as things are running relatively smoothly,“ many companies see no need for action. They waste a lot of money and potential by doing so. In many production companies, productivity is not yet measured consistently and systematically. Often, the number of units produced serves as an indirect indicator of productivity. If a certain number of pieces is reached in this scenario, e.g. per shift, this means that the production has run satisfactorily and vice versa.

However, producing according to gut feeling is not an exact method, because gut feeling is at best suitable for comparison: If things are running as they always have, everything is running smoothly. If there is a deviation, this indicates a need for intervention.

• Up Too Close

You also know the situation from your everyday life. The question is: Do you see your child grow? The answer: You don't see it because you are constantly very close to it. You only notice it when a relative or acquaintance says to your child after some time of absence: „You've grown up a lot.“ Thus it appears that only a certain distance creates a clear view. This also applies to production.

• Transparency With Figures, Data, Facts

It is unlikely that the gut feeling method is used to produce with maximum productivity. Only what can be measured can be permanently improved. In production, the OEE key figure comes into play for this purpose: OEE (Overall Equipment Effectiveness) as a key figure assesses productivity in production companies. It can be automatically recorded with relatively little effort and enables productivity to be monitored in real time. The transparency thus achieved enables faster reactions to deviations and has contributed to the increasing use of the OEE key figure. With the help of OEE, a company's productivity can be increased without great costs; OEE can therefore contribute significantly to increasing margins. More output in the same time at the same operating cost as well as less stress in production due to fewer disruptions are rewarding and thus motivating incentives.

Another example of the financial potential: Let's take a machine that is used in 15 shifts a week for 50 weeks a year. With an hourly operating rate of only EUR 50 including the machine operator, a 1% increase in output corresponds to a cost saving of EUR 3,000 per year. Average rates of increase due to an introduction of MDA are in the range of 5-10%. And we are only talking about a single machine. Just work out the savings potential that can be made here!

Higher Productivity Means:

- Lower costs in terms of personnel and machine hours thanks to shortened order run times
- More output per shift
- Fewer disruptions – smoother processes reduce unrest and chaos

A Look At Practical Examples

Let's start with some almost trivial statements about the productivity of machines and plants.

- The more complex a machine or plant is, the more prone it is to failure in principle. Because of their complexity, there are more potential sources of interference; this inevitably increases the disturbance frequency.
- As the frequency of set-up changes increases, so does the number of malfunctions.
- Machines run more reliably in a steady state. Therefore, single-product lines (monolines) run better than lines with constant product changes.
- The susceptibility of a system to faults increases with age – this is where wear shows its effect.

The OEE reflects precisely these statements, only more clearly because it provides measurable figures.

Several years ago, I presented our productivity measuring device easyOEE to a customer in the pharmaceutical industry. On the spur of the moment, our customer decided to try out the device on a packaging line, after which the device was installed on a single-product line. After approximately 14 days, I called our customer and asked him about his first experience with the device. Our customer then told me that he had doubled his productivity on that line. How, I asked him, did that come about? He replied that the device made him realize how expensive his short downtimes actually are. He said that the fact that there were short downtimes was not a new finding, but how often they

occur was. He then called the plant manufacturer's service technician, who quickly eliminated the causes of the short downtimes. This has doubled the OEE ... Another example: OEE recording made the extreme dependence of OEE on lot size visible for the first time. It became apparent how much the many small orders massively impaired productivity due to set-up and cleaning processes. As a result, the sales side took countermeasures. The newly gained transparency also helped to massively reduce reaction times to machine malfunctions as well as set-up and cleaning times. Overall, it was even possible to reduce shift times despite increasing throughput, resulting in lower personnel costs. At another manufacturer in the meat industry, it became apparent through the OEE recording that the existing three slicers were the bottle neck in production. They were then replaced by a new, more powerful slicer.

Practical examples:

The following prominent cases clearly show why it is worthwhile to deal with the topic of OEE.

