Operational and Manufacturing Excellence
Webinar Series

Process Optimization and Overall Equipment Effectiveness

American Coatings Association Webinar | June 22, 2023

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Operational and Manufacturing Excellence

American Coatings Association Webinar Series

Thursday, June 22
Process Optimization & Overall Equipment Effectiveness

Tuesday, July 18
Optimizing Plant Operations including Design Considerations for Growth

Tuesday, September 19
Optimizing Supply Chain to Increase the Bottom Line

Tuesday, October 17
Safety First! – Best Practices in Environmental, Health and Safety

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Our Mission is Enabling Our Clients to:

- Build enterprises that challenge established thinking and drive transformation.
- Gain competitive advantage through distinctive, targeted, and substantial improvements that sustain profitable growth.
- Unlock new and hidden insights empowering an organization's smart risk-taking, catalyzing innovation excellence and value creation.
- Be successful — because our success emanates from yours.

ChemQuest by the Numbers

1976	Year the firm was established
~130	Total consultants and technical staff
25	Minimum years of experience in specialty chemicals for senior personnel
100%	Percent of our work that is proprietary, offering a full portfolio of services under NDA

Four Pillars of Expertise

Deliver distinctive, thorough, actionable, confidential, and professional work and support our clients in every aspect of sustained, profitable growth, including:

- Business Strategy & Transformation
- Technology Development
- Operational & Manufacturing Efficiencies
- M&A Advisory Services

Process optimization and OEE are about development and executing on the "right" targets for success.

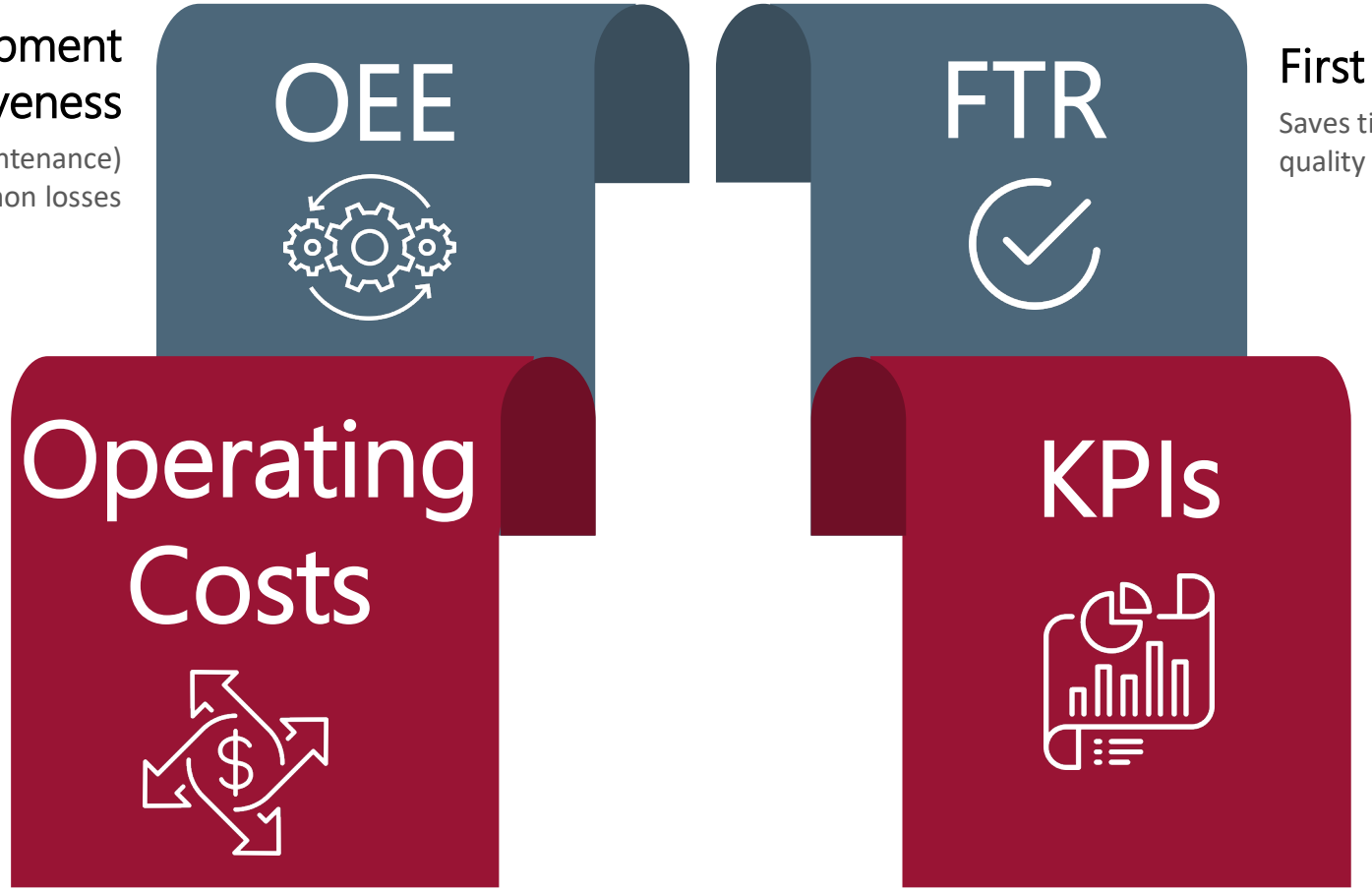
Depending on the business model and value creation drivers, **operational focus should be prioritized based on results**, typically consisting of:

