ENISCO | FORCAM

smart factory experts

MAXIMIZE OEE

GUIDE TO BOOST YOUR OVERALL EQUIPMENT EFFECTIVENESS (OEE)

LET'S TALK ABOUT YOUR FACTORY

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INCREASE ADDED VALUE WITH OEE

Industrial production is in an age of intense competition and rapid change. Efficiency and productivity are now more crucial than ever to remain competitive in global markets and meet increasing customer demands.

The overall equipment effectiveness (OEE) indicator is central in this context. OEE is an internationally recognized standard for evaluating the productivity and effectiveness of production facilities. It measures how efficiently a facility works and allows companies to make targeted improvements in their production process.

OEE comprises three key factors: availability, performance, and quality. Each factor provides crucial information about the weak points and potential within the production process. In combination, they provide a holistic view of production performance and help systematically identify and eliminate sources of loss.

This guide explains OEE's fundamentals, calculation, and strategic value and provides best practices for using OEE to improve manufacturing performance.

OEE = Availability × Performance × Quality

WHAT IS OEE?

OEE is a key metric used to evaluate the efficiency of production facilities. It measures how well a machine or production line achieves its full potential performance and breaks this efficiency down into three key factors:

Availability

The percentage of the planned shift time without a break during which the machine is available (without unplanned downtime or disruptions).

