White **paper**

Understanding OEE

Operational Excellence

teeptrak

I. INTRODUCTION 3

II. WHAT IS A PERFORMANCE INDICATOR? 5
A. Definition 6
B. What is a “good” performance indicator? 7
C. A balanced dashboard to avoid managerial drift 8

III. THE ORIGIN OF OEE AND THE AFNOR STANDARD 9
A. Total Productive Maintenance TPM and OEE 10
B. OEE and its calculation according to the AFNOR standard 11
i. Definitions OEE, OOE, TEEP 13
ii. Example of calculation of the Overall Equipment Effectiveness (OEE) according to the AFNOR standard 15
iii. Other indicators: A, U, P, Q, ... 15
C. The big performance losses 17
i. Availability losses 17
a. Equipment failures/unplanned downtime 17
b. Setup and planned changes/downtime 17
ii. Performance losses 17
a. Minor stops 17
b. Speed reduction 17
iii. Quality losses 18
a. Process defects 18
b. Startup losses 18
D. The role of OEE in the pursuit of operational excellence..... 19

IV. HOW TO COLLECT THE DATA 20
A. Three data entry methods: manual, semi-automatic and automatic 21
i.Manual entry 21
ii.Semi-automatic entry 21
iii.Automatic entry 21
B. Comparison of the three entry methods 22
C. Turnaround between data acquisition and analysis 23
D. How often to measure OEE and its three intermediate rates? 24
E. Which indicators for whom? 25

V. WHY IMPROVE THE OEE? 26
A. Financial ROI of production tools 27
B. Provide transparency to drive improvement projects 28
C. Develop a culture of continuous improvement within your teams 28
D. Be objective about everyone's work 28
E. Reveal the hidden factory 29
A. Deploy appropriate tools and methodologies, including managerial methods 30

VI. WHICH TOOLS AND ORGANIZATION TO IMPROVE THE OEE? 31
A. How to target priority improvements? 32
i. Know your costs 32
ii.Prioritize impact 33

B. Lean tools 34
C. Managerial routines and escalation procedures 35
D. 5P Framework 36
E. ABC Framework: encouraging the right action? 37
i. Antecedents: 37
ii.Consequences 37

VII. THE DANGERS OF OEE 40
A. Risk of overproduction 41
B. Manipulating definitions to have a flattering OEE 42
C. OEE: no improvement without action 42
D. Comparing unrelated OEE 43
E. Not breaking down measurements 43
F. Comparing the evolution of the OEE while ignoring the number of operators 44

VIII. THE MAIN CAUSES OF FAILURE OF OEE MONITORING AND IMPROVEMENT 45
A. A lack of standard in the definition of OEE 46
B. Management has difficulty accepting transparency on its performance 46
C. Continuously forging ahead, never the right time 47
D. Lack of rigor, lack of organization 47
E. Data without action 47
F. Technology replaces human intelligence 48
G. Overconfidence 48

IX. HOW THE IOT TECHNOLOGY BUILDING BLOCKS BRING VALUE TO FIELD TEAMS IN THE USE OF OEE 49
A. Improving the daily life of operators by giving them the right quantity and quality of information 50
B. More complex and integrated tools are not necessarily more suitable 50
C. Ease of use for operator services 51
D. PERFTRAK: the IOT building block for OEE monitoring 51

X. CONCLUSION 52

Version 2022.1

I. INTRODUCTION

"The most dangerous kind of waste is the waste we do not recognize."

Shigeo Shingo

For how many hours per day is your machine producing? Why is your machine idle?

Can you increase your production capacity without investing in a new machine?

Can you produce the same quantities in a reduced plant open time?

The Overall Equipment Effectiveness (OEE) is a performance indicator that provides transparency on the operating time of your machines. Like any key performance indicator (KPI), its purpose is to inform and help employees in decision-making or in defining actions.

Today, there is still no international definition of OEE. In France, AFNOR has developed an OEE standard (NFE 60-182) which will serve as a reference in this white paper. The OEE measures the time needed to produce good parts over the planned production time.

Historically, the monitoring of OEE was done manually on paper by the operators, sometimes with a digital transcription, but today technology makes it possible to automate the collection of data to bring more precision and to update this KPI in real-time. Each method has its advantages and disadvantages which depend on the maturity and the capacity to deploy this indicator in the factory.

In the event of order saturation, reducing the downtime of your machines improves the profitability of your plant. By identifying the causes of downtime, the continuous improvement manager will be able to target and prioritize improvement projects to reduce waste. People are the determining factor in the success or failure of any factory improvement project.

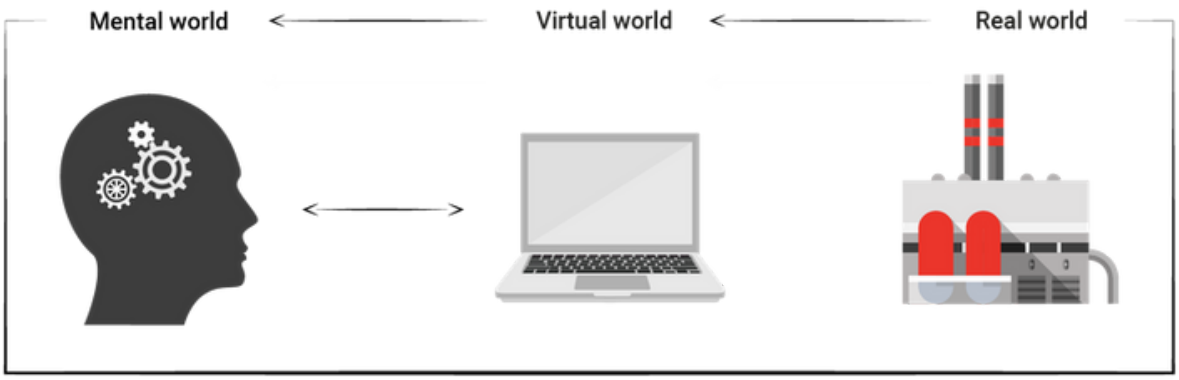
The OEE is an indicator based on a definition. Understanding this definition and correctly interpreting this information is necessary to use this KPI wisely. However, like any KPI, there are risks when it is not well understood or misused. Indeed, the behaviors are subject to drifts which can harm the final objective. Finally, the success or failure of the use of OEE in a factory is often linked to human and managerial causes, and not technological ones.

With the development of IoT solutions, the strategic use of technology improves the daily lives of operators and provides them with key information to improve machine performance. We believe that a solution that brings transparency and values human intelligence in reducing waste is key. This white paper aims to be the guide to OEE, whether you are experienced or new to OEE,
you can use this document as a training tool to train your teams, or simply refer to it to refresh your memory. After reading this white paper, you will know what OEE is, how to calculate it, how to
implement it in your factory, and the mistakes and pitfalls to avoid.

II. WHAT IS A PERFORMANCE INDICATOR?

A. Definition

Aperformance indicator is the representation of a reality on the ground transcribed into a mathematical formula to render a number or a gradation.

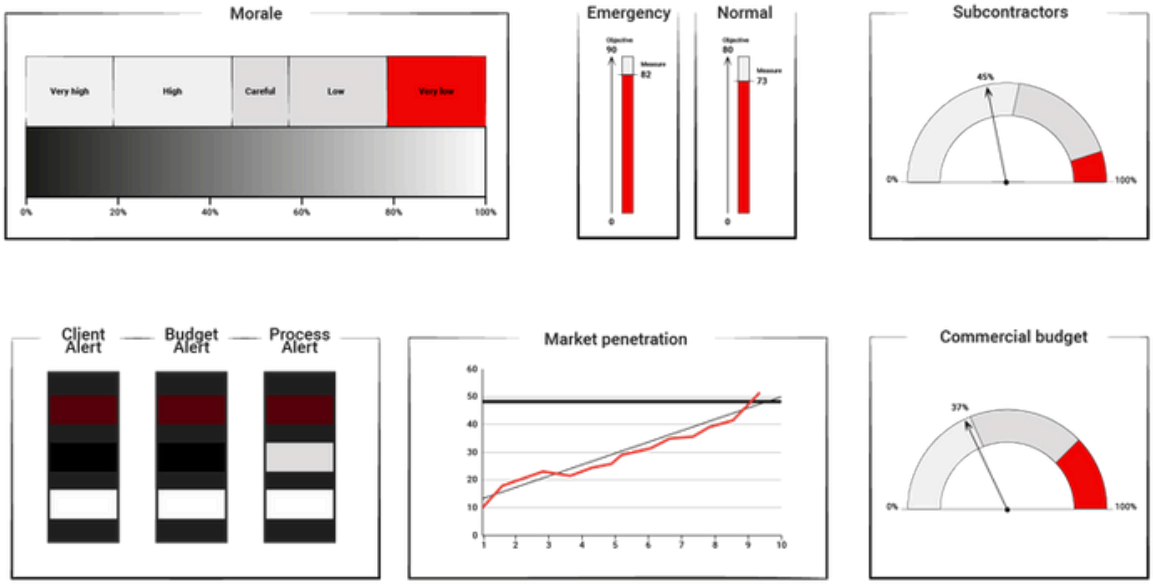


Performance indicators allow the manager to get a picture of the situation at a given time and help with decision-making:

- Did we achieve our goals?
- Are the actions taken moving us in the right direction?
- Are the resources allocated sufficient?

The most commonly used visual indicators are:

- The gauge that indicates if an objective has been reached.
- The curve makes it possible to follow the evolution of one or more variables over time.
- The traffic light sends a warning in the event of a malfunction for greater responsiveness.
- The histogram is a bar chart that shows the distribution of data.



B. What is a “good” performance indicator?

A performance indicator must have "meaning" and must serve the strategy being pursued. A mistake is to multiply the indicators on the dashboard when they are not useful or understood. The data collected must be reliable and useful for the realization of the company's strategy. Otherwise, this indicator will be ignored by the manager in decision-making, or worse, misused.

The indicator must be clearly defined and understood so that the manager can correctly interpret the information and make decisionsaccordingly. The data collection process must be clear and standardized so that the data remains reliable and consistent.

C. A balanced dashboard to avoid managerial drift

Each stakeholder has their own objectives that they seek to achieve. The danger is to achieve one's own goals at the expense of those of other parties. The indicators must therefore be consistent with each other and serve the overall objective. Often, the breakdown of the OOE and the TEEP (also explained in this document), in addition to the OEE, serves this purpose.

A team leader will seek to maximize the uptime of his equipment while the maintenance team will want to have time to perform preventive maintenance and thus prevent malfunctions that could affect the production rate.

Building a dashboard with a portfolio of indicators allows the manager to make decisions without compromising everyone's objectives.

Itis up to management to set the priorities and objectives that the dashboard will measure and track.

Other than the indicators related to production, there are financial, human and ecological indicators that make it possible to achieve, as mentioned previously, the global optimum.

III. THE ORIGIN OF OEE AND THE AFNOR STANDARD

A. Total Productive Maintenance TPM and OEE

The Overall Equipment Effectiveness (OEE) is a performance indicator developed by Harrington Emerson in 1912 in his book
«**The 12 Principles of Efficiency** ».