Overall Equipment Effectiveness

TPM (Total Productive Maintenance)
- The most common losses

Variable/Fixed

COGS (Cost of Goods Sold)
TSG&A (Technical, Selling, General, and Administration)



First Time Right

Saves time and improves overall quality of products/services

Key Performance Indicators

Metrics to track progress, identifying and driving continuous improvement

Minor improvements in operations OEE can make a major difference to overall Total Productive Maintenance (TPM)

Overall equipment effectiveness (OEE) is a KPI that **compares your operation's ideal performance to its overall real performance**.

OEE is a quantifiable way to measure how well your equipment, people, and processes are working by measuring:

- Available time divided by uptime (availability)
- Production/output speed and consistency (performance)
- Number of defects (quality)

OEE uses this data to determine a percentage of good production time for each asset. These OEE scores enable sub-level information to be used to address opportunities.

Reduce and/or eliminate the most common TPM losses.

Equipment-based productivity loss in manufacturing is caused by several common factors relating to **availability, performance, and quality**.

Using the most common losses concept creates a clear path to improving your OEE score:

- Working to reduce **availability loss** of equipment failures or setups and adjustments protects against preventable unplanned downtime while minimizing unplanned stops.
- Addressing **performance loss** that results from idling and minor stops, as well as reductions in speed, prevents small stops and slow cycles from accumulating.
- Minimizing **quality loss** in the form of process defects and lower yield reduces the number of unusable products produced during steady production.

Overall Equipment Effectiveness	Traditional Common Losses	Recommended Common Losses
Availability Loss	Equipment failure	Unplanned stops
	Setup and adjustments	Planned stops
Performance Loss	Idling and minor stops	Small stops
	Reduced speed	Slow cycles
Quality Loss	Process defects	Production rejects
	Reduced yield	Startup rejects

Consistently working within this framework, acting one loss at a time, will lead to steady OEE improvement.

Availability Loss due to: Equipment Failure

Equipment failure accounts for any significant period in which equipment is scheduled for production but is not running due to failure. A simple way to relate to equipment failure is **any unplanned stoppage or downtime**.

Common examples of equipment failure:

- Machine breakdowns
- Improper setup
- Unplanned maintenance

From the broader perspective of unplanned stops, additional reasons include:

- Lack of operators or materials
- Choked by upstream equipment
- Blocked by downstream equipment

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Proven control plans should be put in place to reduce or eliminate equipment failure.

Availability Loss due to: Setup and Adjustments

Setup and adjustments account for any significant period in which equipment is scheduled for production but is not running due to **changeover or other adjustments to equipment**.

Common reasons for setups and adjustments:

- Product-to-product equipment modification
- Changeovers
- Maintenance

Overall Equipment Effectiveness	Traditional Common Losses	Recommended Common Losses
Availability Loss	Equipment failure	Unplanned stops
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Performance Loss	Idling and minor stops	Small stops
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Quality Loss	Process defects	Production rejects
	Reduced yield	Startup rejects

Be sure to take into consideration the overall impact on the production scheduling/planning aspect, especially with changeovers.