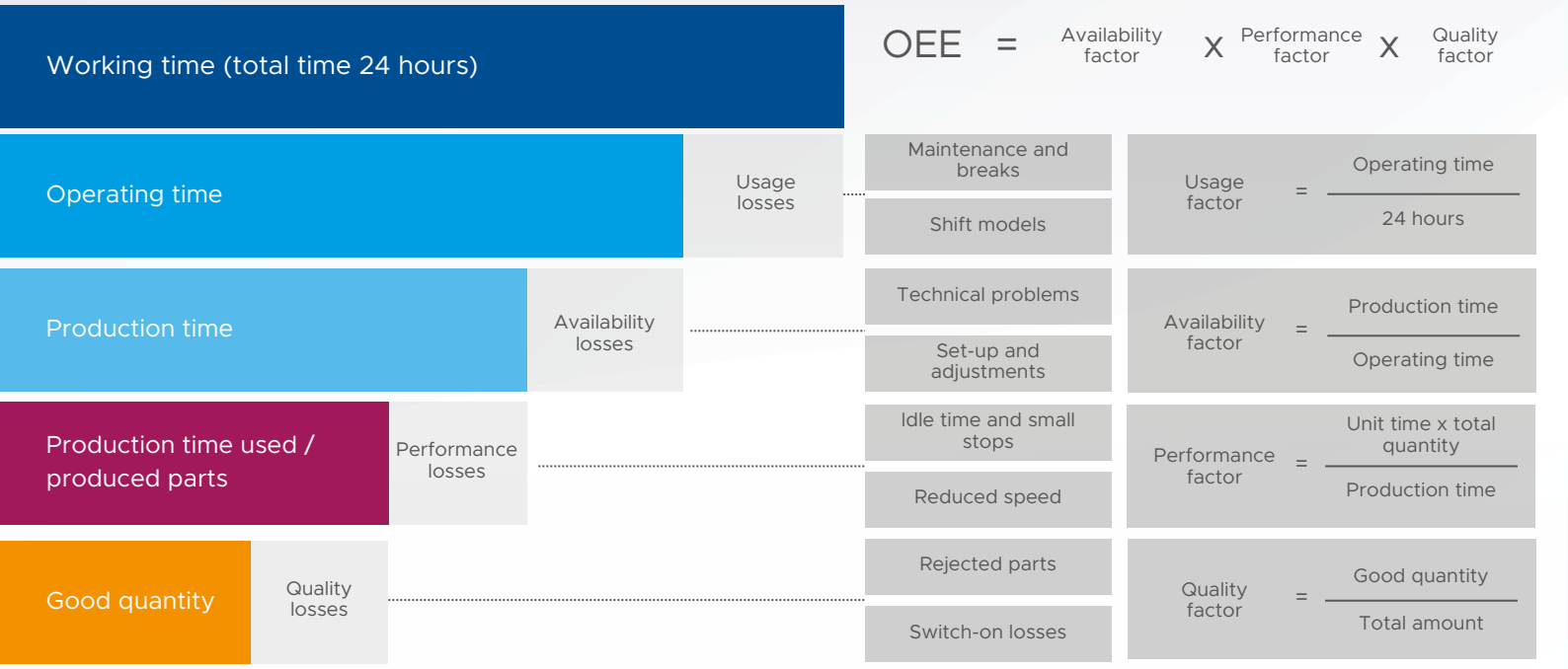
Performance

How fast the machine operates compared to its maximum potential speed.

Quality

The proportion of parts that meet the quality requirements compared to total production.

OEE = Availability × Performance × Quality



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UNCOVER OPTIMIZATION POTENTIAL

Losses
35%

Optimization potential

OEE
65%

Efficient production time

By showing detailed losses, factory teams have the transparency they need to pinpoint the most significant problems. The Pareto principle, also known as the 80/20 rule, states that about 80% of the results are caused by 20% of the causes. By using OEE data in a smart factory, this critical 20 % of problems can be identified and addressed in a targeted manner to increase efficiency significantly.

In a smart factory with connected machines and real-time data analytics, companies can optimize areas with the greatest impact on overall productivity. This improves OEE and overall production performance and resource utilization, leading to less downtime and higher quality.

THE 6 BIG LOSSES

Downtime

Unexpected machine downtime or malfunctions that result in downtime. Examples include machine defects, repairs or emergency maintenance.

Setup and adjustment losses

Time losses due to set-up processes, tool changes or adjusting machines when production changes occur. This also includes test runs after adjustments.

Small shutdowns

Frequent, short interruptions that do not constitute a complete failure, such as blocking of materials, jamming, or other minor problems that can be quickly resolved.

Production committee

Losses caused by defective products manufactured during regular operations that do not conform to specifications.

Start-up losses

Quality problems and scrap during the start-up phase of a machine after a downtime or setup. This often happens before the machine is operating stably.

Reduced speed

Losses caused by machines working more slowly than planned or at maximum speed. Causes include wear and tear, poor maintenance or incorrect machine settings.

Availability losses

These losses reduce the actual available production time.

1) Downtime (breakdowns)

Unexpected machine downtime or malfunctions that result in downtime. Examples include machine defects, repairs or emergency maintenance.

2) Setup and Adjustment Losses

Time losses due to set-up processes, tool changes or adjusting machines when production changes occur. This also includes test runs after adjustments.

Performance losses

These losses affect productivity during operation.

3) Minor Stoppages

Frequent, short interruptions that do not constitute a complete failure, such as blocking of materials, jamming, or other minor problems that can be quickly resolved.

4) Reduced Speed

Losses caused by machines working more slowly than planned or at maximum speed. Causes include wear and tear, poor maintenance or incorrect machine settings.

Quality losses

These losses occur when parts do not meet quality requirements.

5) Start-up Losses (Startup Rejects)

Quality problems and scrap during the start-up phase of a machine after a downtime or setup. This often happens before the machine is operating stably.

6) Production Rejects

Losses caused by defective products manufactured during regular operations that do not conform to specifications.

Summary

1. **Availability: downtime, setup and adjustment losses.**
2. **Performance: small downtimes, reduced speed.**
3. **Quality: start-up losses, production waste.**

Reducing these losses leads to higher OEE and thus more efficient production.