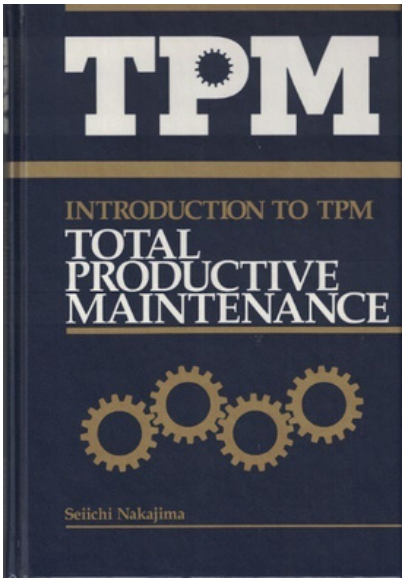
Inthe 60s, Seiichi Nakajima talks about OEE in his book Total Productive Maintenance (TPM) to measure the utilization rate of an industrial installation.

The objective of TPM is to create a system to maintain machines and equipment in optimal operating conditions in order to strive for zero breakdowns, zero defects, and zero accidents.

Each individual is encouraged to take responsibility for their work tools by taking care of them.

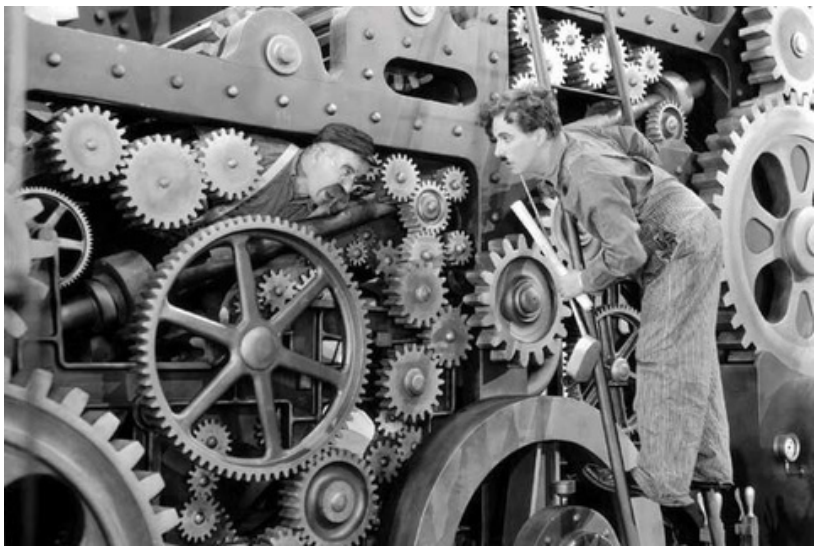
The OEE is the indicator most frequently used today to measure the performance of equipment even if there is no international consensus on this indicator today.

We have also observed that the standard itself is rarely fully respected and that each manufacturer uses similar but specific indicators.



***TPM* de Seiichi Nakajima**

Nevertheless, the measurement provided by such an indicator is entirely relative and is, in practice, rather used to identify areas for improvement. The OEE improvement is measured against a benchmark for a given piece of equipment; the value of this indicator is therefore specific to this equipment and cannot be compared with other types of equipment in other departments or factories.



B. OEE and its calculation according to the AFNOR standard

> *"You can't improve what you don't measure."*
>
> ***Peter Drucker***

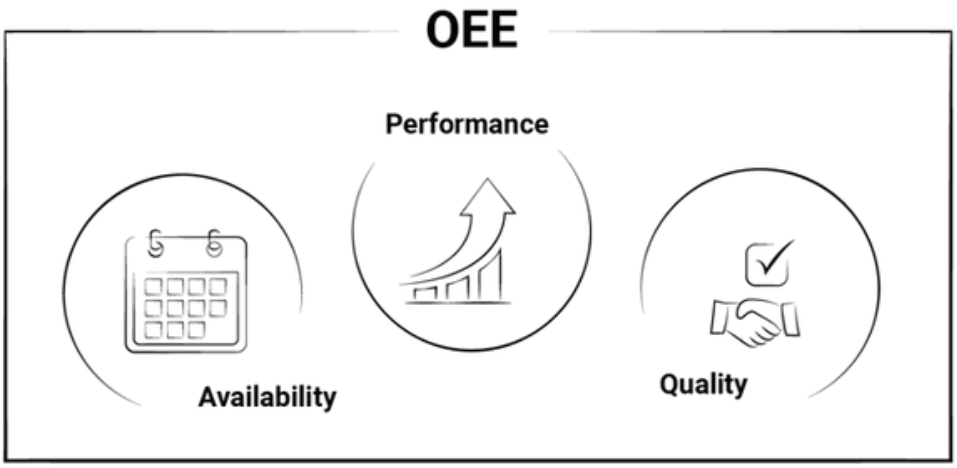
The AFNOR NF E60-182 standard of May 2002 defines the calculation method of the performance indicators of the means of production OEE, OOE, TEEP. It specifies the definitions of the state times and the elements necessary for the evaluation of the performance indicators of the means of production, and allows a reliable monitoring of these means.

A classic performance indicator is by default a ratio VA / (VA+NVA) where:

- VA = Value Added
- NVA = Non-Value Added

The definition of VA for the OEE/OOE/TEEP is always the same: fully productive time.

The notion of NVA varies. Increasing the value of the indicator corresponds to reducing the NVA according to its definition.



i. Definitions OEE, OOE, TEEP

The **Overall Equipment Effectiveness (OEE)** measures the effective production time of a means of production, excluding planned downtime. It is the ratio between the number of good parts produced and the number of parts that could theoretically be produced during the planned production time.

OEE = tU/tR

The **Overall Operations Effectiveness** evaluates the actual production time of good parts compared to the time the workshop is accessible, excluding the time the factory is closed. tO is therefore the opening time of the factory. This indicator is often called “lights on indicator” and sometimes Overall Operations Effectiveness (OOE).

OOE = tU/tO

The **Total Effective Equipment Performance** assesses the actual production time of compliant parts manufactured compared to the total time of the measurement period which is often a day (24 hours). This indicator is often called TEEP (Total Effective Equipment Performance).

TEEP = tO/tT

These indicators take into account notions of time:

- **The total time (tT)** is the reference time or total time (24 hours, 7 days a week, 365 days a year).
- **The plant open time (tO)** is the theoretical usable time of the machine to produce when the factory is open. This is the maximum number of hours of operation of the equipment.
- **The planned production time (tR)** is the planned number of hours spent on actual production.
- **The run time (tF)** is the number of hours of production of good and bad parts, including non-production times (loading time, waiting time, series change, etc.).
- **The net run time (tN)** is the actual production time of good and bad parts, excluding the speed differences.
- **The fully productive time (tU)** is the production time of good parts only at the nominal or theoretical speed.

TT	Total Time	
TO	Plant Open Time	Plant shutdown
TR	Planned Production Time	Schedule Loss
TF	Run Time	Availability Loss
TN	Net Run Time	Performance Loss
TU	Fully Productive Time	Quality Loss

OEE = Overall Equipment Effectiveness

OOE = Overall Operations Effectiveness

TEEP = Total Effective Equipment Performance

ii. Example of calculation of the Overall Equipment Effectiveness (OEE) according to the AFNOR standard

P	Production		40000	p	part
C	Cycle Time		4000	p/h	4000 parts per hour
S	Scraps		600	p	part
tT	Total Time		24,0	h	hour
tO	Plant Open Time		22,0	h	hour
tR	Planned Production Time		12,5	h	hour
tF	Run Time		12,0	h	hour
tN	Net Run Time	P/C	10,0	h	40000/4000
tU	Fully Productive Time	(P-S)/C	9,85	h	(40000-600)/4000
OEE	Overall Equipment Effectiveness	tU/tR	78,8%		9,85/12,5

iii. Other indicators: A, U, P, Q, ……

The indicator of availability (A) is obtained with the formula Run time / Planned production time.

A = tF/tR

It is the ratio between the time the machine produces parts (good or bad) and the planned time of production that excludes unplanned stops.

Or

Number of parts (good or bad) that should have been produced during the time spent on production / Number of parts theoretically feasible during the time required

The utilization rate (U) is obtained with the formula Planned production time / Plant open time.

U = tR/tO

It is the ratio between the time during which the machine must actually produce during working hours over the maximum operating time of the machines. A 100% deviation of this indicator implies planned downtimes.

The performance rate (P) is obtained with the formula Net run time / Run time.

P= tN/tF

Itis the time ratio that measures the slowdowns and micro-stops on the effective production time.

The quality rate (Q) is obtained with the formula Fully productive time / Net run time.

Q = tU/tN

It is the percentage of production time of good parts over the production time of all parts (good and bad).

OEE = Availability x Performance x Quality

Going back to the previous example:

P	Production		40000	p	part
C	Cycle Time		4000	p/h	4000 parts per hour
S	Scraps		600	p	part
tT	Total Time		24,0	h	hour
tO	Plant Open Time		22,0	h	hour
tR	Planned Production Time		12,5	h	hour
tF	Run Time		12,0	h	hour
tN	Net Run Time	P/C	10,0	h	40000/4000
tU	Fully Productive Time	(P-S)/C	9,85	h	(40000-600)/4000
OEE	Overall Equipment Effectiveness	tU/tR	78,8%		9,85/12,5
tO	Plant Open Time	tU/tO	44,8%		9,85/22
tR	Planned Production Time	tU/tT	41,0%		9,85/24
tF	Run Time	tF/tR	96,0%		12/12,5
tN	Net Run Time	tR/tO	56,8%		12,5/22
tU	Fully Productive Time	tN/tF	83,3%		10/12
OEE	Overall Equipment Effectiveness	tU/tN	98,5%		9,85/10

C. The big performance losses

One of the primary goals of TPM and OEE programs is to reduce and/or eliminate what are known as the “six big losses” – the most common reasons for productivity losses. Regarding Lean, the six big losses are forms of waste. They do not add value to the products. On the contrary, they reduce the efficiency of a machine which is measured through OEE or other indicators.

i. Availability losses

a. Equipment failures/unplanned downtime

The first big loss is caused by equipment not operating when scheduled for production, resulting in unplanned downtime. This can be due to machine breakdowns, tooling failures or emergency maintenance stops.

b. Setup and planned changes/downtime

The second big loss is also caused by downtime when equipment is not operating due to a change, machine and tool adjustments, or scheduled maintenance, as well as setup times and quality inspections.

ii. Performance losses

a. Minor stops

Minor stops represent short periods of time when the equipment stops operating. They can be caused by material jams, product flow obstructions, incorrect settings. These issues normally do not require maintenance personnel and can be resolved by the operator in a few minutes.

b. Speed reduction

Common reasons for reduced speed include the following: uncleaned machinery, worn equipment, lubrication, materials, environmental conditions, operator experience, general starting and stopping methods.