Performance Loss due to: Idling and Minor Stops

Idling and minor stops account for time when the equipment stops for a short period (a few minutes or less) while the operator resolves an issue. A simpler way to view it is **any small stop leading to performance loss**.

Examples of idling and minor stops:

- Raw material disruptions
- Plugged transfer lines
- Incorrect operator parameters or work instructions
- Improper calibrations
- Need to locate ancillary equipment
- Design issues

Overall Equipment Effectiveness	Traditional Common Losses	Recommended Common Losses
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This category usually includes stops that are well under 5 minutes and don't require maintenance personnel. Root causes are often chronic, which can make operators somewhat blind to the full impact.

Performance Loss due to: Reduced Speed

Reduced speed (sometimes called slow cycles) accounts for time where **equipment runs slower than the ideal cycle time**.

Examples of reduced speed:

- Poor maintenance
- Substandard raw materials
- Limited ancillary equipment
- Poor environmental conditions
- Operator inexperience or lack of training

Overall Equipment Effectiveness	Traditional Common Losses	Recommended Common Losses
Availability Loss	Equipment failure	Unplanned stops
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Quality Loss	Process defects	Production rejects
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Reduced speed includes anything that keeps the process from running at its theoretical maximum speed (sometimes referred to as ideal run rate or nameplate capacity).

Quality Loss due to: Process Defects

Process defects account for **defective material produced as off-spec batches or from startup until steady-state production is reached (continuous process)**.

Examples of process defects:

- Lot-to-lot raw material variation
- Incorrect equipment settings
- Operator or equipment handling errors

Overall Equipment Effectiveness	Traditional Common Losses	Recommended Common Losses
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Process defects includes scrap material as well as material that must be reworked, since OEE measures quality from a first-pass yield perspective.

Quality Loss due to: Reduced Yield

Reduced yield accounts for **material lost due to poor processing that results in suboptimal finished product output**.

Examples of reduced yield:

- Suboptimal changeovers
- Incorrect settings on a new product run
- Equipment that requires warmup cycles
- Poor operator training

Overall Equipment Effectiveness	Traditional Common Losses	Recommended Common Losses
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Depending on the costs associated, yield losses can have a significant impact on a company's profitability.

Biggest OEE mistakes

Focusing on the OEE score vs. the underlying losses

The true value of OEE comes from understanding the underlying losses and acting accordingly.

Using “budget” or “standard” speeds for ideal cycle time

Many companies confuse the two and end up creating slower targets. While useful for planning purposes, they don’t help optimize potential.

Overemphasizing OEE on the shop floor

Too much pressure will result in potential poor behavior. Best to provide extensive training on the positive behaviors that impact the underlying common losses to OEE.

Collecting too much data

Keep OEE data collection simple. Too many reason codes create confusion for the operators, which can prevent them from doing their jobs effectively.

Instead: “Collect less and do it well.”

Comparing different processes across locations

Unless processes are the same across sites, you can potentially put operators in a position to fudge data or at a minimum demotivate them due to unjust comparisons. For example:

- Complexity of parts/products produced
- Number of production changeovers is inherently different

Excluding changeovers

Changeover time is lost production time making product, so it is important that reducing changeover time is given the utmost attention.

Think of an auto race such as NASCAR or Formula1, where the tires are changed by the pit crew. Time is of the essence!