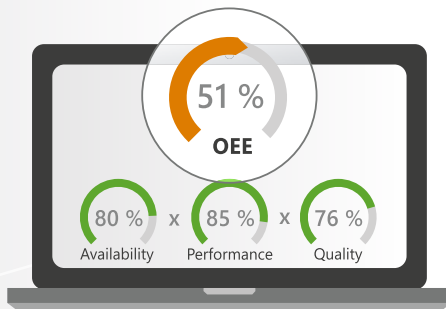
- Swiss production plant of a food company saves CHF 75 thousand with an EUR 400 investment.
- Meat products manufacturer doubles its output in 2.5 years and saves several 100 thousand EUR in personnel costs.
- Pharmaceutical packaging line increases OEE from 40% to 80% in just one week.



What Is OEE?

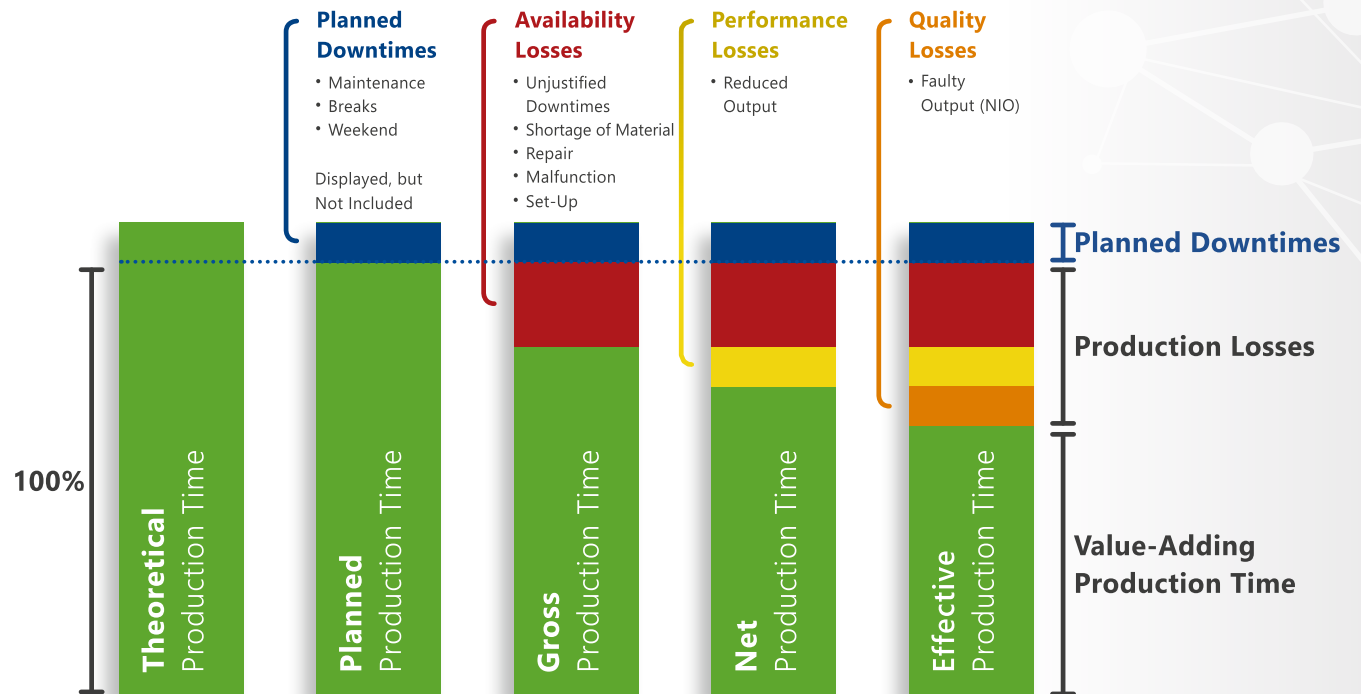
The OEE value is a central key figure for evaluating the productivity of a machine, plant or line. The abbreviation OEE stands for **“Overall Equipment Effectiveness.”**

The OEE value is the product of **availability, performance and quality level**. The calculation of the OEE value thus includes losses due to unplanned downtimes, deviations from the planned number of units, and defective parts and parts that need to be reviewed.