iii. Quality losses

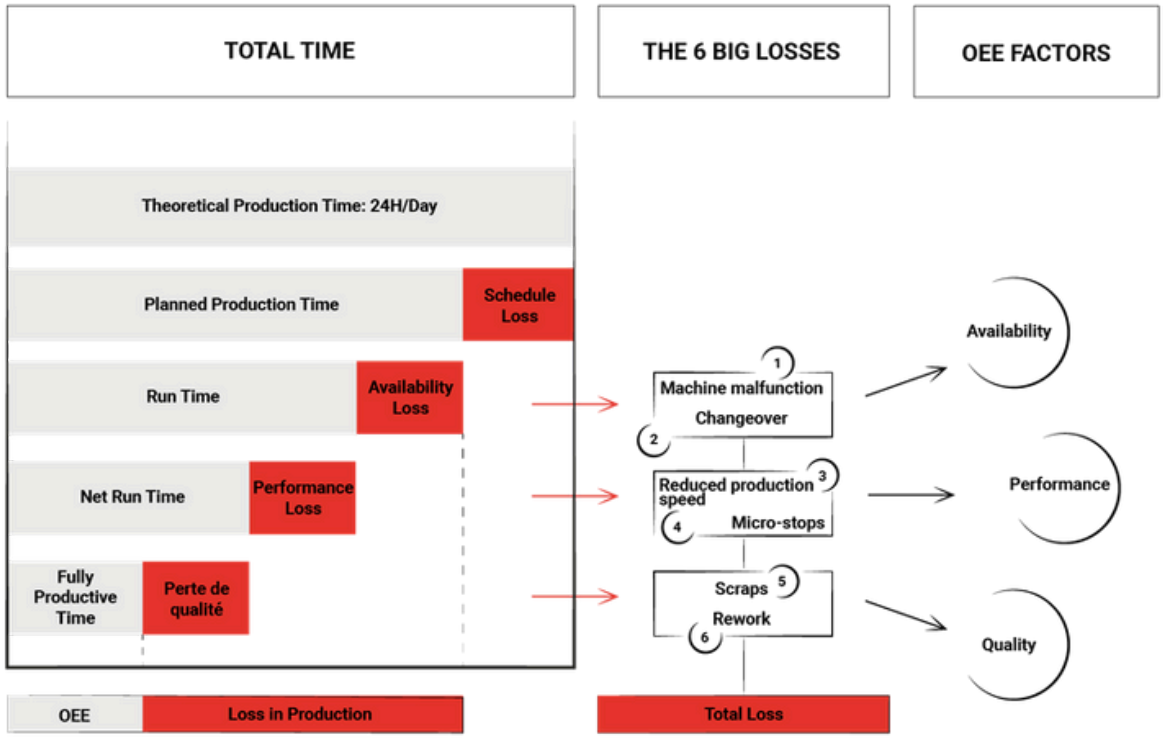
a. Process defects

Quality loss occurs when the machine fails to produce good products the first time. Since the part cannot be recovered, the material is wasted.

b. Startup losses

A startup loss occurs when the quality is not met, but the product can be reprocessed into good products. In this case, it is always considered a loss, because the effort to process the product twice creates waste.

Depending on the factories, the proportion of losses varies. Each industry has its specificities. Contrary to popular belief, it is not clear that the losses associated with breakdowns are the most important. It is often the opposite.



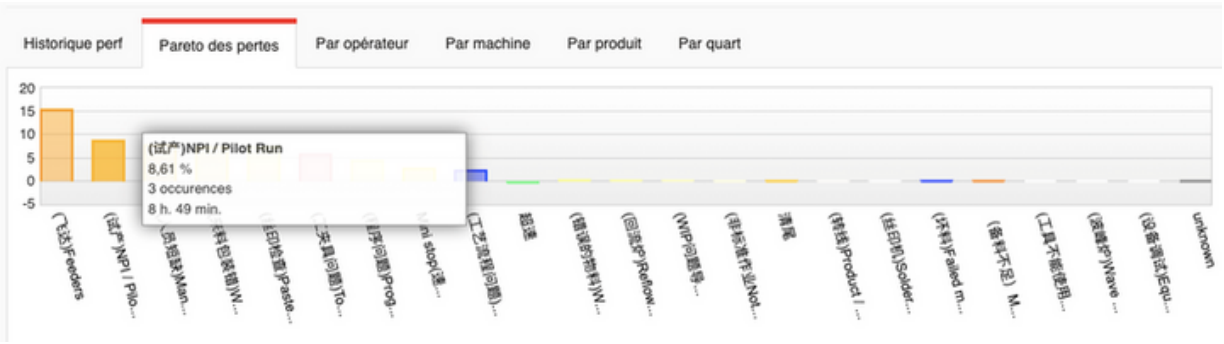
D. The role of OEE in the pursuit of operational excellence

What is interesting is not the nominal value of OEE because it only reflects past performance but the detail of the performance losses which define three rates:

- Availability
- Performance
- Quality

Why are these factors not all 100%?

Identifying the root causes of performance losses using a loss tree, then a Pareto chart allows all the causes to be identified, quantified and ranked in order of importance. By identifying all the causes and their duration, it is possible to do a Pareto chart to rank the causes that impact the OEE (or any other relevant indicator) in descending order. Working on the top causes (impact/effort matrix) will have the most significant impact on your OEE.



IV. HOW TO COLLECT THE DATA

- *Do you want to start monitoring and improving OEE?*
- *Or are you already tracking OEE and want to compare data acquisition methods?*
- *What are the existing methods and which ones to choose?*

A. Three data entry methods: manual, semi-automatic and automatic

i. Manual entry

The operator records the times and causes of production downtime on paper in order to provide the details necessary for the OEE analysis. The measurement can also be made in "parts" equivalent.

The form is standardized and simple so that the operator can fill it out quickly, unambiguously and its reading leaves no room for interpretation.

At the end of the period, a person collects the documents to consolidate the information in an Excel or in a system to make an analysis of the OEE.

Often, this entry mode involves significant reprocessing of the data.

ii. Semi-automatic entry

Thanks to automations and sensors, downtimes and micro-stops or the counting of parts are automatically recorded. The operator only has to specify the causes of the stop via a touch pad, keyboard, barcodes or buttons.

Via the system, the data is automatically consolidated for analysis.

This is our preferred method.

iii. Automatic entry

The machine is capable of specifying the downtime and micro-stops, and specifying the causes.

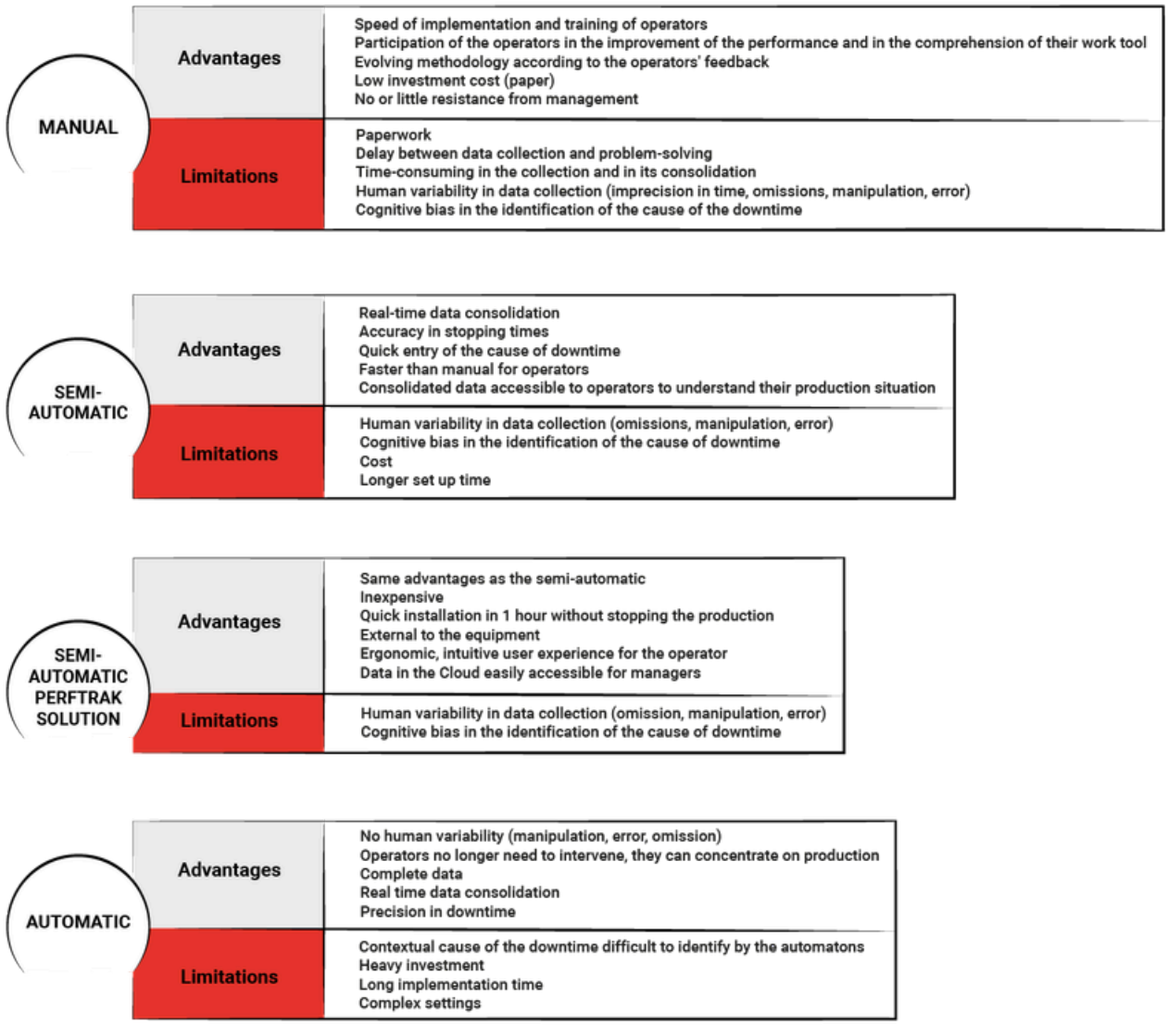
As with semi-automatic entry, data is consolidated automatically for analysis. The operator no longer needs to intervene on OEE monitoring.

Unfortunately, the majority of stops are contextual and not necessarily related to the equipment. The automatic reports are often not exhaustive and do not make it possible to fully understand the stops and therefore to prioritize improvement actions.

B. Comparison of the three entry methods

In reality, a factory with a fleet of heterogeneous machines can combine these three methodologies. On old machines, the automatic or semi-automatic collection of the OEE is difficult or very expensive. Since the ROI is not certain, manual entry is adopted by default.

Another challenge is consolidating data into one format when all three methodologies are used and when technology differs between machines.



C. Turnaround between data acquisition and analysis

An immediate or rapid analysis of the performance loss causes allows teams to be responsive and committed to resolving the cause.

When the report arrives in the hands of the manager several days (or even weeks) late, it is already in the past. Instinctively, teams are often preoccupied with the problems of the moment and quickly forget the risks dating back several hours or several days.

The reliability of information, the immediate collection of causes and real-time reports strongly influence the success of projects to improve the OEE and its three intermediate rates.