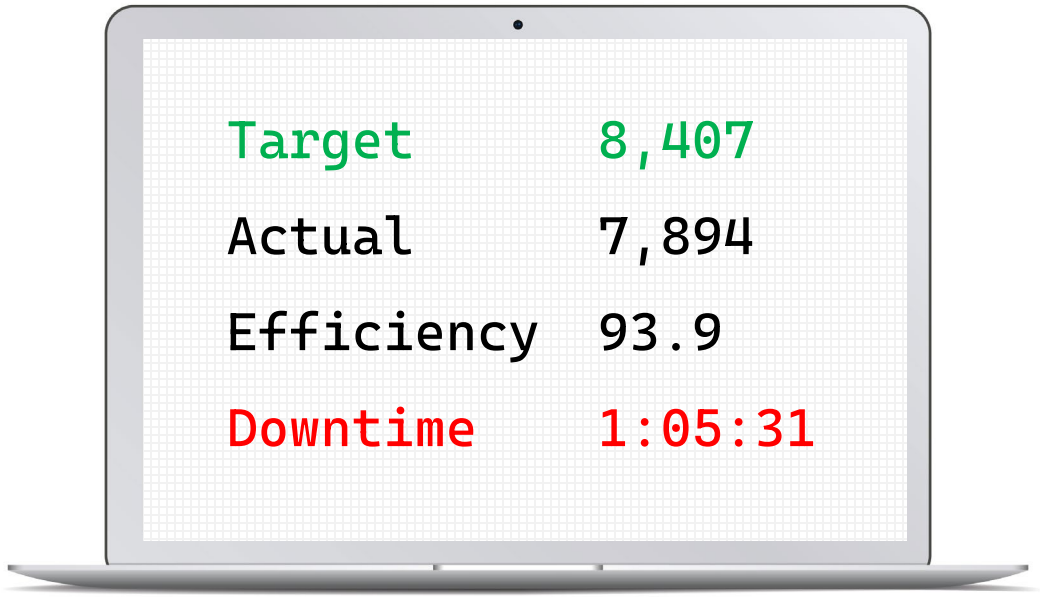
Good plant floor metrics — TAED

Target
Real-time production target driven by planned production rate

Actual
Actual production rate

Efficiency
Ratio of target to actual; how far ahead/behind production is running by percentage

Downtime
Accumulated unplanned stop time updated in real-time; this will encourage focus on a key actionable improvement area

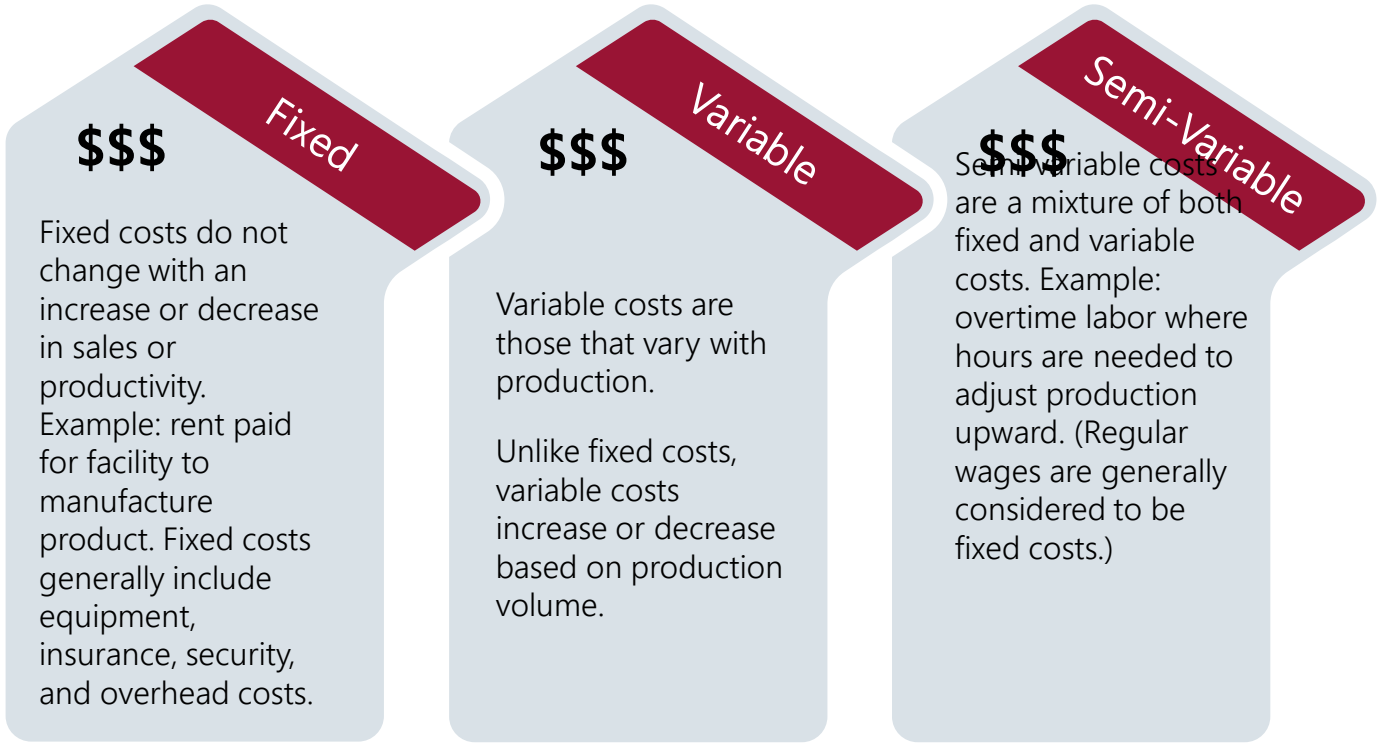


Simple dashboard for supervisors and shop floor showing clear and achievable metrics that everyone on the team understands.