THE COMPONENTS OF OEE

AVAILABILITY

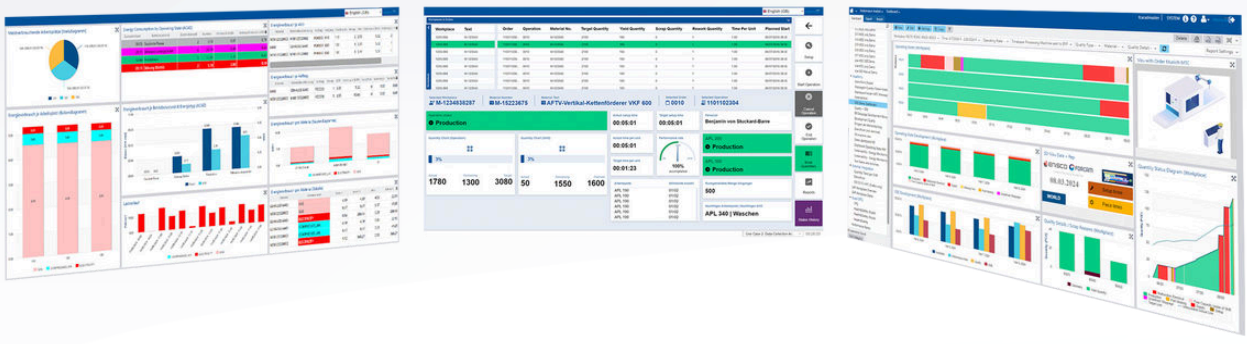
Availability measures the time a machine is productive relative to its planned operating time. The main reasons for availability losses include:

- Planned downtimes: maintenance, setup times, planned breaks.
- Unplanned downtime: machine failures, unexpected maintenance work.

Possible reasons for unplanned downtime

Mechanical failures	Electronic problems	Incorrect operation	Poor maintenance
Missing or delayed spare parts	Environmental conditions	Material supply	Inefficient production planning

Root cause analysis for unplanned machine downtime



A breakdown of unplanned downtimes makes it possible to determine the actual cause and to eliminate it specifically through continuous improvement measures.

THE COMPONENTS OF OEE

PERFORMANCE

Performance describes whether a machine is operating at its maximum possible speed. Common reasons for performance degradation are:

- Micro-stops: short-term interruptions.
- Slower production speed: When machines run slower than the designed optimal speed.

$$\text{Performance} = \frac{\text{Time per unit x total quantity (actual speed)}}{\text{Actual production time (Maximum speed)}} \times 100$$

Example:

If a machine can produce 100 parts in an hour but only produces 80 parts, the output is 80%.

Interpretation

- **100% performance: The system runs at the maximum possible speed.**
- **<100% performance: The system is running slower than the maximum speed, indicating potential optimization measures.**

Factors influencing performance

Technical limitations	**Employee qualifications**	**Material quality**	**Production planning**

The performance component of OEE is crucial for identifying and minimizing speed losses. Targeted measures to increase performance can reduce downtime and inefficiencies.

THE COMPONENTS OF OEE

QUALITY

Quality measures the proportion of fault-free parts produced in relation to total production. Reasons for quality losses are:

- Defective products: Parts that need to be reworked or discarded
- Rejects: Products that do not meet the specifications

$$\text{Quality} = \frac{\text{Good quantity}}{\text{Total amount}}$$

Example:

If 90 out of 100 parts produced are rated as flawless, the quality is 90%.

Interpretation

- **100% Quality: All units produced meet the quality requirements.**
- **<100% Quality: Part of the production is defective, indicating opportunities for improvement.**

Factors influencing quality

Machine settings	Material quality	Employee qualifications	Production environment

WHY IS OEE IMPORTANT?

Optimizing OEE has a direct impact on a company's productivity and profitability. High OEE means less downtime, less production loss, and fewer quality defects. The main benefits include:

Realistic planning times

Collecting actual cycle time data allows for realistic, up-to-date planning that optimizes production flow.

Cost reduction

Reduced downtime and optimized production processes lower costs and improve resource efficiency.

Capacity increase

More efficient use of existing plant capacity maximizes production output without additional investments.

Improved competitiveness

Higher Overall Equipment Effectiveness (OEE) enables faster and more flexible responses to market demands.

Sustainability

Increased production efficiency reduces resource consumption and minimizes waste.

Practical example: Increase in OEE by 8%

Thanks to the introduction of MES FLEX, Foundation Wellness increased its overall equipment effectiveness (OEE) from 77% to almost 85% in the first year. The solution enabled better data collection, reduced downtime and supported strategic decisions. Instead of just reacting to problems, the factory teams were able to optimize their production processes in a targeted and sustainable manner. Smart data thus made a decisive contribution to increasing efficiency.