To facilitate exchanges within the same company,itis important to use identical calculation rules even if the measurement methods aredifferent. Although the values are difficult to compare, this uniformity allows employees togetused to it. Performance tracking takes some time to become fully embedded in the corporateculture. By always following the same calculation method, the increase in skills ofcurrent and future teams will be shortened. Indeed, due to their sometimes complex nature,itisnot always trivial to discuss performance indicators. This is all the more true if they areheterogeneous or if they change frequently

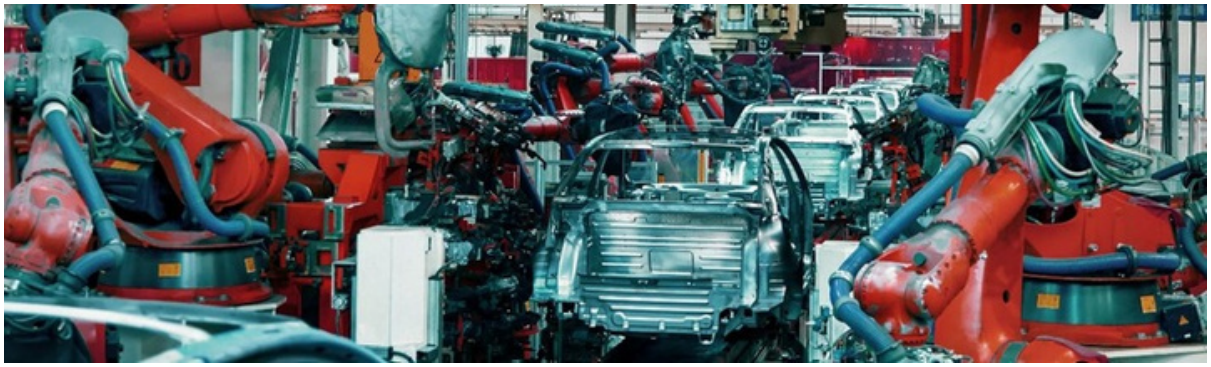
D. How often to measure OEE and its three intermediate rates?

Measuring OEE at various time horizons serves several purposes:

- Real-time allows to increase the responsiveness of the teams in the event of problems
- Short-term measurement makes it possible to work on the organization of daily life and to calibrate priority daily tasks
- Long-term measurement allows to deal with substantive issues and tackle the most significant losses, even if on a daily basis they may seem insignificant.

Ifyou are just starting, you will need to track the OEE for some time in order to collect enough data on downtimes and causes. Then, new data and changing priorities will determine the hindsight necessary to obtain the best analysis.

As a reminder, the three intermediate rates are the loading rate, the performance rate, and the quality rate (see Other indicators Availability, Performance, Quality on page 14).



E. Which indicators for whom?

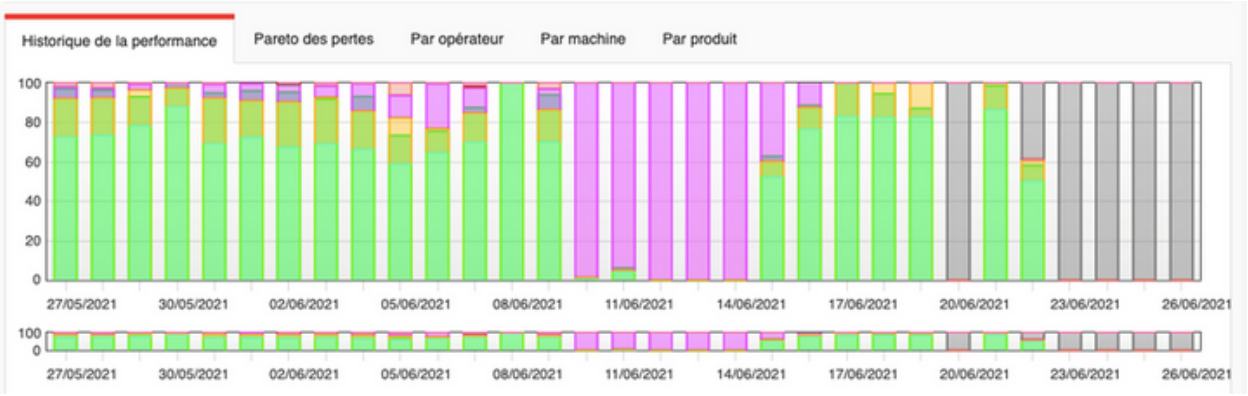
Monitoring OEE and its three rates provides transparency from the production manager to the operator who can, each at their own level, make decisions to achieve their goal.

The team leader will know if they are on time to finish their orders and take corrective action ifthe rates are not satisfactory.

For the production manager, by making a correlation between OEE and the variable and fixed costs, they can estimate the average unit cost with precision.

For the production planning manager, they will know more precisely the real cycle time of each reference and will be able to guarantee a delivery date with confidence.

With these KPIs in your dashboard, you can quickly identify performance drifts in the operating time of your machines and address them.



V. WHY IMPROVE THE OEE?

« Without data, you're just another person with an opinion. »

W. Edwards Deming

The purpose of a factory is to make a profit. The OEE is an operational indicator that helps to achieve this goal.

A. Financial ROI of production tools

Your machine fleet is a material investment from your capital or credits. This investment improves profits through productivity gains by substituting capital for labor.

Improving your OEE allows you to add value to your machines by producing more parts right the first time with the same number of machines. With higher productivity, you lower your unit costs.

- Produce more with the same tools
- Produce over less time / more efficiently with the same tools

Shutting down equipment reduces energy and raw material consumption, and reduces machine wear. Better utilization of resources avoids overtime and allows resources to be allocated elsewhere.

B. Provide transparency to drive improvement projects

> *“If you can't mea sure it, you can't manage it.”*
>
> ***Peter Drucker***

Only after measuring availability, performance, and quality, and the causes that affect these three rates, will you know where to focus your efforts.

Without monitoring OEE and downtime causes, not only do you not know if your machine fleet is running and producing good parts, but you're ignoring all the problems that affect their proper functioning. It is impossible to reduce waste effectively without this information.

C. Develop a culture of continuous improvement within your teams

Monitoring the OEE manually or semi-automatically requires the cooperation of the workshop operators. Active participation of operators allows them to become aware of the problems. Since they are in *Gemba* (in situation), they are best able to notice problems and offer pragmatic solutions to improve the OEE. If the problem is technical, industrial engineers will have the information to improve machines and processes.

D. Be objective about everyone's work

Ifthe data is correctly reported, the production delay following a breakdown will not be attributed to the performance of the operators.

The operator will not be wrongly charged for induced downtimes.

E. Reveal the hidden factory

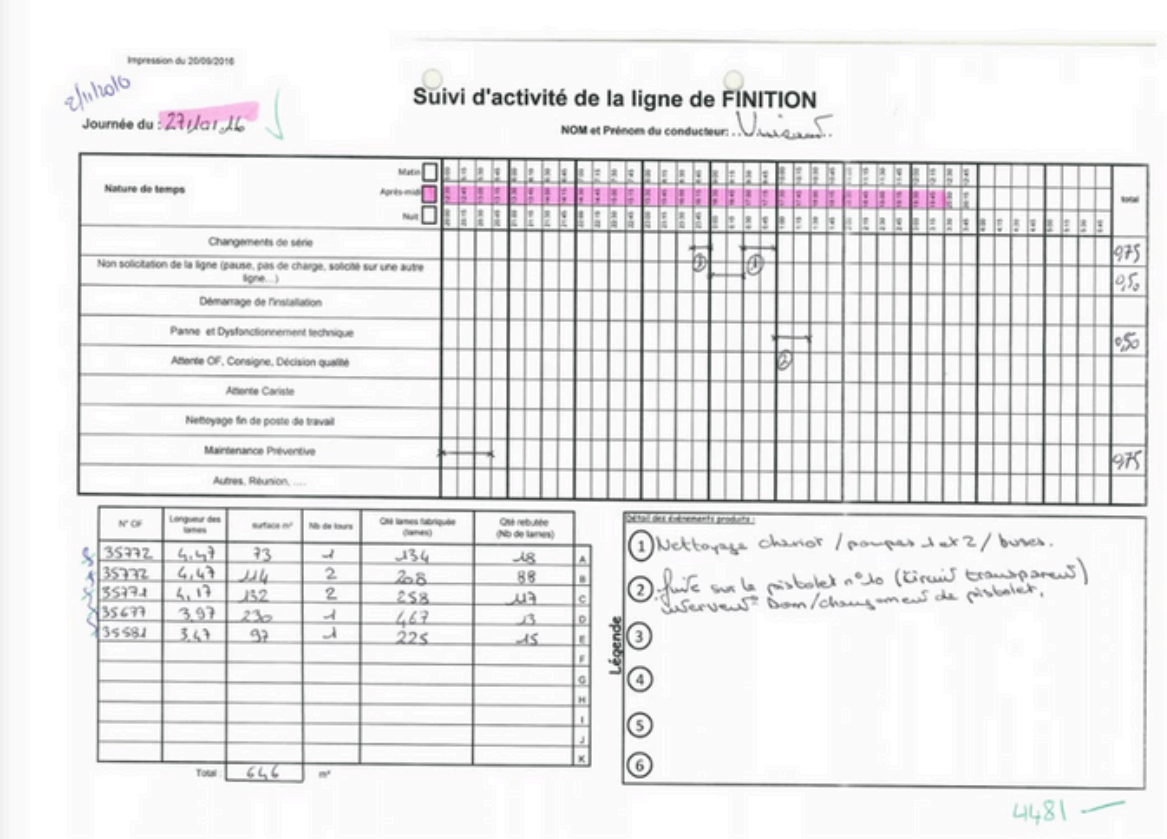
Armand Vallin Feigenbaum popularized the concept of the hidden factory in the 1970s. The hidden factory encompasses all the actions carried out in the factory that negatively impact the quality and efficiency of the processes, and which go unnoticed. According to Armand V. Feigenbaum, the hidden factory represents between 20 and 40% of the factory's untapped capacity.

With the monitoring of the OEE and its three intermediate rates, you will be able to reveal this hidden factory with all the waste that affects your availability, performance and quality.

The most important benefit of utilizing your hidden factory is that you can expand your capacity without additional capital expenditure. In other words, you can do more with what you already have.

A. Deploy appropriate tools and methodologies, including managerial methods

There are tools and methodologies to improve OEE effectively.



Impression du 20/09/2016

Suivi d'activité de la ligne de FINITION

Journée du : 27/01/16

NOM et Prénom du conducteur : Vincent S.

Nature de temps	Matin / Après-midi / Nuit	total
Changements de série		975
Non sollicitation de la ligne (pause, pas de charge, sollicité sur une autre ligne...)		0,5
Démarrage de l'installation		
Panne et Dysfonctionnement technique		0,50
Attente OF, Consigne, Décision qualité		
Attente Cariste		
Nettoyage fin de poste de travail		
Maintenance Préventive		975
Autres, Réunion, ...		

