THE REYNOLDS COMPANY
ELECTRICAL SUPPLY

TRC User Group

Scalable OEE

March 17, 2021

Our Guest Panelists

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Business Lead, Architecture
and Software
Rockwell Automation

2021 Online Events - Register to receive a calendar invite

THE REYNOLDS COMPANY
ELECTRICAL SUPPLY

Tech Talks

- HART and Highly Integrated HART
  - March 24th @ 10am
- Rockwell Software Activation Update
  - April 7th @ 10am
- WIN911 Alarm Notifications for Industry and IIoT
  - Apr 21st @ 10am

User Groups

- Machine Learning and AI for Industrial Application

  April 14th @ 10am

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What are your priorities right now?

Are you trying to:

- Reduce downtime
- Reduce cycle time variation
- Increase production without buying new equipment
- Reduce unit costs
- Reduce overtime
- Improve quality

IT'S REALLY ABOUT REDUCING COSTS

You may be considering:

OEE Analysis | Downtime Tracking | Machine Monitoring | LEAN | Process Improvement

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What is OEE?

Put simply, ***OEE assigns numerical value to improvement opportunity***

It factors in the availability, performance and quality of output of a given piece of equipment and tells you this:

- How much right-first-time product did this machine produce compared to what it should have produced in the allocated time?

In other words, is a piece of equipment effective within its value stream?

- Does it let you meet present or future customer demand?
- If not (and this is critical), OEE helps you analyze the reasons why so you can address them systematically

How OEE Works

The OEE calculation rolls the “6 big losses” into one number that represents the effective operating rate for a piece of equipment or synchronized line.

That translates to the percentage of product produced compared to what could have been produced in the scheduled time under ideal circumstances:

- No Downtime
- No Speed Loss
- No Quality Loss

Three Categories, 6 Big Losses

Availability (downtime)	Performance (speed/throughput)	Quality (defects)
1. Equipment failure (breakdowns)	3. Idling	5. Process defects (scrap, repairs)
2. Setup and adjustment	4. Reduced speed of operation	6. Reduced yield (from startup to stable production)

Why does an OEE system make sense?

Three general ways to reduce cost of an automated process:

1. Reduce unproductive machine time
2. Reduce cycle times
3. Reduce waste/scrap

OEE measures the three things that reduce costs

1. Productive time = “Availability”
2. Cycle times = “Performance”
3. Waste/scrap = “Quality”

OEE % = Availability % x Performance % x Quality %

Higher OEE = Lower costs

Availability

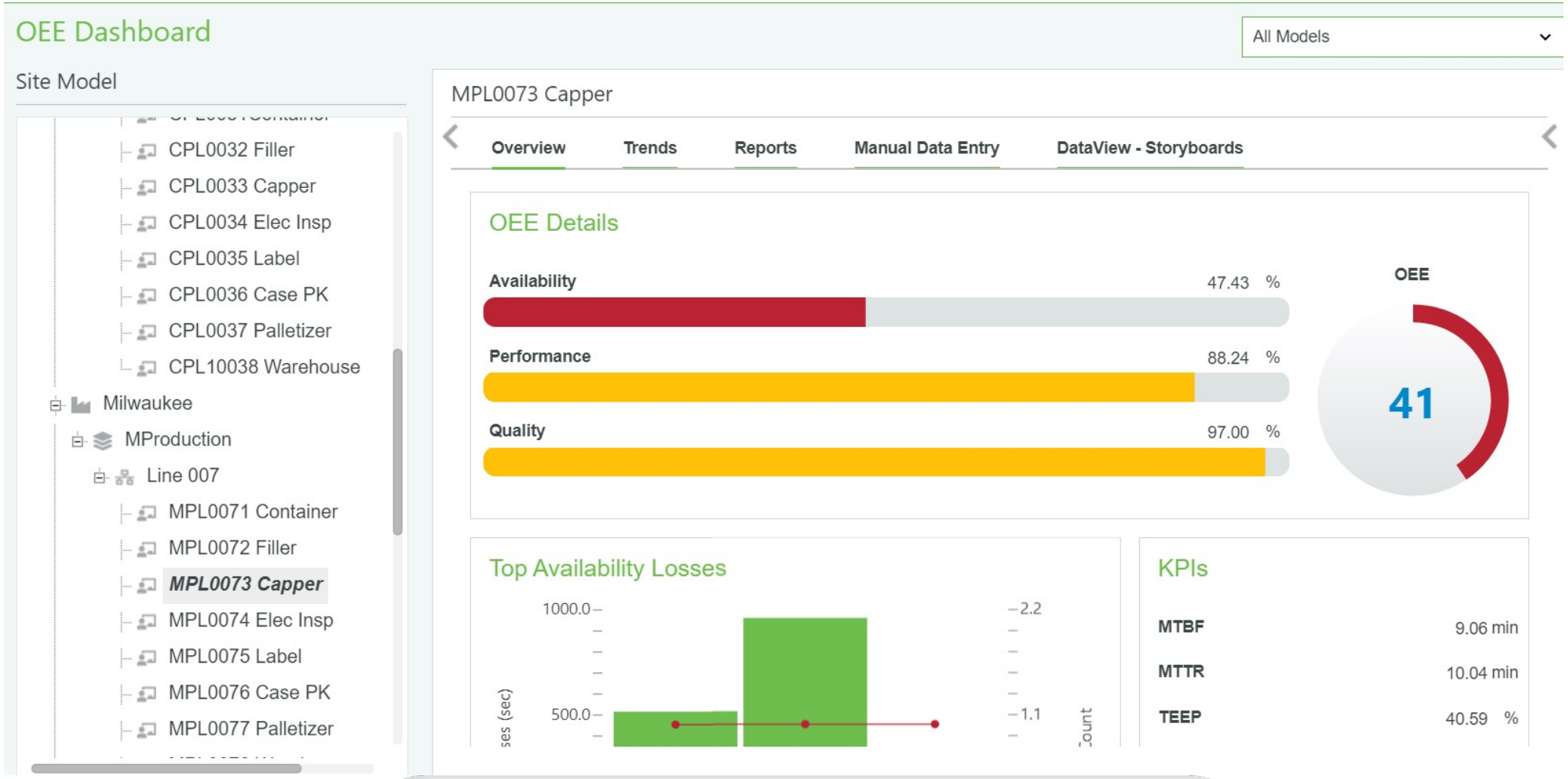
Ratio of actual Running Time to expected Running Time

Running Time ÷ Available Time

- Available Time is the time that a machine is expected to be producing.
- Available Time usually does not include time set aside for planned maintenance or breaks.
- Available Time may be further reduced if a machine is not needed to meet production demand.
- Running Time is actual production time, not including downtime (setup, adjustment, breakdowns, etc.)

Example: Availability Loss – Workcell View

- OEE value impacted by availability losses



Availability Loss – “I know what’s wrong, now what?”

- Availability Loss provides the score of how much an asset operated within its designated production time. Now what?

- ***What events occurred that caused lost production time?***
  - Were there major events that caused a lot of downtime but didn’t happen often? OR
  - Were there events that happened frequently but not of great duration?
- ***Can the events be correlated to other data?***
  - Example: as line speed increased, did events become more frequent?
- ***Are there other pieces of information to be collected that would drive further clarity into what is happening?***
  - Line Speed or other process variables
  - Other fault conditions

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Performance

Ratio of output produced compared to a standard

Actual output ÷ Standard output

The rule of thumb for standard output is to use the **best output rate known** to be produced on the machine, regardless of whether that is above or below design speed

- If a machine outperforms its best output rate, performance rates will exceed 100%, which should not happen
- On the other hand, if the machine has never been able to achieve its design spec, it's usually not helpful to use that as the standard