This Results in the Following Calculation Formula

$$\text{Availability \%} \times \text{Performance \%} \times \text{Quality \%} = \text{OEE \%}$$



▶ With the OEE value, all plant losses can be systematically identified, analyzed and then eliminated.



Calculation of the OEE Value

• Availability

The degree of availability of a plant, machine or line results from the relationship between the actual and theoretically possible production time. The availability is reduced by disruptions and times that are used to eliminate disruptions. Preparing and re-processing a plant, machine or line also reduce the degree of availability. This results in the following formula for calculating the degree of availability:

$$\text{Degree of Availability} = \frac{\text{Actual Production Time}}{\text{Planned Production Time}}$$

• Performance

The performance level of a plant, machine or line results from the ratio between the parts actually produced and the technically possible parts per time unit. This is because a plant, machine or line cannot always be operated at the highest speed according to the manufacturer's specifications. The cycle times depend, among other things, on the manufacturing processes, on the products to be processed and also on the operating personnel. Thus, idling and minor interruptions as well as reduced operating speeds lead to a reduction in the performance level. This results in the following formula for calculating the performance level:

$$\text{Performance Level} = \frac{\text{Actual Performance}}{\text{Target Performance}}$$

• Quality

The quality level of a plant, machine or line is determined by the proportion of good parts produced in relation to the total number of parts produced. The higher the quantity of good parts achieved, the better the quality of the manufacturing processes. Process errors that cause scrap and rework minimize the quality level just as much as, for example, reduced output due to start-up losses during production start-up. This results in the following formula for calculating the degree of quality:

$$\text{Degree of Quality} = \frac{\text{Good Parts}}{\text{Total Parts Produced}}$$

▶ **The OEE key figure shows the entire production process in a single figure. An example:**

One machine has achieved the following results during the period of use to date:
An availability level of 93.55%, a performance level of 71.12% and a quality level of 100%.
 This results in an OEE value for the current operating time of **(93.55 x 71.12 x 100)% = 66.53%**.

Approaches to OEE Acquisition



Manual Acquisition

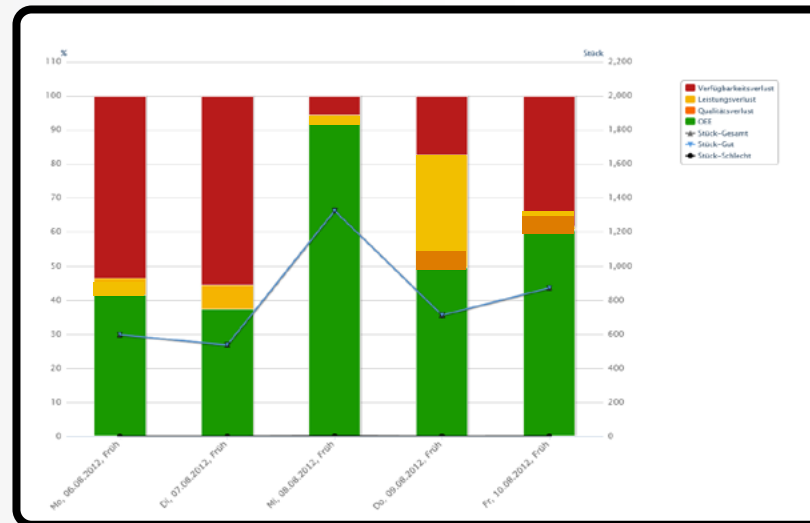
The manual approach is based on hand-written records in which production employees manually record each downtime with its duration and cause. From this, the availability is determined.

Counting the number of pieces produced, e.g. per hour, is the basis for determining the performance factor and writing down bad parts allows the quality factor to be determined.



Automatic Acquisition

The automated approach uses the production cycle as a source of information for clocked machines and systems. As long as a cycle is generated within a specified interval, the data acquisition software "knows" that the machine or plant etc. is producing and is therefore available. With a time measurement between 2 cycles, the software can determine the actual cycle and relate it to the target cycle. This is how the performance factor is determined. The quality level is determined by entering bad parts.