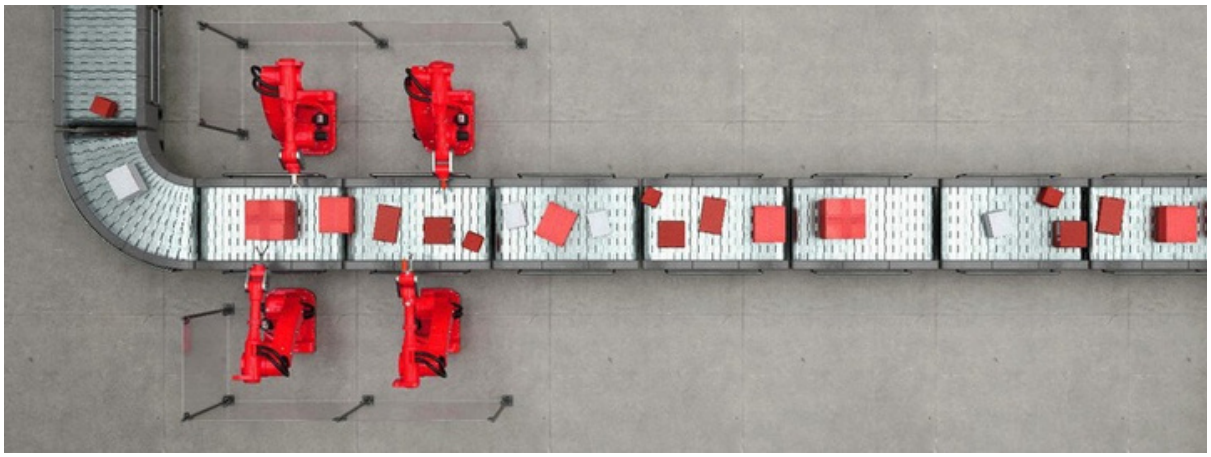
N° OF	Longueur des lames	surface m²	Nb de tours	Qté lames fabriquées (lames)	Qté rebutée (Nb de lames)	
35772	4,47	73	1	134	18	A
35772	4,47	114	2	208	88	B
35771	4,17	132	2	258	43	C
35677	3,97	230	1	467	13	D
35581	3,47	97	1	225	15	E
						F
						G
						H
						I
						J
						K
Total		646	m²			

Détail des événements produits :

1. Nettoyage chariot / pompes 1 ex 2 / buses.
2. Fuite sur le pistolet n°10 (tirant transparent) intervention Dom / changement de pistolet.
3.
4.
5.
6.

Légende

4481



VI. WHICH TOOLS AND ORGANIZATION TO IMPROVE THE OEE?

A. How to target priority improvements?

i. Know your costs

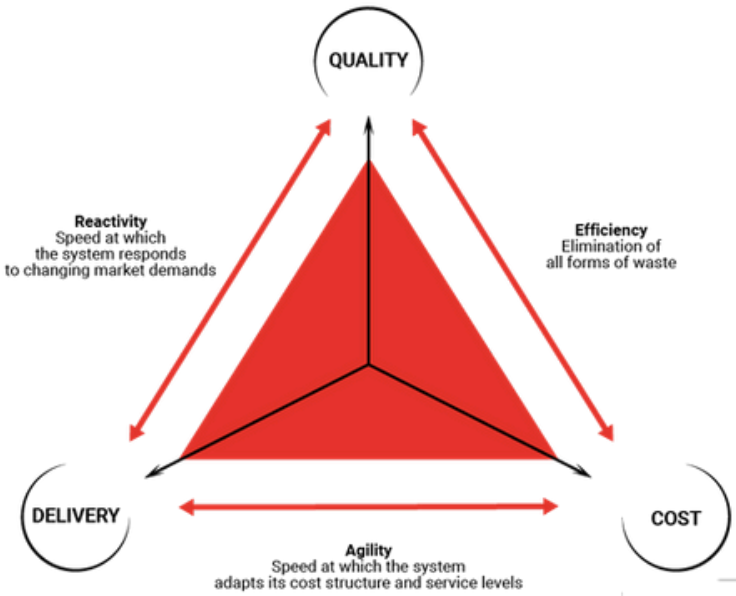
Do you know your fixed costs, variable costs, direct and indirect costs?

By knowing your costs (or large expenses), you will be able to estimate how much each lost point of your three intermediate rates costs you.

This information allows you to rank improvement projects in order of financial impact.

Then, cross-reference this information with your continuous improvement expertise to select the projects to be carried out as a priority.

Improvement projects are good, but is the ROI obvious?

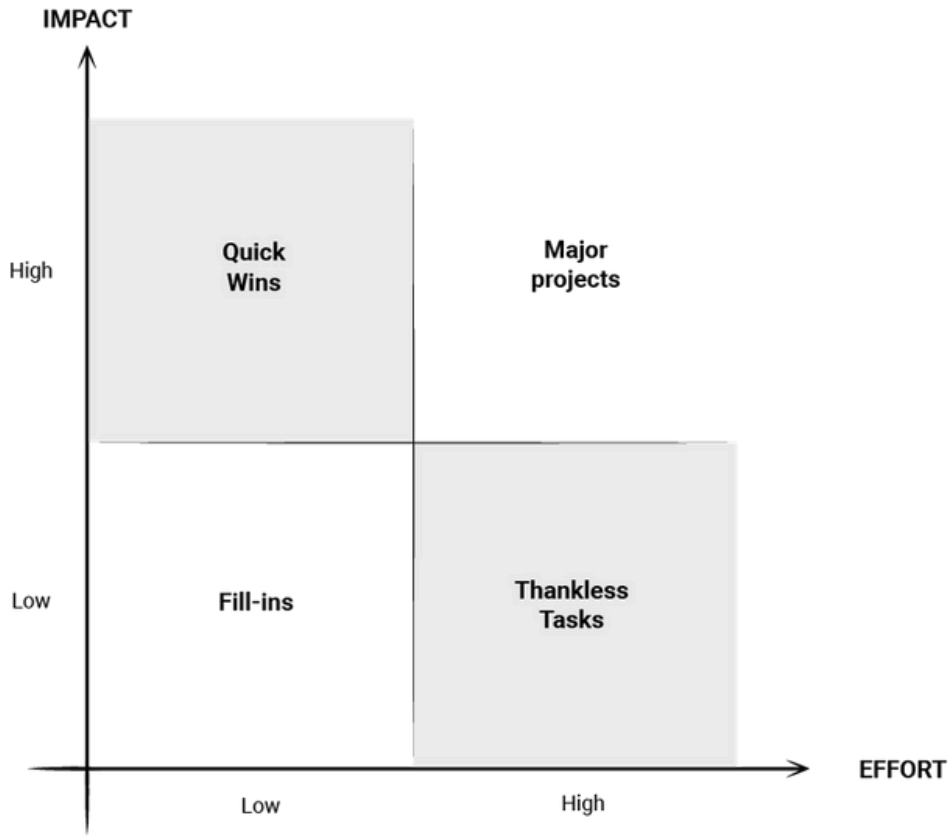


	Variable	Fixed
Direct	Raw materials Packaging Energy Personnel costs Non-quality	Investment Amortization Personnel costs
Indirect	Consumable Energy Maintenance	General and administrative expenses Maintenance

ii. Prioritize impact

Because time is often the number one resource in a factory, it is essential that it is used wisely. All resources must be focused on the most impactful actions.

To do this, we advise you to classify your actions in the following quadrants and to prioritize quick wins before major and minor actions.

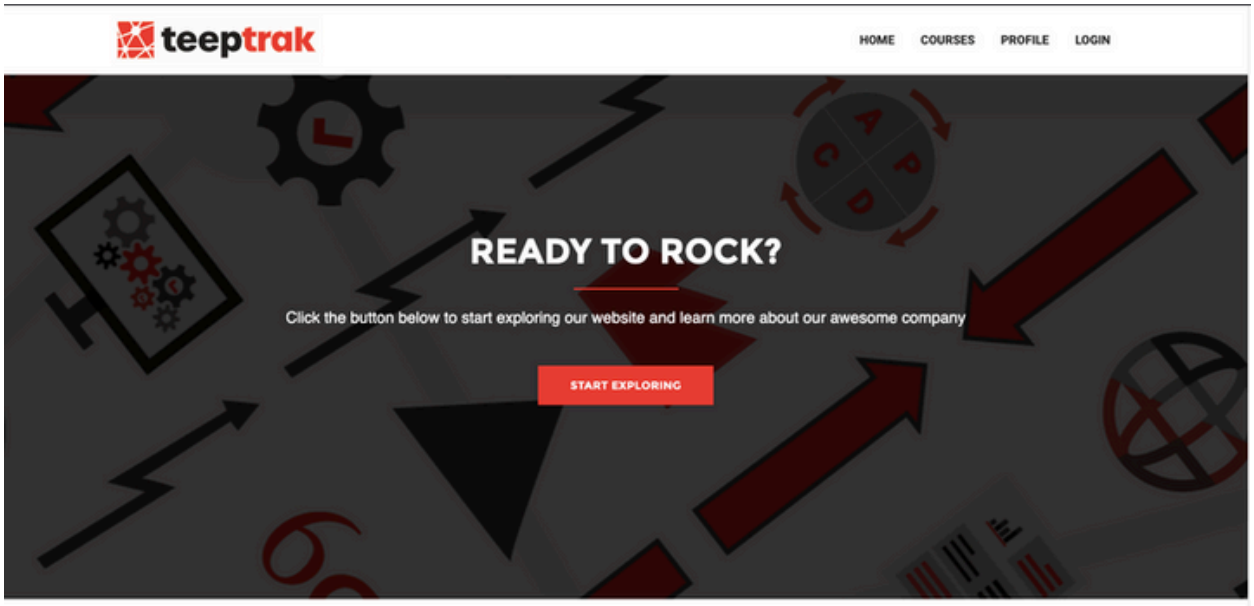


B. Lean tools

Ifyou want to monitor your OEE and reduce your waste, you already have the Lean spirit. The literature on Lean tools like 5S or SMED is abundant.

Tomonitor the improvement actions, the PDCA and a simple table allow to obtain the best results.