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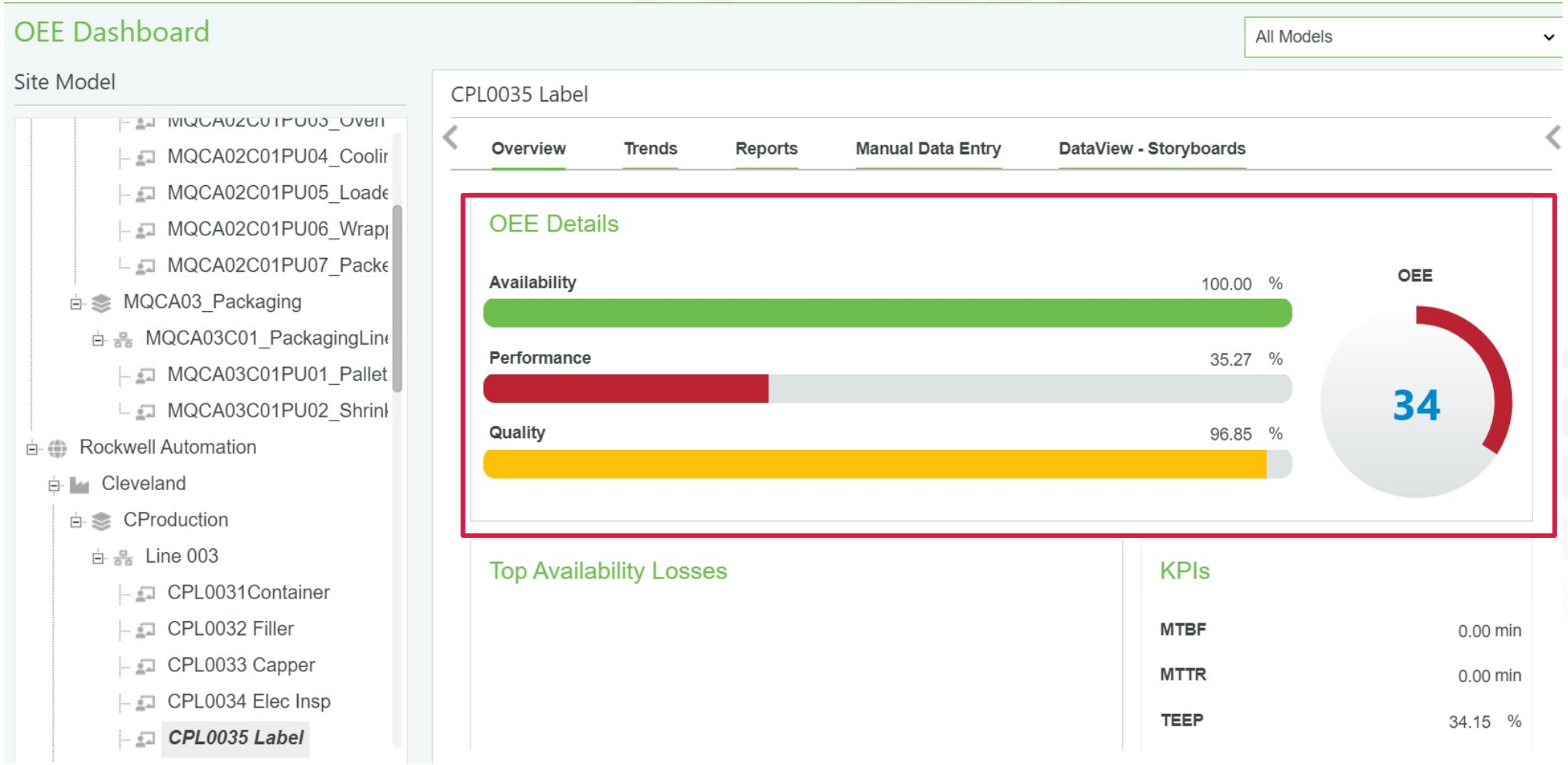
Any losses due to producing at less than ideal rates show up in the performance rate