Operational costs need to be managed effectively for optimum success.

Operational costs are **ongoing expenses incurred from the normal day-to-day running of a business**. They can be categorized as fixed, variable, or semi-variable.

- Cost of Goods Sold (COGS)
- Technical, Selling, General, and Administrative (TSG&A)
- Other operating costs may include:
  - Rent
  - Equipment
  - Inventory
  - Marketing
  - Payroll
  - Insurance
  - R&D



Depending on the company, operational cost categories will be governed by specific accounting policies and relationship to the income statement.

Do not ignore processes in the TSG&A departments.

Many organizations focus all or most of their continuous improvement on manufacturing, leaving the non-manufacturing areas such as TSG&A as ripe opportunities.

Process improvement areas where opportunities might present themselves:

- Standardized processes
- Automate where possible
- Up-to-date information
- Continuous improvement
- Waste elimination
- Free-up resources for more value-added activities
- Review all of the above annually

Often, the only way for improvements to occur is through change management.
The best way to start is to establish a baseline for your processes. It is important to include the staff in this exercise, if possible.

Tools to best manage TSG&A costs

Process Mapping

Useful visualization tool that is typically an easy way to get contributions from staff.

- Start to uncover where the inefficiencies lie
- Communication with your team is important, so they can see the benefits of their activities and how they can affect productivity

Delegation

Important practice to make sure the right people are performing the right tasks.

- Empower the team
- Lower end work (low risk) and higher end work (high risk) are being performed appropriately
- Results in higher staff trust levels and development

New Technology

Important to always look for new technologies to improve your processes.

- Best to do a simple ROI analysis

Outsourcing Tasks

Where possible, outsource work that your company can't handle as effectively as someone else could.

- Might be due to staffing shortfalls or expertise gaps
- Can also be more effective than hiring personnel that require specific training, etc.

A “First Time Right” mindset is well worth the effort.

First Time Right (FTR) is both a manufacturing principle and a KPI that **denotes the percentage of product that is produced within specification**.

With origins in Six Sigma, FTR is not about achieving perfection. Instead, the aims are:

- Developing controls
- Using the right assets
- Mindset in place toward perfection using science over art
- Consistency

Remember, Six Sigma allows for 3.4 defects per million transactions.

The goal of FTR is to produce all units correctly the first time, thereby:

- Eliminating the need for any rework
- Reducing waste and operational costs
- Optimizing efficiency

The costs associated with additional inspection, first pass yield losses, and added labor and energy all add up to a non-optimal environment.

Calculating an FTR score

Depending on the operational complexity, **a total FTR score in the high 90s percent is viewed as excellent** while a score in the high 80s percent shows significant room for improvement.

$$FTR = \frac{\text{\# of Units in Specification}}{\text{Total Units}} \times 100$$

FTR in manufacturing can be improved via:

- Standardized operating procedures (SOPs)
- Monitoring
- Consistent materials
- Maintenance
- Operator training to include feedback