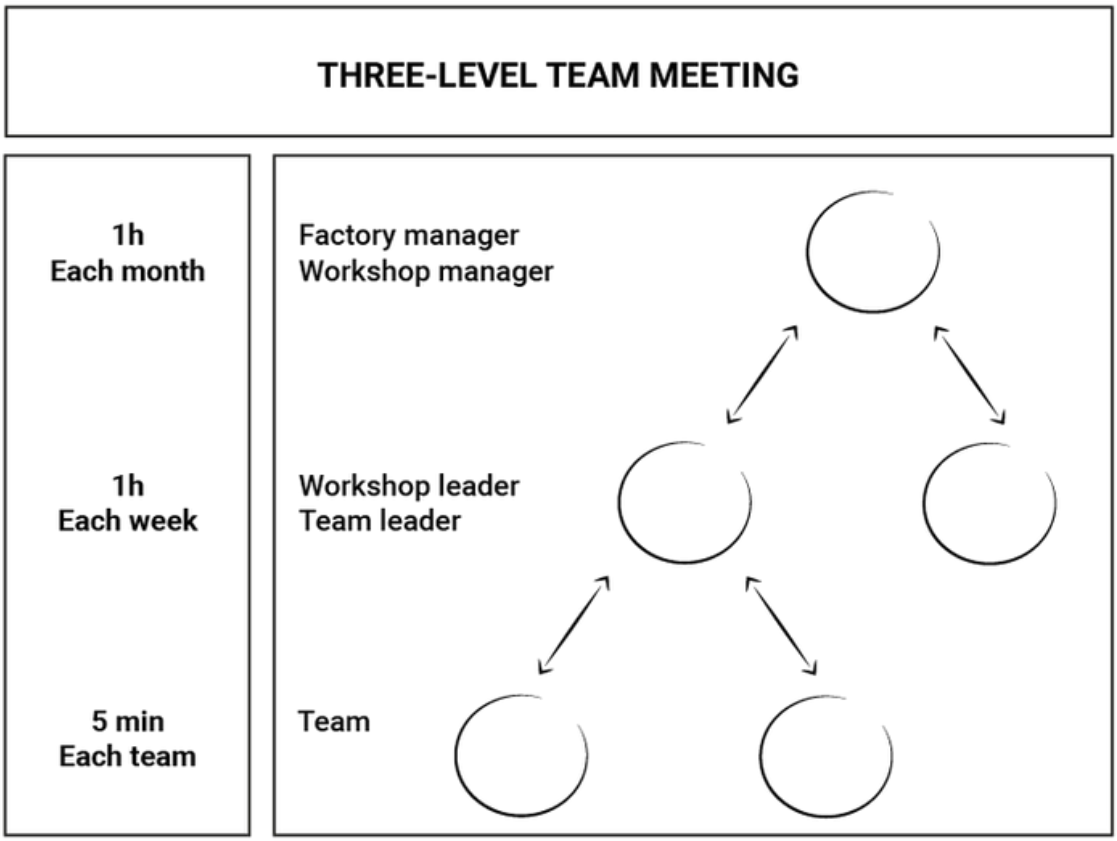
You will find on the TEEPTRAK Lean Academy the Lean tools and examples to help you reduce your waste (reserved for our clients):



https://lean.teeptrak.net/

C. Managerial routines and escalation procedures

When the problem is outside the operator's responsibilities and five-minute morning meetings cannot solve it, the team leader must be able to escalate the information to line management who will have the authority, the skills and resources needed to solve the problem.



D. 5P Framework

This framework is used to ask the right questions before embarking on an OEE project.

Purpose

Confirm that the goal is the same for everyone.

Is there a shared (and sufficient) sense of priority?

Principle

What about the general attitude of the teams? Corporate culture?

Processes

Are the managerial routines in line with the objective?

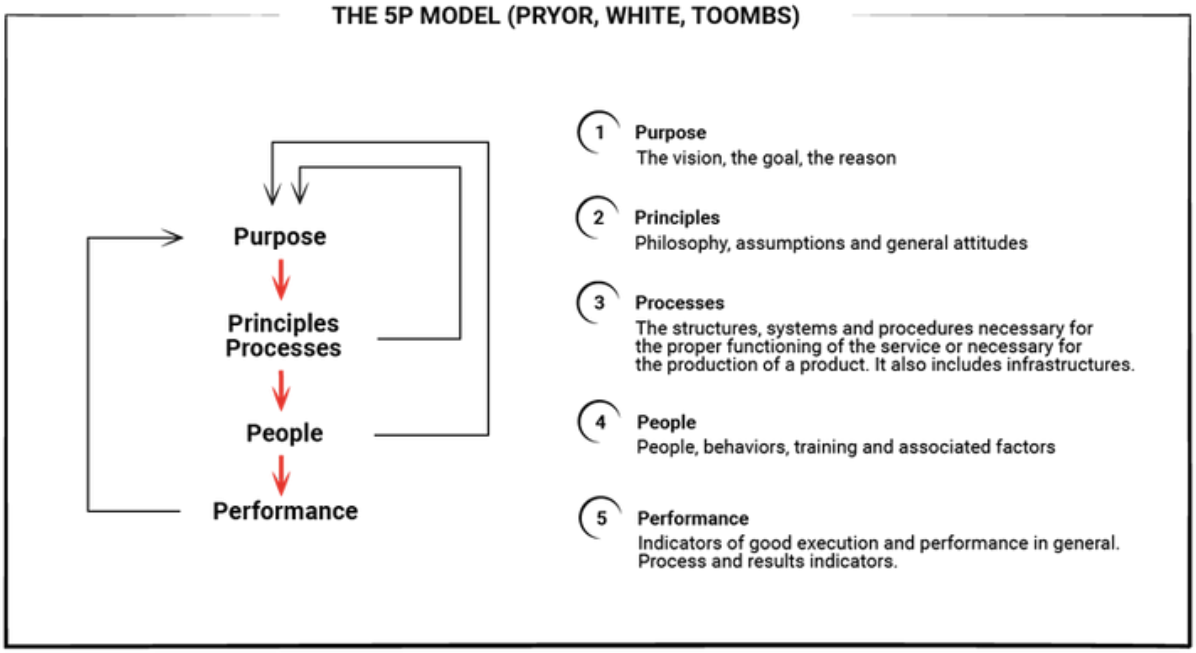
People

ABC Framework

Performance

Is the whole mechanism fluid and functional?

A mistake is to embark on OEE and continuous improvement projects without having prepared the essentials.



E. ABC Framework: encouraging the right action?

To go even further in the process, the ABC Framework can help you identify the key success factors to obtain the desired mobilization.

The human is still and always will be at the heart of the workshops. The success of OEE implementation depends on factors that the ABC approach allows to formalize in the most comprehensive way possible.

Maximizing your performance indicator (in this case the OEE but not only) requires a certain state of mind and behavior from the field teams. It is this behavior that we must seek to steer in the right direction.

Behavior: The actions that management expects from the teams.

To secure this behavior, key factors are necessary but not sufficient, we will call them

i. Antecedents:

- Are employees clear about what is expected of them? Is the objective clear (definition, target)?
- Do they have the knowledge and skills to do what is expected of them?
- Do they have access to the necessary tools?

These antecedents, if they are lacking in whole or in part, are a source of failure. However, their presence is not enough. They play a role prior to the definition of the objective. To guarantee the achievement of the defined objective (the Behavior), consequences (positive and/or negative) must be managed. These consequences are the most direct possible result of the behavior and condition the human to be encouraged or discouraged depending on the outcome.

ii. Consequences

These occur at 5 levels:

- Organizational: What are the rewards for stakeholders? Promotions? Line
- management: Does the line management support and is invested in this project?
- Peers: Is there healthy competition and collaboration in the deployment and success of the project?
- Beliefs: Do the stakeholders believe in the project?
- The work environment: If the project is successful, will the day-to-day work be easier for the stakeholders?

Let's take an example of questions to ask yourself before embarking on a project for monitoring and improving OEE

Antecedent

Does everyone know what is expected?

- If you do manual data collection, who is responsible for collecting the documents and consolidating them, are the roles and responsibilities clear?
- Who will review the information in the report?
- Is there a qualified person to implement continuous improvement projects?
- Will the resources necessary to carry out the actions be available?
- What authority will this person have over the other teams?

Do they have the knowledge and skills to do what is expected of them?

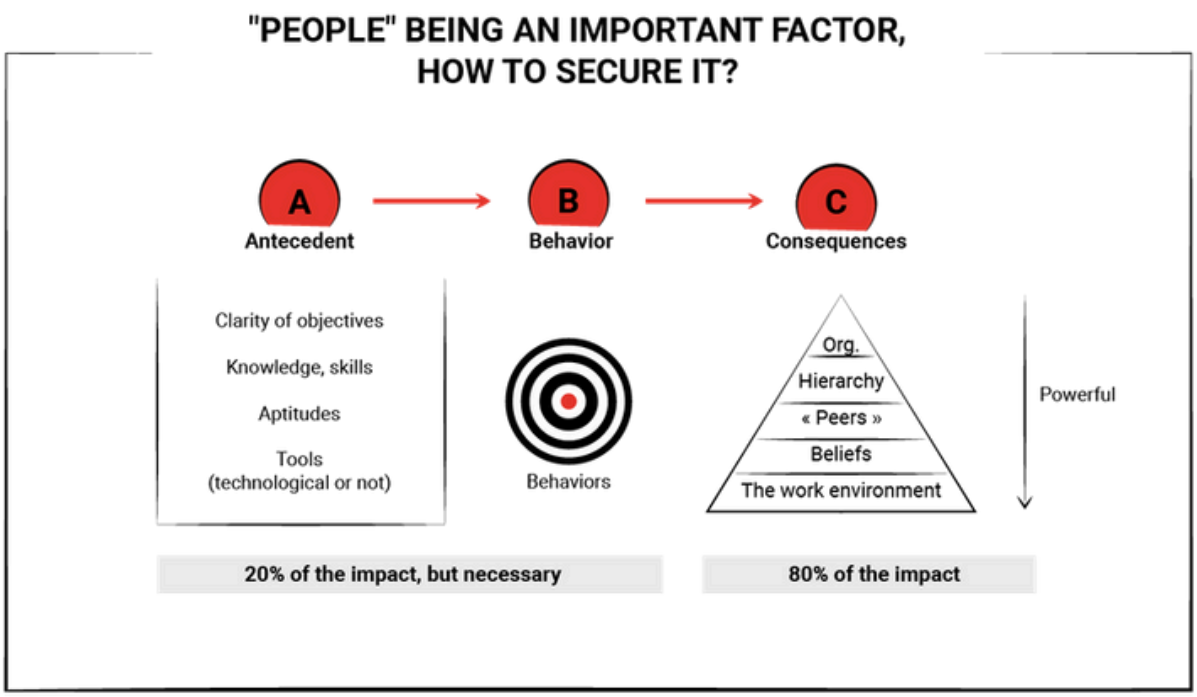
- Do the operators and the management understand OEE and its purpose?
- Have they been trained in filling out the form?
- Do the teams know how to correctly interpret the data in the report?
- Do the operators know how to identify the causes of downtimes?

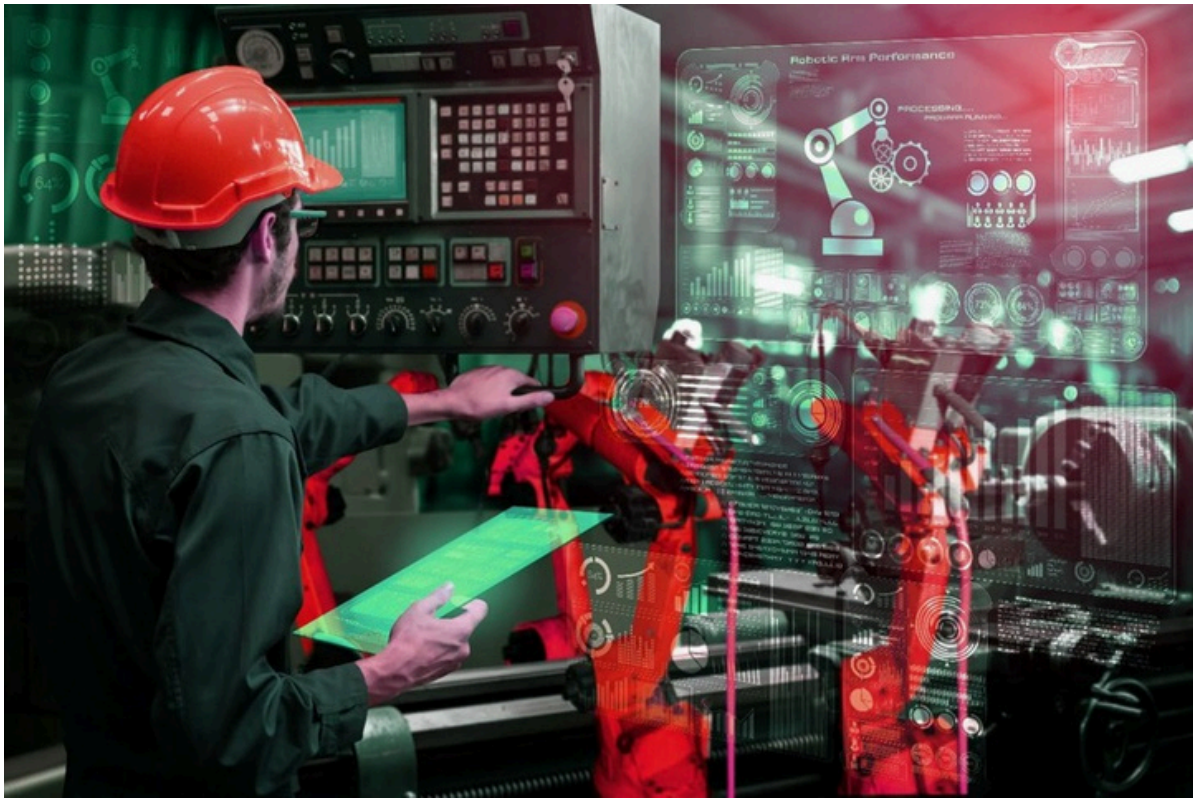
Do they have the necessary tools available?