Example: Performance Loss

- OEE value impacted by poor performance rating

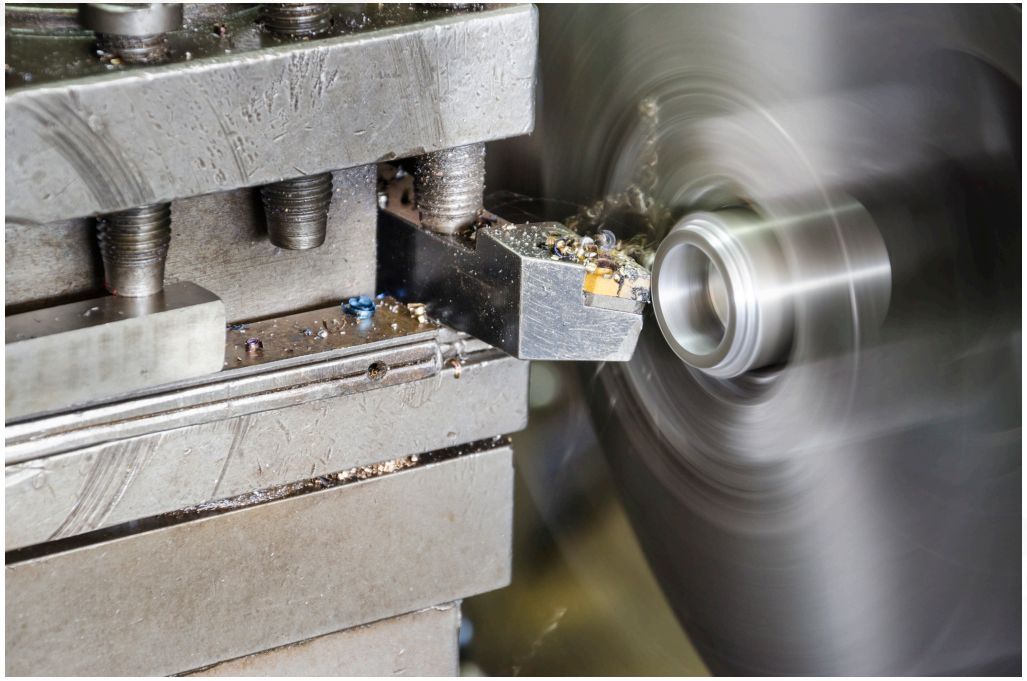


Performance Loss – “I see what’s wrong, now what?”

- Performance Loss provides the score of how an asset performed versus its ideal rate. Now what?

- ***Can the collected performance information be correlated to other data?***
  - Do variations in raw materials cause performance changes?
  - Does one shift perform better than another when making same products?

- ***Are there other pieces of information that would drive further clarity into what is happening?***
  - Line Speed or other process variables
  - Does quality vary by changes in other conditions on the line?