Learn more

PRACTICAL STEPS FOR OEE IMPROVEMENT

PHASE 1
Collect and analyze data

To use OEE effectively, relevant data must be continuously collected and evaluated. To do this, data models must normalize them and make them available to an MES.

PHASE 2
Root cause analysis

Availability, performance and quality losses should be analyzed regularly to identify the root causes of inefficiencies. Methods such as the 5 Whys analysis or FMEA (Failure Mode and Effects Analysis) are helpful here.

PHASE 3
Continuous Improvement

OEE is an ongoing process. The introduction of a continuous improvement system (CIP), for example within the framework of Lean Manufacturing or Six Sigma, can increase OEE in the long term.

PHASE 4
Employee involvement

Training and raising employees' awareness of the importance of OEE helps to avoid errors and operate machines correctly. A transparent flow of information about production goals and performance motivates the workforce.

PHASE 1
COLLECTING DATA

The longest journey begins with the first step: The path to the Smart Factory starts with connecting all machines digitally and networking the shop floor and top floor on one platform. The goal: Planning and production run synchronously, and target and actual states are available in real-time and at any time, even across the country, language, and time zone borders.

"Without digital data, it is difficult to determine what the biggest problem is"

Eric Jarvis, Director of Operations
at Foundation Wellness

Challenge: Heterogeneous machine parks

The challenge is that most factories have heterogeneous machine parks - systems from different manufacturers and generations. Therefore, High-performance technology is required to connect all machines quickly and easily and consolidate all operating and machine data on one platform.

Older machines are connected via an “I/O Ethernet converter” in the control cabinet. This provides the necessary Ethernet conversion of the data.

Newer machines are already equipped with processors and software. The data is read out directly, and additional functions are available. Modern machines have an extra machine control, and data processing occurs directly in the systems.

With AC4DC, FORCAM ENISCO offers a connectivity solution that enables all machines to be digitally connected to manufacturing execution systems quickly and securely.

PHASE 2
ROOT CAUSE ANALYSIS

Goal of the root cause analysis

The second phase of OEE optimization focuses on root cause analysis. Availability, performance, and quality losses should be analyzed regularly to identify the main causes of production inefficiencies and develop targeted measures to eliminate these losses.

Methods for root cause analysis

1) 5-Why-Analyse

The 5-Why analysis is a simple but effective method for identifying causes. It involves repeatedly asking the question "Why?" until you get to the root of the problem. This helps avoid superficial causes and identifies structural or process-related issues.

Procedure:

Formulate the problem and ask the question “Why?” five times to find the deeper cause of the problem.

2) FMEA (Failure Mode and Effects Analysis)