Example of an OEE evaluation available at the push of a button in graphical form:

- Availability loss
- Performance loss
- Quality loss
- OEE value



The Two Approaches Differ in Terms of Time Required and Detection Accuracy.

With the manual approach, the time required for recording by ticking off predefined reasons for disturbances is still within limits, whereas writing down free texts not only takes more time, but also makes subsequent statistical evaluations more difficult. This is a major disadvantage of the manual approach – the data collected is then usually transferred manually to an Excel file for evaluation, which takes time.

By far the greatest disadvantage, however, is that the evaluations always only display past processes. You could also say that disturbances are viewed from the rear-view mirror. This method does not support fast reactions when disturbances occur.

Advantages of Automatic OEE Recording

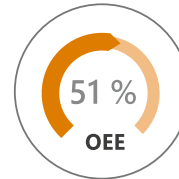
The Advantage: The Automatic Acquisition Can Provide Data Immediately in Any Form and Trigger an Alarm in Case of Malfunctions!

- Sudden, undesirable situations can be quickly responded to, e.g., by automatically triggering alarms, thus preventing the situation from getting worse through rapid countermeasures.
- Evaluations without further action at the push of a button and in real time.
- In principle, automated recording can be implemented on any clocked machine or plant, regardless of its age. The common belief that automated recording only works with new machines and equipment is wrong. The idea behind this is probably that recording requires direct access to the machine controller, i.e. PLC, which admittedly could be difficult with old machines. However, a direct PLC connection is not at all necessary for this, nor is it tied to the existence of a PLC at all.
- Access to the machine control is not always necessary: It often takes less effort to pick up a suitable, clock-synchronous signal at a suitable point or to generate this signal via a button or a light barrier and to process it further with the aid of an acquisition module.
- Easy integration: Today's acquisition modules can be integrated into an existing Ethernet infrastructure without any technical problems.
- Visualization of the data in real time: OEE software, which is usually installed on standard office PCs, prepares and visualizes the data. The production manager can thus see at a glance how productive the machines and systems are. The production manager can decide how the OEE values should be displayed: By machine, shift, product, order or personnel, etc.
- Clear presentation: The data can be presented in different views, be it as a diagram or in the form of lists. With data processed in this way, it is possible to quickly identify which machine is running optimally, where intervention is required, and what causes losses.

Potential for improvement in production become apparent at a glance!



What Is the Benefit of OEE ?



OEE Delivers Results – but It Depends on What You Make of Them.

OEE provides exact figures. These figures are the benchmark for productivity; they always clearly show how high the productivity is at all times. OEE is thus, in a sense, a tachometer for the production manager. Behind these figures are facts – collected information about all processes and malfunctions that are stored in a database. They form the basis for analyses and the foundation for improvement processes. OEE shows where optimization is necessary and useful. And the success – or failure – of measures implemented can be seen immediately. As a monitoring tool, OEE enables the monitoring of individual machines, complex systems or the entire factory in real time. By highlighting all errors and disruptions in the production process, it is used to permanently evaluate production efficiency. Weak points and causes of loss are immediately visible.

With OEE, the production manager has a tool at hand with which he can eliminate one productivity killer after another and thus increase productivity noticeably and sustainably.

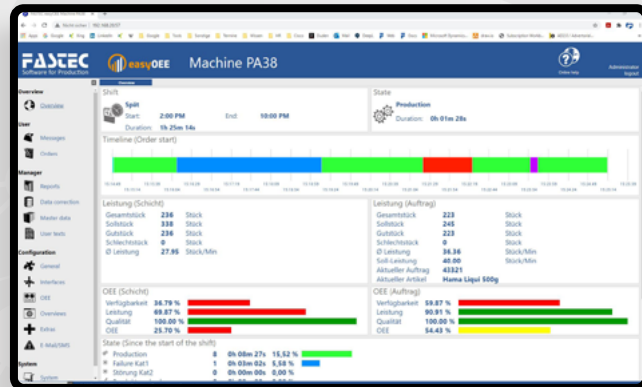
Unfortunately, it should be noted here that the desired positive results do not come about by themselves, but are the result of persistent examination of the topic. The systematic approach also has a name: It is called CIP – Continuous Improvement Process. The name says it all and the greatest difficulty, according to my observations, is maintaining continuity. It makes a considerable difference between good and first-class manufacturing companies. The rule of thumb here is: Perseverance pays off.