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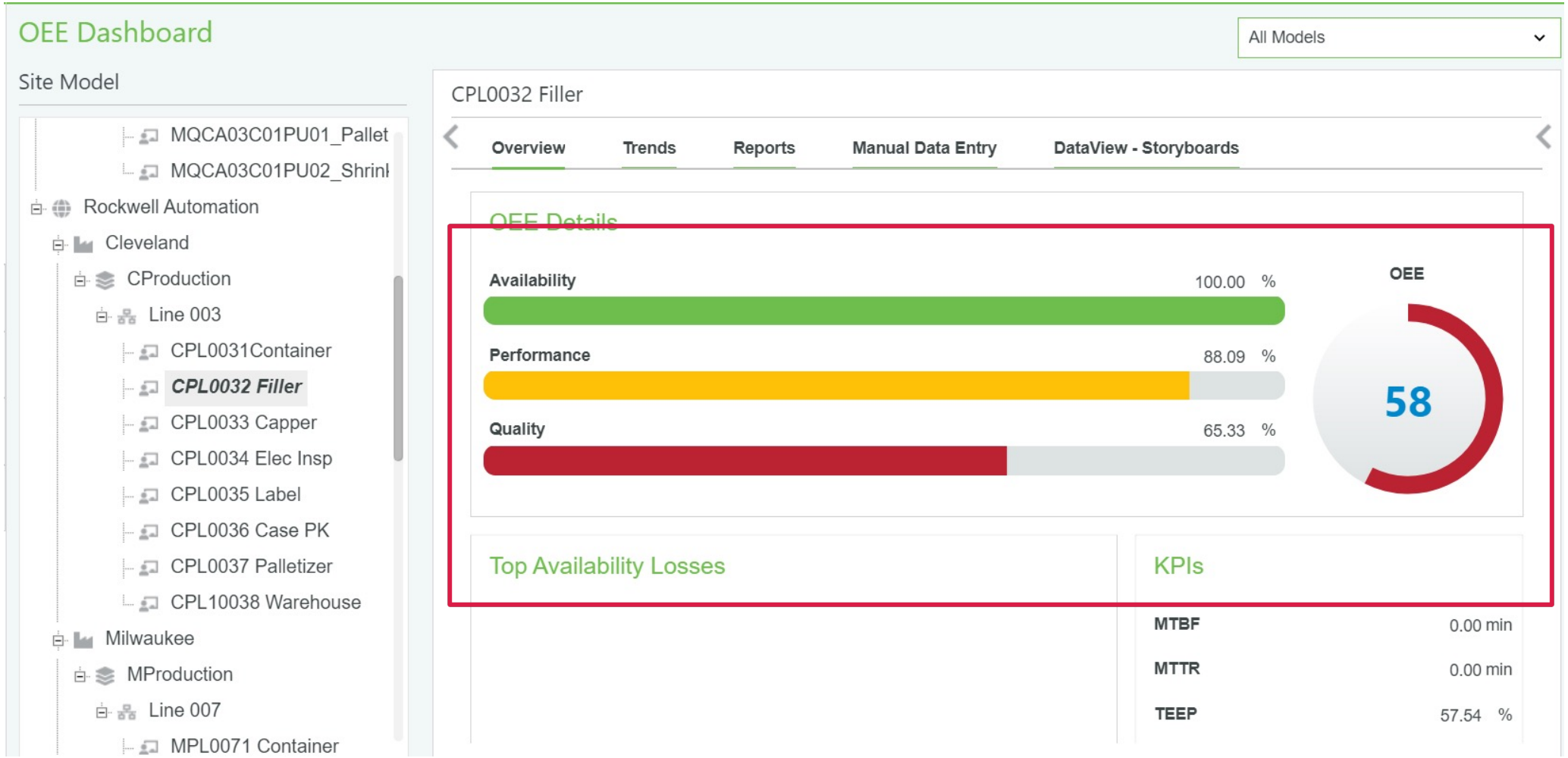
Quality

Right-first-time output ÷ Total output

- Ratio of good output compared to total output
- Any defective output, including output that needs rework or repair or is scrapped, is not counted as good output.

Example: Quality Loss

- OEE value impacted by loss of quality.



Quality Loss – “I know what’s wrong, now what?”

- Quality Loss provides the score of how much good, first-time-through, production an asset produced. Now what?
- ***Can additional data help determine reasons for poor quality?***
  - Can scrap reasons be determined or collected?
- ***Can the collected data be correlated to other data?***
  - Is there data from quality lab tests that can be correlated to the production counts?
  - Can the quality loss be related to costs to show financial impact of poor quality?
- ***Are there other pieces of information to be collected that would drive further clarity into what is happening?***
  - Line Speed or other process variables
  - Environmental variables

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Overall Equipment Effectiveness (OEE)

Key Performance Indicator (KPI)