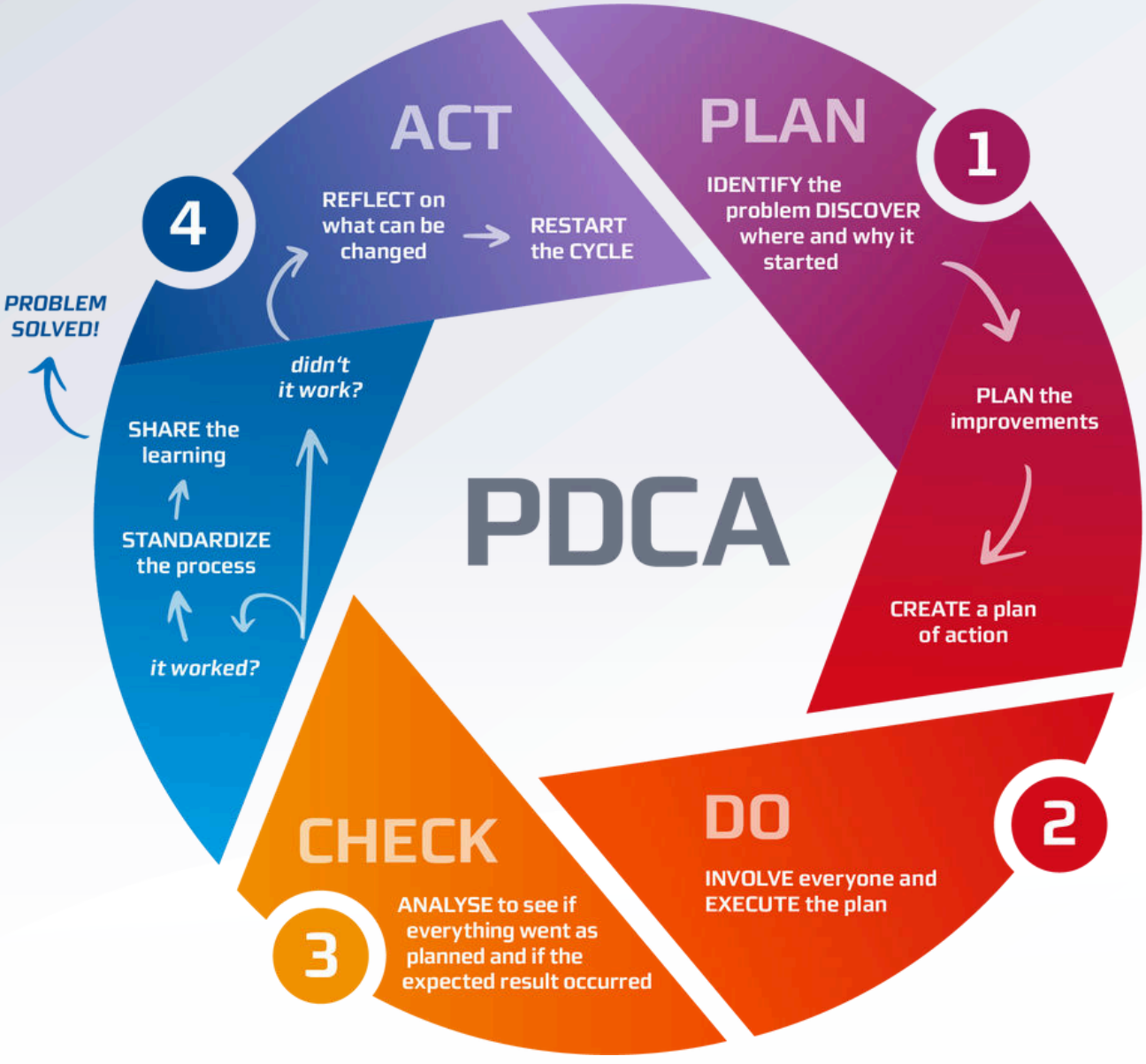
The FMEA is a structured method for identifying and evaluating potential errors and their impact on production. It supports problem prioritization and prevention.

Procedure:

1. Identify possible sources of error (e.g., machine, process, material).
2. Assess risks based on the likelihood of occurrence, significance, and detectability.
3. Create measures to reduce risks and document progress.

PHASE 3
CONTINUOUS IMPROVEMENT

Integrating the CIP into the OEE approach leads to a gradual and continuous improvement of machine availability, performance, and quality. This takes place in several stages



CIP process to improve OEE

1 Collect data and identify problems

Collect OEE data and prioritize problems. Use OEE analytics to identify the areas of greatest weakness.

2 Plan

Select a specific area to improve based on your evaluations. Develop hypotheses and actions to improve availability, performance and quality.

3 Do

Implement the planned improvements on a small scale. Make sure that the entire team is involved in the process and that clear goals are set for implementation.

Check: Measure and evaluate results

4

Measure the impact of the implemented measures on OEE. Compare the new OEE values with the previous ones to determine whether the improvement is significant. Conduct regular OEE evaluations to see how the measures have affected availability, performance and quality.

5 Act

If the results are positive, implement the improvements permanently in the production process.

If the results are not satisfactory: Analyze why the measures were not successful and adjust the plan accordingly. This leads to a new plan phase in the PDCA cycle.

PHASE 4
EMPLOYEE INVOLVEMENT

As with any change, it is important to communicate a lot with employees beforehand and to prepare the management level in order to successfully establish the change.