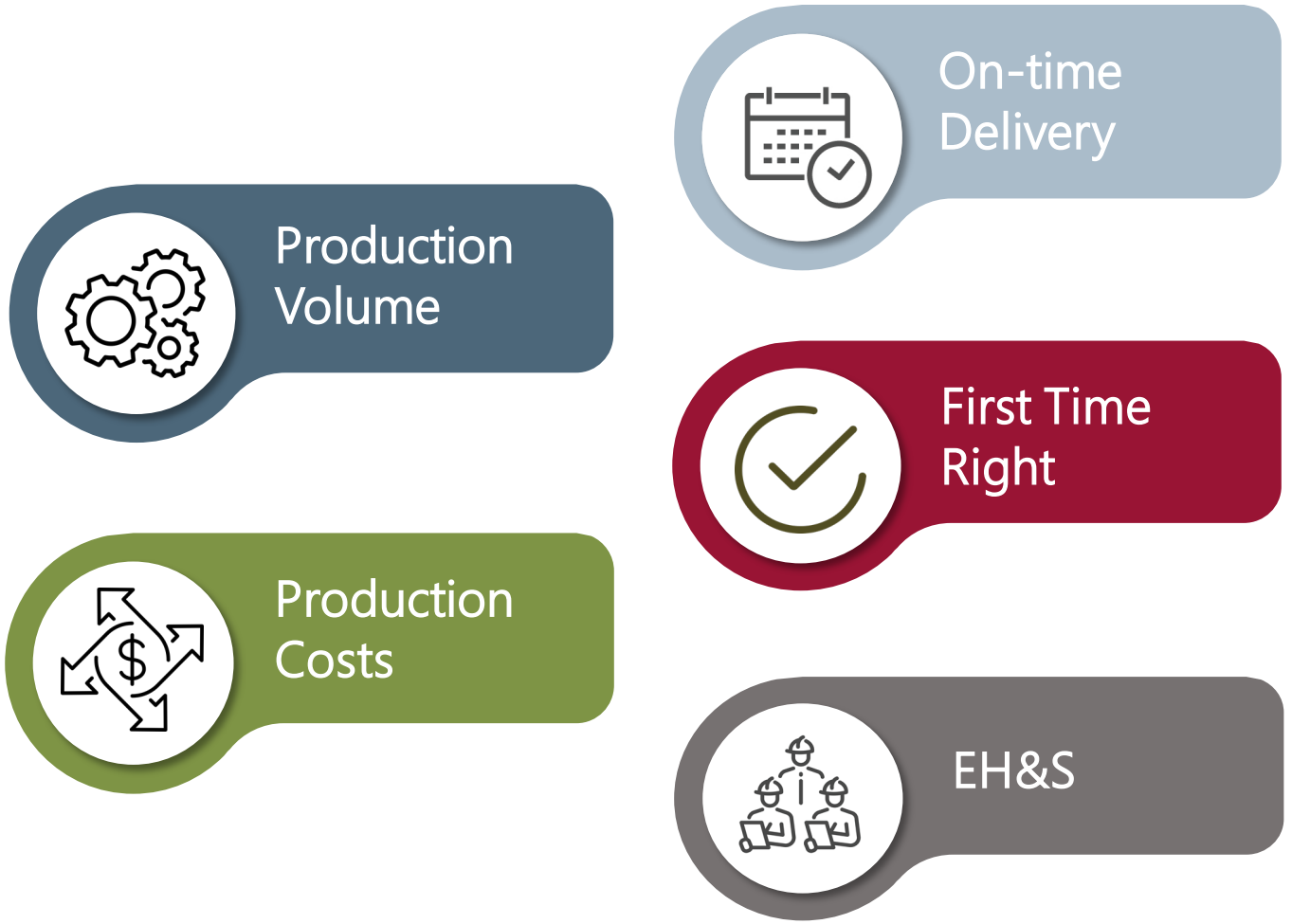
Ideally, it is best to establish FTR before bad habits ever get started.

KPIs are metrics used to measure performance.

While it is common for companies to develop key performance indicators (KPIs), **related success is not guaranteed**.

Problems can arise when:

- Trying to establish too many KPIs
- Not establishing the "best" or most productive KPIs
- Not prioritizing KPIs effectively (e.g., treating them all the same)
- Using ineffective or even inaccurate dashboards, leading to lower productivity



KPI best practices

It is imperative that you create and maintain KPIs that are **relevant to your business**.

KPI scorecards are critical to performance improvement.

It is important to develop KPI scorecards that **have buy-in and involvement from team members, as well as senior leadership**. For best results:

Goals need to be realistic and attainable.

Team members need to be respected, involved in the scorecard development process, and supported with resources.

Team members need to be held accountable for what they control.

Leadership needs to be involved and interactive in the process by asking questions, as well as engaged in the scorecard review process.

Team members need to be informed/educated regarding how improvements (or the lack thereof) have an impact on the business.

Results should be validated by a third party (e.g., accounting/ controlling department) to assure accuracy. Where applicable, this could include tracking improvements to the P/L or B/S.

Process optimization and OEE are key to manufacturing success!

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Thank you!
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