Available Time = Shift time – Unavailable Time

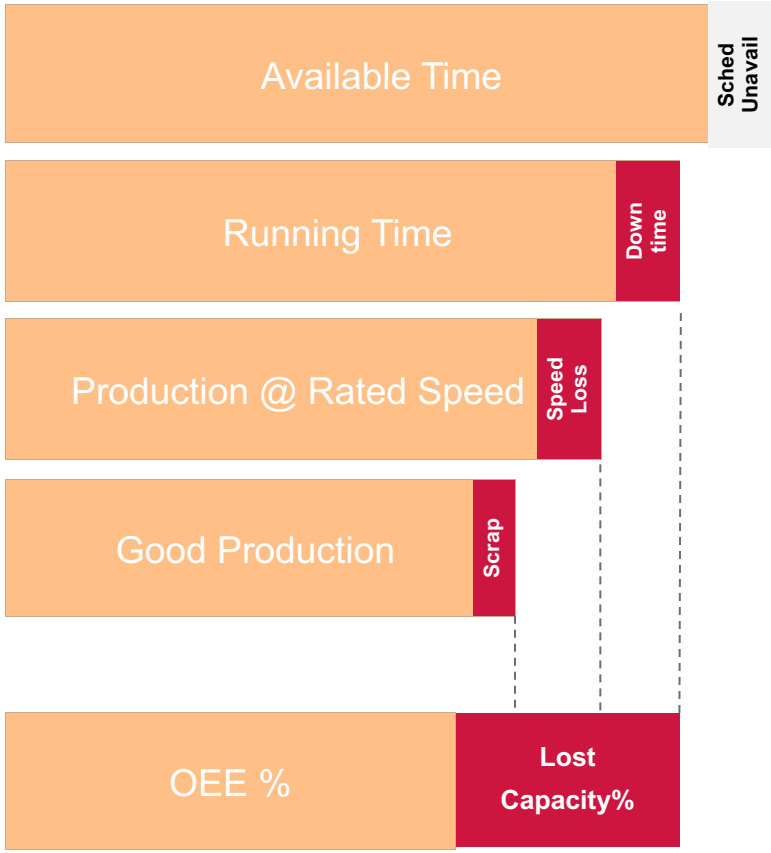
Availability% = $\frac{\text{Running Time}}{\text{Available Time}}$

Performance% = $\frac{\text{Total * Ideal Cycle}}{\text{Running Time}}$

Quality% = $\frac{\text{Total – Scrap}}{\text{Total}}$

Overall Equipment Effectiveness (OEE) = Availability x Performance x Quality

Time (One Shift)



Loss Causes

Scheduled Unavailable Time
Breaks, meetings, maintenance, etc.

Downtime
Breakdowns, setups, changeovers

Speed/Cycle Time Loss
Reduced speed, cycle time variation

Quality Loss
Rejects, scrap

Why is OEE so prevalent?

It is a simple performance indicator that everyone can relate to

- It is the ratio of good parts produced vs. what could have been produced under ideal conditions: no downtime, no cycle time erosion, and no scrap
  - › OEE = Actual / Ideal

It can be applied to any machine, in any industry, anywhere in the world

- Because it shows a machine's actual performance compared to its theoretical maximum, OEE can be used to accurately compare the performance of any machine, line, area, operator, etc. to any other.

Why is OEE so prevalent?

If you are running *normally*, meeting schedules, you may think there's nothing to improve

Metrics like "build-to-schedule" don't tell you whether machines are being used effectively

- Because the target is based on schedule, or present demand, not on theoretical capacity
- You might be running at a greatly reduced speed but still reaching your target.

When a focus team applies OEE to each step in a line or at each machine they can usually readily identify opportunities for reducing 6 big losses

Why is OEE so prevalent?