For Whom Does OEE Pay Off?

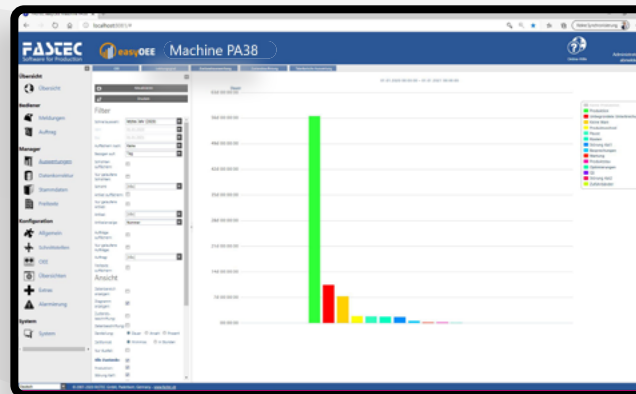
OEE is useful for manufacturing companies in many industries with discrete manufacturing processes. Especially in machine-intensive industries with high machine hour rates, an OEE system quickly pays off. If malfunctions are prevented and sources of error are identified, this is reflected in higher productivity at the same operating costs, only by avoiding failures and waste. With this, the calculation is quickly made. As has been shown in practice, the use of OEE in production companies committed to the Continuous Improvement Process quickly becomes an indispensable control tool.



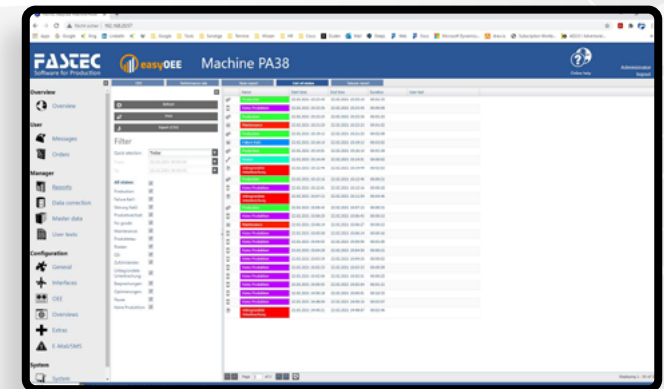
OEE Shows Where Optimizations Are Necessary and Useful



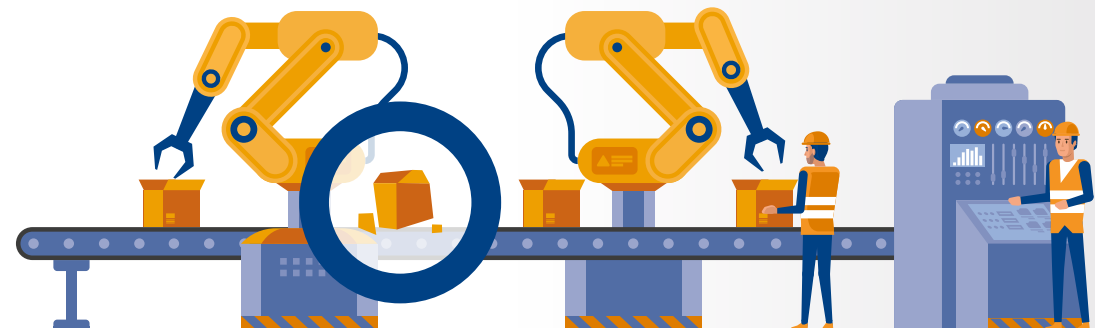
Machine detail view: At this point, the condition of a machine can be monitored precisely. The OEE value determined from the production data is calculated from data recorded in real time and is displayed permanently.