- If you want to do manual data collection, is the form ready and printed?
- In which system will the information be consolidated?
- Do the teams have access to a computer to consult the data?

Consequences

- Organizational: In the event of improved machine performance thanks to OEE monitoring, what are the key rewards for each stakeholder?
- Line management: Will the factory manager value the results related to this project?
- Peers: Do the different team leaders want to reduce their waste to have a better OEE than that of the other teams (by displaying them for example)?
- Beliefs: Do the stakeholders believe that monitoring the OEE will have a positive impact on their work? If line managers do not believe in it and take a dim view of OEE monitoring, the project will most likely fail.
- The work environment: If the OEE is improved, is there a risk that management will decide to reduce the number of operators to save money? If so, the operators will surely not play the game knowing that if successful, they will find themselves unemployed.


"PEOPLE" BEING AN IMPORTANT FACTOR,
HOW TO SECURE IT?
A
Antecedent
B
Behavior
C
Consequences
Clarity of objectives
Knowledge, skills
Aptitudes
Tools
(technological or not)
Behaviors
Org.
Hierarchy
« Peers »
Beliefs
The work environment
Powerful
20% of the impact, but necessary
80% of the impact



VII. THE DANGERS OF OEE

Is 100% OEE all the time ideal and even desirable??

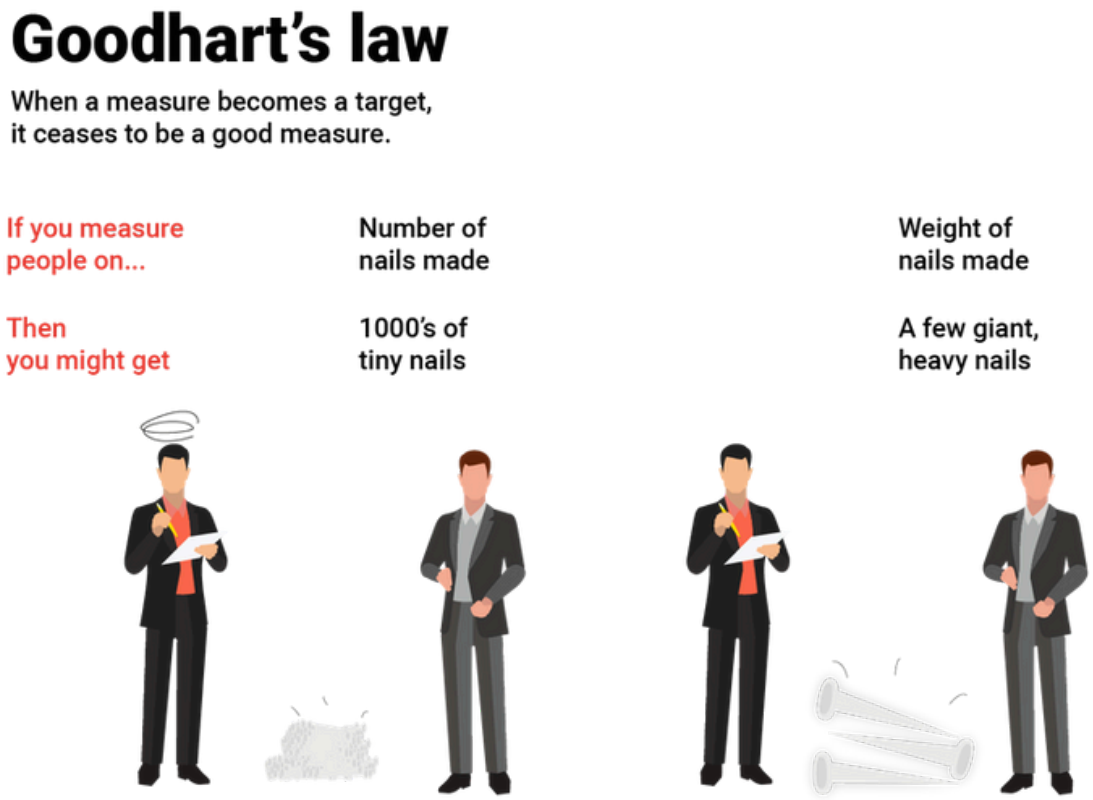
A. Risk of overproduction

When the management sets the OEE as a KPI to absolutely improve, the manager will make decisions to maximize the OEE even if this generates waste.

> *Goodhart's law: "When a measure becomes a target, it ceases to be a good measure."*

For example, in order for the machines to produce without stopping, they can produce more than necessary. Or hire more operators than necessary and have them work overtime so that production never stops to maximize OEE.

A high OEE only makes sense if the production is sold. If there is no order, it is better to have a low OEE than to inflate stocks.



B. Manipulating definitions to have a flattering OEE

- Lower the quality standards to have a 100% quality rate.
- Schedule mandatory breaks (meals, coffee), preventive maintenance, adjustments and conditioning of the machine, product changes to improve the availability rate.
- Set a theoretical standard cycle time that is slower than the actual rate, so when there is a loss in performance, it is less noticeable.

By playing on the definitions, it is even possible to have an OEE greater than 100%.

The purpose of the OEE and its three intermediate rates are to provide transparency on the problems to then reduce waste and not to inflate one's ego.

The OEE is not an objective but a management tool.

C. OEE: no improvement without action

The OEE and its Pareto chart are only data on past performance and problems. Without improvement action, these same performances and problems will repeat themselves.

Has the management understood the interest of the OEE? Does the company have a culture of continuous improvement?

In reality, when the calculations to obtain the OEE are complicated or tedious, managers do not take the time to go into the details. The OEE then serves as a means of measurement and not as an opportunity to improve. If it is not at the required level, it will fall on the managers.

Thanks to the details of the OEE, it is also easier to choose the ideal interlocutor. Indeed, not everyone has the same responsibilities for the equipment. The maintenance department, in charge of availability, will be more or less involved in equipment depending on the score of said availability.

D. Comparing unrelated OEE

Itis tempting for management to compare the OEE between factories and workshops, but it does not make sense if the machines are different and make different products. Each machine has its own specific downtime causes. For the comparison to make sense, it would be necessary to compare two similar machines producing a similar product. In some large groups, the errors mentioned above are frequent. Everything starts from the first, the comparison between the factories. Despite lines, a number of operators, even different processes, it's an easy way to put performance in front of each other. From there, the less honest will not hesitate to modify well-chosen values to increase the OEE. As a result, the various intermediate rates are distorted. This is exactly the wrong thing to do, because you turn the indicator into a tool with no added value. It goes against the Lean spirit.

E. Not breaking down measurements

Looking only at the OEE does not reveal waste. Here are two 79.5% OEE. Although identical, they hide two different situations. Indeed, if 1% quality is worth as much as 2% availability (because the cost of the raw material, for example, is very high), then the financial performance is totally different for the same OEE. The monitoring of OEE, intermediate rates and causes of performance loss provide transparency on the machines. The continuous improvement manager can understand and then target the improvements that are considered priorities.

	WEEK 1		WEEK 2
OEE	79,5 %	=	79,5 %
Availability	90 %	↗	95 %
Performance	93 %	=	93 %
Quality	95 %	↘	90 %

F. Comparing the evolution of the OEE while ignoring the number of operators

Operator salaries are a burden on the company, how many resources have you allocated to line A to achieve a OEE of 79.5%? Ignoring the number of operators is ignoring the cost of performance.

	WEEK 1		WEEK 2
OEE	79,5 %	=	79,5 %
Number of operators	3	↗	5
Performance by operator	26,5 %	↘	15,9 %

VIII. THE MAIN CAUSES OF FAILURE OF OEE MONITORING AND IMPR OVEMENT

A. A lack of standard in the definition of OEE

Here is an example: in the same factory, two workshops follow their OEE on paper, each using their own definition of OEE. One incorporates preventive maintenance, shift changes and meal times into the Availability calculation, while the other incorporates them into planned downtimes. The measurement is totally different...

Or, the quality rate of the first workshop is always considered at 100% because the rework times are excluded from the OEE calculation.

Management, sometimes removed from the field, finds it difficult to understand what is really hidden behind each OEE if they do not take the time to compare the respective definitions of the workshop indicators.

B. Management has difficulty accepting transparency on its performance

More than once, the OEE is a number in a report among other KPIs. Management does not understand the definition of OEE or its calculation. They are satisfied when the OEE is close to 100% because they tell themselves that the machines are “running”.

A client in China had an OEE consistently above 100%. The plant manager and the line manager were proud of this figure. After using our solution to track their OEE according to the AFNOR standard, their OEE was closer to 40% than 100%. They rejected our solution altogether and went back to their old method of calculation.

C. Continuously forging ahead, never the right time

> *“I don’t have time to reduce waste,*
>
> *I need more orders for this to be useful.”*

Being Lean allows you to be more resilient when demand slows down or even decreases. In tense or slow situations, monitoring OEE is not the priority of management. Its monitoring is neglected.

Management ignores that, all other things being equal, reducing production costs improves the margin.

Selling price – Production cost = Margin

D. Lack of rigor, lack of organization

> *“Anyway, we don't do anything with the OEE.”*

When the OEE is tracked on paper, operators will forget to write downtimes and downtime causes. The data collected is therefore approximate or even false.

Or, knowing that nothing is really done with the data and that the OEE is just a facade KPI, the operators fill in the document as quickly as possible to satisfy their team leader.

E. Data without action

Management starts tracking the OEE of each of their machines overnight. However, managerial routines and standards are not yet in place. The project does not yield any results.

F. Technology replaces human intelligence

“I already know my OEE via my MES."

The manager knows the value of their OEE via their MES system, they do not want to understand how this OEE is calculated and how the main losses are explained. The data, which is only partial, is not used (or cannot be used) for continuous improvement.