OEE helps match the theoretical capacity of equipment with production demands

- If you are not meeting demand and you find that equipment is underperforming (operating at a low OEE), you know you have an ***equipment effectiveness problem*** that can be improved
- If equipment is operating at a high OEE but not meeting customer demand, you know you have a ***capacity problem***
- And even if you are meeting current demand, without OEE you don't know whether you have **spare capacity** to keep up with changes in demand
- OEE is commonly used to provide the **objective evidence** that is required to justify capacity expansion investments

OEE can’t tell you ALL you need to know

A simple line performance metric like OEE doesn’t tell you where or why you are experiencing losses

- You may be operating at 80% or 90% of perfect, but you have to look beyond OEE to analyze your losses
- OEE can be used more as a concept than as a line performance metric
- Use it to teach people what loss is and how to look for it on their line

Knowing OEE%, Availability%. Performance%, Quality % is not enough

- Not just “Availability” – you need detailed, machine-specific tracking of important events, including downtime and unproductive time – and the reasons for it
- Not just “Performance” – you need accurate cycle times – by product, by shift, by operator…
- Not just “Quality” – you need scrap reasons and counts
- You probably also need information that has nothing to do with OEE

OEE is a leading indicator that can point you in the direction where improvement is needed; then it becomes a lagging indicator to tell you whether or not you did the right thing.

Information gathered manually

Typically, information is gathered manually or from various plant systems. Reports are generated in Excel spreadsheets and distributed in paper form.

Some issues with manual collection:

- Gathering data is tedious, time consuming and expensive
- Inaccurate, incomplete data
- Data is “stale” at time of reporting
- Data and reports are not available for analysis
- Data is not detailed enough to be actionable
- No time - you still have to attain today’s production goals!

Is this working for you?

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How do you improve efficiency?

Collect and store performance data

- Not on a clipboard
- Not in an Excel spreadsheet
- From the control system
- Using existing PLC/HMI (which likely already has the data you need!)

What kind of data?

- Production counts
- Scrap rates
- Machine cycle times
- Downtime times and causes
- Unproductive time (in all its forms)
- Machine states
- Quality problems