Graphic display of the cause of the disturbance: The height of the bar reflects the duration and thus the severity of a disturbance.



Tabular list of malfunctions: Here you can see which malfunction occurred when and for how long. In this example, the results are listed according to the duration of the fault.



Introduce OEE and Ensure Long-Term Success

• How Is OEE Introduced?

When introducing the OEE in production companies, rights of co-determination must be observed in Germany. Even if the primary aim is to optimize machine output by first recording and then reducing machine downtimes and performance losses, it is usually possible to refer back to the machine operators. However, this is not permitted without the consent of the works council. It is therefore important to involve the works council before OEE is introduced. In addition, a company agreement regarding data collection should be concluded.

It is just as important for a successful system implementation to include all employees involved. Even with automated data acquisition, employee input is usually still required. Thus, the quality of the data depends on the correctness of the entries. Therefore, all employees must be trained to the point that they can carry out all entries properly and precisely. In addition to completeness, the correctness of the entries must also be ensured. This requires involving all employees in the improvement process. All employees have to be well informed and know why they are doing something and how to do it properly. Thorough training of all employees is critical to long-term success.

• Ensuring Long-Term Success

After thorough employee training and a short adaptation phase, all the necessary requirements for the initiated improvement process are met. The recorded data creates the transparency needed to identify weak points. These have to be classified first according to their importance and then they can be systematically addressed and successively eliminated. Any machine and system problems that arise should also be eliminated quickly and consistently. A production manager can only expect commitment and motivation from the employees if it is ensured that the working conditions meet the highest standards – the production manager has to ensure that the machines and systems run properly to name just one condition. For optimal results, it is a proven method to discuss the recorded data and the evaluations based on this data in regular meetings with all parties involved and to define suitable countermeasures. Only by stabilizing the CIP, lasting improvements can be achieved and the pitfalls of everyday life – fatigue and creeping neglect of the improvement process – can be avoided. It is necessary to give high priority to the importance of CIP in the management, to entrust a production manager with it and to make it a permanent topic. This is the only way to achieve success with lasting results.

• How Quickly Can OEE Be Introduced?

How can OEE be implemented quickly and as efficiently as possible once a company has decided to take this path? It should be clear to everyone that an OEE implementation cannot be accomplished without constant effort. Especially at the beginning, you need an employee who can take care of the technical side and especially the careful introduction. In many cases, it has proven useful to start the implementation with external support, e.g. as part of a bachelor's or master's thesis. The introduction of an OEE system can be implemented in two to four months from the technical perspective. Another two to three months are needed for a sound employee training. In total, four to seven months of intensive work on the topic of OEE are required.



The Fastest Way to OEE: easyOEE

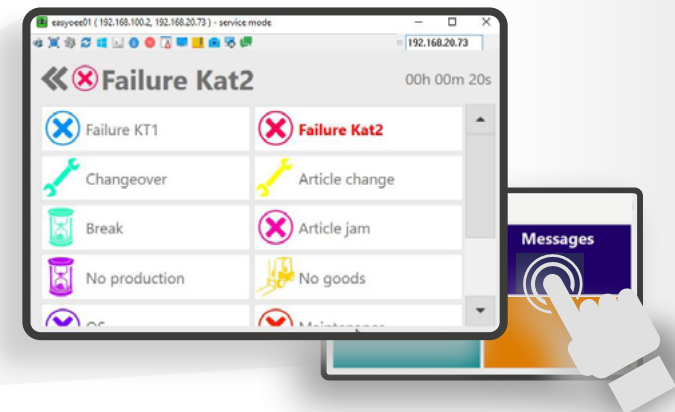
However, there is a way to immensely accelerate the OEE entry. For this purpose, our company offers a productivity measuring device, the easyOEE. This is a device that can be used to record the OEE key figure of a machine or plant.

easyOEE can be integrated directly into the intranet and, thanks to the integrated web server, can provide machine data in real time as well as extensive evaluations in the

web browser on all connected PCs without additional software installation. This means that a system for learning and optimizing production is available within a very short time, which significantly accelerates the OEE implementation. If a company still has doubts about the benefits that can be expected from an OEE system, it can use easyOEE to analyze the potential. All of this is possible without any investment risk, because the easyOEE device can be rented cost-

effectively on a monthly basis. easyOEE can be adapted by the user to the specific production conditions without any prior knowledge. The initial configuration takes place as part of a short training session, and the user can then carry out further adjustments independently without spending a lot of time.