Managing the Change Process Correctly

1 Secure acceptance

Ensure acceptance. The transformation to a smart factory is a management issue and must be accompanied by a change process with regular information for everyone.

2 Appoint a transformation team

Appoint a transformation team with participants from as many areas of responsibility as possible. The team develops a plan of action and a timetable.

3 Start with pilots

Start with pilots. Install the technology on three “problem” machines first. Motto: Gain experience while main production continues.

4 Start regular communication

Daily shop floor meetings in the factory hall bring every employee up to date.

5 Communicate successes widely

This strengthens acceptance and motivation for the later rollout.

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PRACTICAL EXAMPLE FOR OEE IMPROVEMENT

Initial situation

A company focused on high-precision manufacturing supports numerous products and variants for its customers. The large number of product variations goes through different production steps, which makes manual planning and delayed feedback on the production status difficult. Manual planning processes and a lack of real-time information on the production status prevent targeted improvements and efficient production control.

Project goals

The project aimed to enable precise production control and real-time monitoring by introducing a Manufacturing Execution System (MES). The focus was on the following aspects:

- Real-time transparency about deviations and losses of all machines and workstations.
- Machine data collection (MDC) for continuous analysis and reporting.
- ERP integration to synchronize the ERP system (here SAP) with production to promote daily improvements by the LEAN/CIP team.

The basis was the provision of realistic master data and precise production control, which allowed for dynamic designing of the production plan and the creation of optimal work schedules.

Initial findings

After the introduction of the MES system and the connection of the machines, the company identified the main weaknesses in an initial report:

- **Low utilization:** A utilization between 30% and 40% due to the large number of orders, order changes and setup times.
- **Cycle time deviations:** Significant deviations in cycle times – planned times deviated between 20% and 50% from the actual execution time.
- **Production delays:** A delayed start to production due to resource constraints early in the production process, resulting in delays in completion.

Implementation and measures for improvement

Measures to increase OEE:

Team setup and role allocation

A dedicated employee with a strong focus on process optimization was nominated as project manager to ensure continuous implementation and monitoring of the measures.

Regular data analysis and reporting

- Daily analysis of MES reports to identify priorities and create a clear action plan.
- Introduce daily meetings to address team challenges and develop improvement ideas openly.
- Determination of necessary investments and process adjustments.

Employee training and motivation

- To promote acceptance and understanding, the company provided comprehensive training to the team on new processes and the use of the MES system.
- The company highlights the positive impact on efficiency, job security, and satisfaction to promote awareness.

Results after one year

One year after the implementation of the MES system and daily process optimization, significant progress could be seen:

- **Increased capacity utilization:** Workplace utilization was increased to almost 60%, almost doubling production capacity without additional investment.
- **Focus on cycle times and disruptions:** The ERP system adjusted materials with the highest cycle time deviations daily. Production stoppages were analyzed and reduced through targeted measures. A real-time support system for unexpected downtimes ensured a quick response.
- **Improved production planning and on-time delivery:** Planning accuracy was increased, allowing products to be picked up on time on the planned end date.

Conclusion

The company significantly improved its OEE values by introducing an MES system and systematically using the data collected in real-time. Creating transparency through precise production reports enabled targeted process improvements and led to a doubling of production capacity. This optimized the total cost of ownership and supported the company's competitiveness.

INCREASE OEE WITH MES FLEX

MES FLEX offers you a wide range of functions to increase your efficiency.

1. Visualization and Reports

- Plant and production status: Real-time display of machine status and production times to determine production availability, performance and quality.
- Reports for OEE analysis: Predefined and configurable reports on availability, performance levels and quality indicators over different periods of time.
- Auto-reporting and alarms: Automated sending of reports and notifications when certain thresholds are reached, e.g., in the event of deviations in cycle time or unexpected downtimes.