G. Overconfidence

"I don't need to monitor my OEE,

Ialready know the causes of downtimes of my machines.”

The production manager hasacognitive bias, they evaluate the performance of the machines not via objective data but viatheirpersonal experience. Under these conditions, the manager will refuse to monitor their OEE.

Our experience systematicallyproves that equipping machines with factual systems leads to conclusions on non-performancethat are very different from the preconceptions of the teams, however experienced they maybe.

IX. HOW THE IOT TECHNOLOGY BUILDING BLOCKS BRING VALUE TO FIELD TEAMS IN THE USE OF OEE

A watchword is essential in the choice of anynew solution, technical or not: **the buy-in from the teams (simplicity of use, impact, durability)**.

Systems that are too complex are rarely fullyutilized by field teams. Yet they are often the ones that have the greatest impact on production efficiency.

A. Improving the daily life of operators by giving them the right quantity and quality of information

The sources of performance improvement (excluding external purchasing costs) in a factory are diverse. They can come from a set of levers:

- Better field organization
- Optimized planning and scheduling (size and order of batches)
- Improved equipment availability (preventive / corrective / autonomous maintenance, others).
- Smoothing the flow, balancing the different production stages of the line
- Improved quality, reinforced process controls
- The use of new technologies, in particular automation

Monitoring OEE allows an excellent understanding of the causes of efficiency losses that prevent the production lines from achieving the “ideal” performance. In the majority of cases, these are “simple” problems which are often poorly treated due to lack of time, money or technical/managerial skills.

Would more information really be useful?

The problem therefore does not come from the difficulty in identifying the problems but in measuring them, prioritizing them and above all in dealing with them in the right order of priority with the right corrective measures.

B. More complex and integrated tools are not necessarily more suitable

There are obviously complex problems that can only be identified and solved by having a “global” vision. However, these problems represent only a small part of the non-performance for almost all factories today.

Human and contextual intelligence as well as managerial initiative remain the most important and least used tools. Today, technology cannot replace it despite the promises of many "Industry 4.0" players.

How to give people simple and intelligible information to help them in their decision-making? By giving them transparency on the causes of non-performance of their assets (technical but also human) and supporting them in taking improvement actions (human training).

C. Ease of use for operator services

The human is the first actor of success, how to make the task easier for them?

Technology, when poorly integrated, is often a source of additional workload rather than help. The implementation of complex systems often has little or no real use (and therefore has an overestimated ROI).

A simple system for feeding back the causes of non-performance with the minimum of functionalities allows teams to focus their time and energy on improving and taking action rather than on analysis, reporting or interpretation of data.

The interface must also be very simple and accessible to field teams, allowing them to use the technology with ease.

Each “population” must have its “building block”, simple, adapted and above all easy to use so that their daily actions change and generate more value for the company.

The real problem is not to know if the systems will be able to guide the operators in the choice of actions but to know if they will really change the actions, the priorities, if they will replace the non-value-added tasks or even if they will ensure that people's daily lives really change. You have to put the features in the context of the company to be able to calculate a “realistic” ROI.

The potential is often overestimated and ultimately "change management" is a bottleneck.

D. PERFTRAK: the IOT building block for OEE monitoring

The PerfTrak solution makes it possible to retrieve, in real-time, the operating status of an equipment and then to identify performance losses.

We then involve the operators in the qualification of the losses.

All the information collected is automatically consolidated, analyzed and returned to the supervision site to enable the teams to implement the most relevant action plans.

TEEPTRAK does not have the core business of consolidating all the data, nor of creating a transverse system to help strategic decisions or at a global level.

Our solutions are intended to be easy to use for field teams with a minimum of restitution functionalities to help them make the decisions that will allow them to really improve their performance at the scale of the equipment, the production line or the factory. We therefore represent a unique specialized building block.

X. CONCLUSION

A performanceindicatoristherepresentationofarealityontheground. A

clearlydefinedandmeaningfulperformanceindicatorguidesmanagementinitsdaily actions.OEEisapopularperformanceindicatorintheindustrytotrackmachineperformance. PopularizedbySeiichiNakajimainhisbookTPM,theOEEisusedtorevealthecausesof performancelossandthenreducethiswaste.TheAFNORNFE60-182standardofMay2002 definesthecalculationmodeoftheperformanceindicatorsofthemeansofproductionOEE, OOE, TEEP.Itspecifiesthedefinitionsofthestatetimesandtheelementsnecessaryforthe evaluationoftheperformanceindicatorsofthemeansofproduction,andallowsreliable monitoring of these means.

One oftheprimarygoalsofTPMandOEEprogramsistoreduceand/oreliminatethe"big losses" - the most common reasons for productivity losses: the human factor.

Collectingthedataisthefirststepintheanalysisof OEE.Manual,semi-automaticand automaticentrieseachhavetheiradvantagesanddisadvantages.Choosingtheentrymethod dependsonthematurityinmonitoringtheOEEandthebudget.ForthosenewtoOEE monitoring,gettingstartedwithmanual,paper-basedmonitoringisaquickandinexpensive method.However,togointothedetailsandhavemoreprecision,therearetechnologiesto automate the collection and consolidate it.

ImprovingtheOEEallowsaROIoftheproductiontools,tobringtransparencytobetter managethecontinuousimprovementprojectsandtobeobjectiveontheworkofeveryone. By improvingyourOEEthroughreducingyourwaste,youwillimprovetheprofitabilityofyour machines, thereby producing the right parts, the first time, in the scheduled time.

There aretoolsandorganizationstoimproveOEEsuchastheQCDmodel,theABCframework, and Leantools.TheOEEisnotatoolwithoutrisks.Itiseasytomanipulateitsdefinitionin order tohideperformancelosses.TheOEEisonlyanindicatorandtobeuseful,thedata collected and consolidated must be transformed into improvement projects

The reasonsforthefailureofOEEmonitoringanditsimprovementaremoreoftenhumanthan technical.MisunderstandingthedefinitionofOEEanditspurposecanleadtooverproduction. Technologybringsinformation,butdecisions,actionsandgoalsarestilltheresponsibilityof humans.

WantingtodeployOEEmonitoringthroughouttheplantovernightisasuddenworkoverload which, without managerial routine, leads to disappointing results.

Technologytodaymakesitpossibletocollectaninfiniteamountofdata.Whatinformation shouldbecollected?Forwhatpurposes?ForwhatROI?Doesthefactoryhavetheskillstouse this data?

Today,therearetechnologicalbuildingblocksthatimprovethedailylivesofoperatorsby givingthemtherightquantityandqualityofinformation.Thesimplicityofuseandthelimited functionalitiesoftheIOTsolutionsinOEEmonitoringmakethestrengthsofthesesolutions.

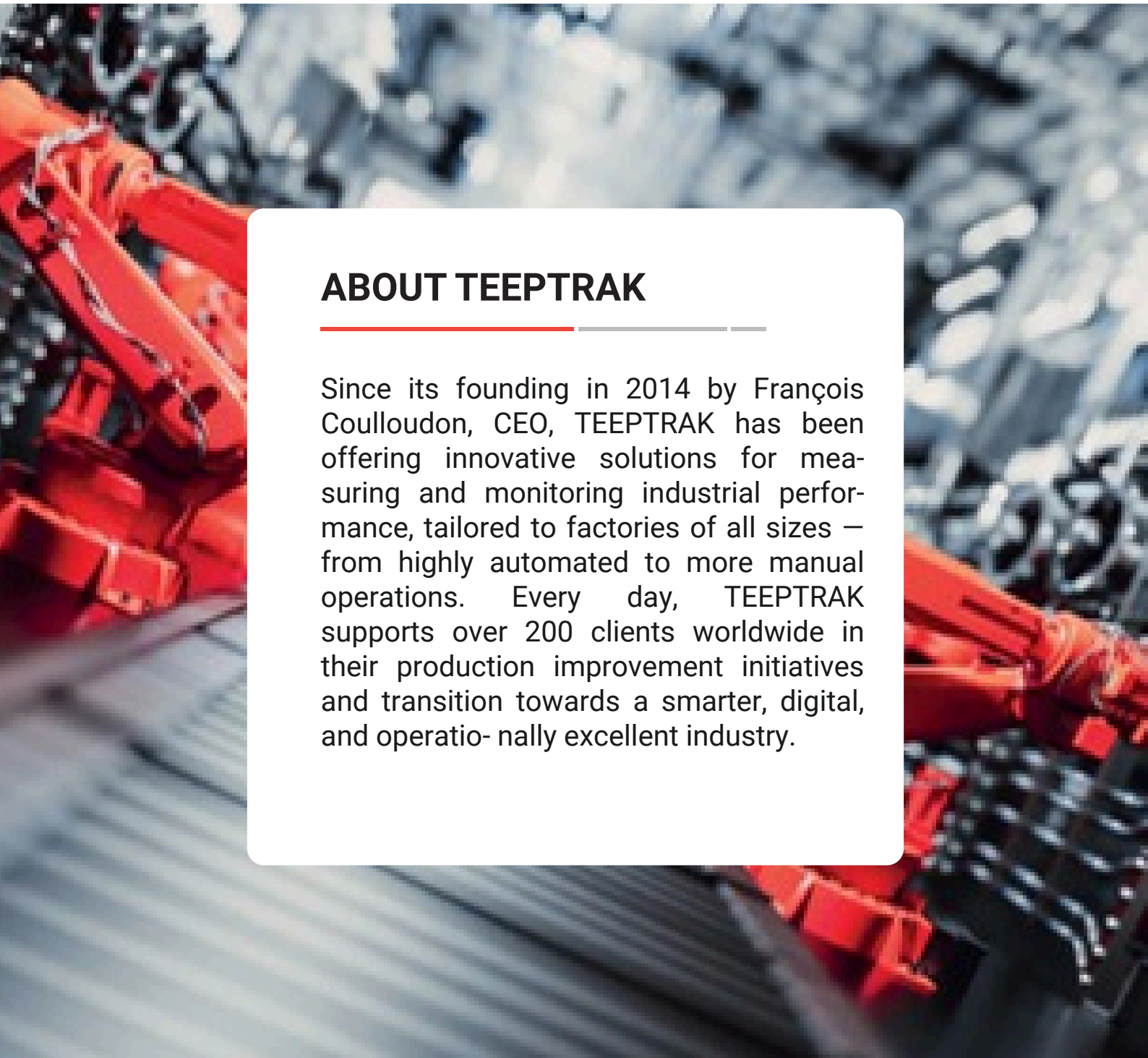
Humanintelligenceisthekeyfactorinperformance.Selectingtheappropriatetechnologyfor your situationwillprovideyouwiththedataonyourOEEanditsperformancelossesthatyou will beabletotransformintoimprovementprojects.

Want to connect?

Get in touch with us

REQUEST A DEMO

106 rue du chemin vert
75011 Paris, France
info@teeptrak.com
+33 6 40 63 26 73



ABOUT TEEPTRAK

Since its founding in 2014 by François Coulloudon, CEO, TEEPTRAK has been offering innovative solutions for measuring and monitoring industrial performance, tailored to factories of all sizes — from highly automated to more manual operations. Every day, TEEPTRAK supports over 200 clients worldwide in their production improvement initiatives and transition towards a smarter, digital, and operatio- nally excellent industry.