 LAN Data access via the company's own cable network	 WLAN Data access via your inhouse wireless network
 Direct Connection Direct connection of the easyOEE to your PC	 Offline Operation Data storage on USB stick, read out at PC workstation



easyOEE is delivered as a ready-to-use system. No additional software and hardware components are required. It is therefore up to the user to decide how machine data and OEE values are to be accessed.

Reasons for disruptions that can be reported via easyOEE. The names for the causes of the disruptions can be customized.

Experience of Our Customers



"We didn't know exactly what availability and performance our lines brought. We therefore started with the productivity measuring device easyOEE to perform a status quo analysis on three machines in packaging. Thanks to easyOEE, we were able to increase our OEE value on these three machines by up to 11% in the very first month.

Building on this, the MES system FASTEC 4 PRO was then introduced, which uncovered further capacity reserves and brought another 10% increase in OEE in the first year of operation."

Belal Al-Shaibani
Process Manager

MEDICE Arzneimittel Pütter GmbH & Co. KG



"The setting up of the easyOEE terminal in advance and the installation on site was successfully completed in a very short time and was almost self-explanatory. The import of the article master data from the ERP system was also carried out quickly and smoothly in order to avoid parallel master data maintenance.

Through the additional connection of a simple hand scanner, the process data such as article number and process order number are read in by the employee, thus preventing input errors. All in all, a very fast and cost-effective way to address and drive the topic of OEE in the company."

Marc Bruns

Group IT Manager

Gustav Berning GmbH & Co. KG



"About a year ago, we had an OEE of 35% and we currently reach 60%. We can now react to disturbances in production on time thanks to the transparency achieved, thus we can also plan in advance much better – hectic rushes are a thing of the past.

If something unusual happens in production, we are able to react immediately and in a targeted manner. In addition, everything is logged in detail and documented so that it can be evaluated, in this way we can achieve constant process optimization with regular evaluations."

Dirk Kirchner

Production Manager

VION Convenience GmbH

Stay Competitive in the Long Term – With Us.

OEE is only the first step on the way to increasing productivity. With easyOEE you have successfully taken the first step. Further steps must follow in order to remain successful in the long term. Today, production companies have to produce cost-optimized, on schedule, flexible, customer-specific and traceable starting at lot size 1. The requirements for this are transparency through real-time information, good planning, and fast and adequate reactions to deviations.

Our Manufacturing Execution System (MES) FASTEC 4 PRO is the perfect tool for this endeavor. We are offering solutions since 1995. With FASTEC 4 PRO you can gain the ideal level of transparency in all areas of production and make use of previously unused potential to increase productivity and explore process optimization. Through focused planning, you can react to requirements from sales at short notice. FASTEC 4 PRO controls and documents your production processes and makes them traceable, even with lot size 1.

We would also like to give you a good advice personally!

Our sales department will be happy to provide you with further user reports and information material! Or else, make an appointment with our sales department for a presentation at your location, in our company or via web. Of course, you can also experience easyOEE and FASTEC 4 PRO live and on site with our customers.



About the Author

Dr. Karl-Heinz Gerdes is the founder and former managing director of the FASTEC GmbH and has been active in the field of computer-integrated production for over 30 years. During his studies he was already working on microprocessor-controlled automation solutions. The development of decentralized control and networking solutions for interlinked plants

with master computers was ultimately the guiding principle for the founding of the FASTEC GmbH.

The MES solution FASTEC 4 PRO, which is distributed by FASTEC today, was developed on this basis and has become even more sophisticated due to the experience gained from many complex customer projects.

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Additionally, we offer videos of our software and customer solutions in our YouTube channel:

www.youtube.com/FASTECGmbH

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