2. Shopfloor Management

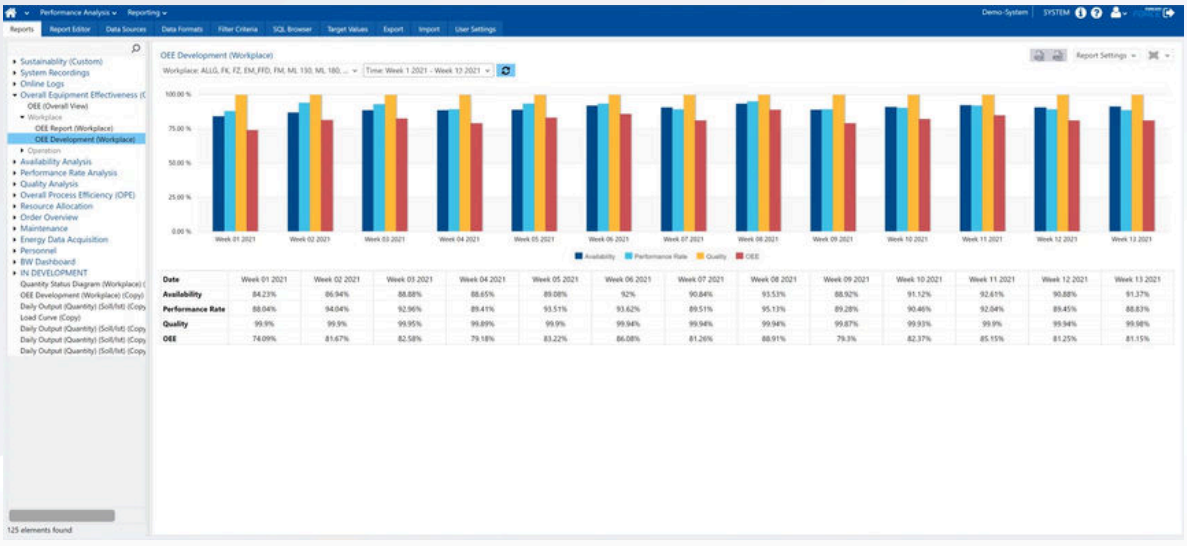
- OEE and OPE report: Detailed analyses of OEE and Overall Process Efficiency (OPE) with a focus on lead times, setup times, and process availability.
- Visualization of target/actual deviations: Display deviations in real time with an overview of machine status, order progress and quality data.
- Ticketing and fault management: Possibility to create tickets in the event of faults and assign them directly to those responsible for quick resolution and documentation.

3. Dashboards and individual visualizations

- Data consolidation: Dashboards enable a clear consolidation of the most important production data, including all relevant
- OEE metrics.
- Custom views: Display of specific production data
- (e.g. availability of individual workstations) and filter options for quick analysis of sources of loss.

4. Staff times and attendance

- Recording of personnel times: Feedback on attendance times and productively used times for a comprehensive unit cost calculation.
- Overall Labour Effectiveness (OLE): Calculating and reporting employee efficiency to supplement OEE data with personnel-related productivity metrics.



SHORT PROFILE
FORCAM ENISCO

FORCAM ENISCO GmbH is a leading global provider of production control solutions, dedicated to empowering large and medium-sized enterprises to achieve sustained competitiveness through data-driven production technologies.

Operating under the FORCAM ENISCO umbrella, which includes FORCAM GmbH and ENISCO by FORCAM GmbH, we are a complete solution partner for discrete manufacturing. Our modular software solutions guide clients at every stage of their digital transformation journey, enhancing production processes and advancing Smart Factory capabilities. We enable seamless integration and customization of existing and new IT systems to create tailored, scalable production environments.

FORCAM ENISCO's technology is trusted by a diverse range of companies—from industry giants to innovative medium-sized businesses—such as Airbus, Audi, Bizerba, BMW, BorgWarner, BWF Group, Daimler, Foundation Wellness, Pratt & Whitney, Schaeffler, Swarovski Optik, and Voestalpine. Today, our technology optimizes and monitors over 100,000 systems worldwide, driving efficiencies and elevating production outcomes.

We look forward to hearing from you!

Our experts will be happy to answer any questions you may have. Simply send an email to:

customerrelations@forcam-enisco.net