Automated performance data collection

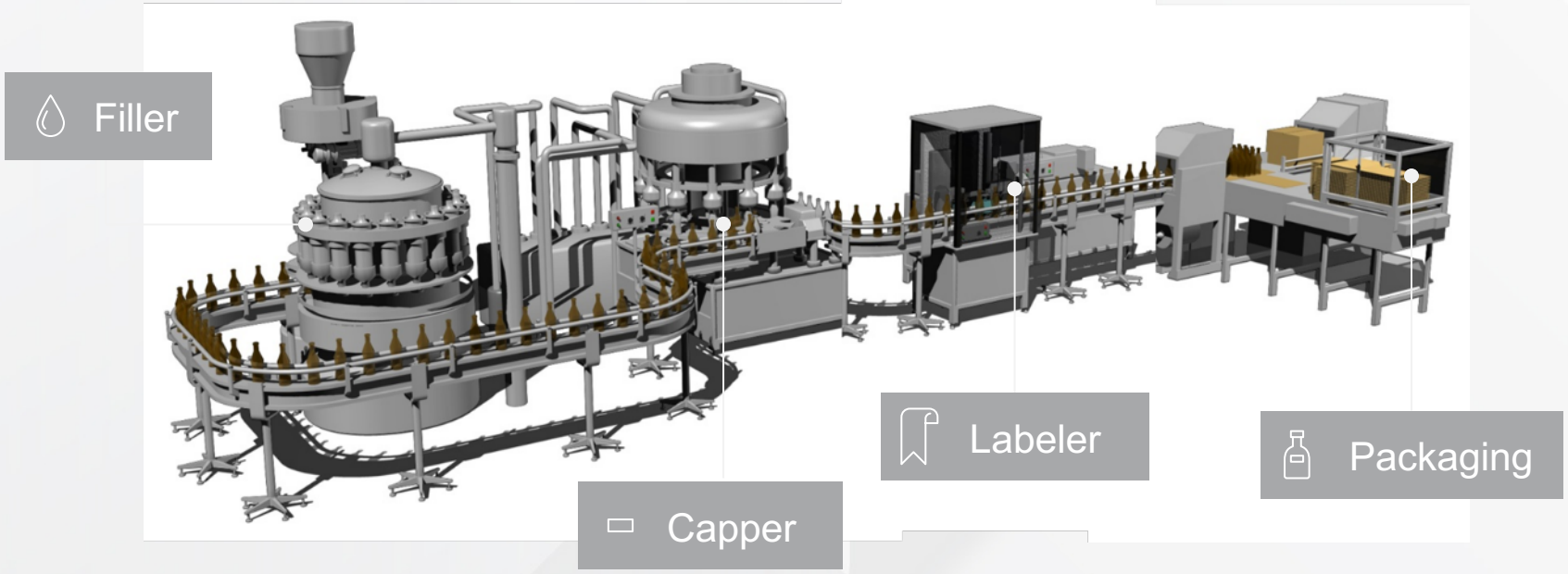
All data comes from control system tags

Timely, reliable

Accurate, precise

Analyze the individual operations of a line or the entire line

OEE, Downtime, Events can be measured individually or as a whole



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What do you do with the data?

Analyze the data:

- How are we doing?
- What's happening right now?
- What are the real problems?
- What should we focus on first to make things better?
- What else do we need to measure?

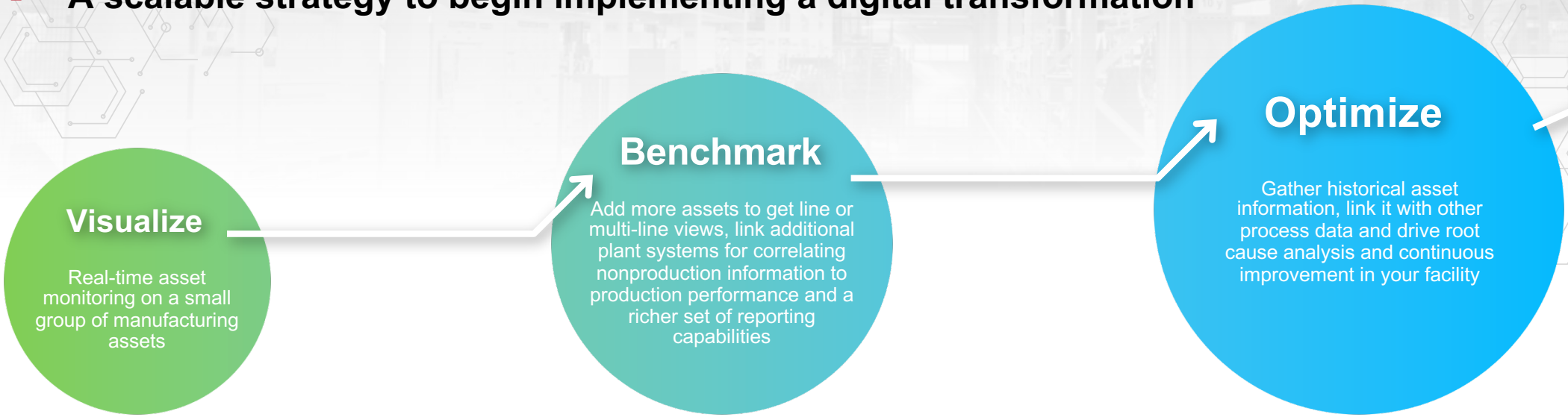
Act on the data to make process improvements

Measure the impact

Repeat

Where to start: scalable OEE solutions

- **A scalable strategy to begin implementing a digital transformation**



See assets in real time

Begin to have enough meaningful information collected within the first 30 days to begin planning the next phase of their journey

Overall asset performance

Measure downtime, capacity, and rejects

See the top faults

Move from a reactive to downtime issues and fix reoccurring failures

Stabilize the assets

Gather meaningful production data that can be used to build ROI analysis on investments

Measure performance

Produce insights and corrective actions to drive and document real performance improvement

Spot real-time bottlenecks in a line or production area

Richer insights correlate production performance to goal

Connections to non-production data sources like MRP, HR, Quality, etc.

Define, measure, and implement continuous improvement objectives

Sharpen your insights

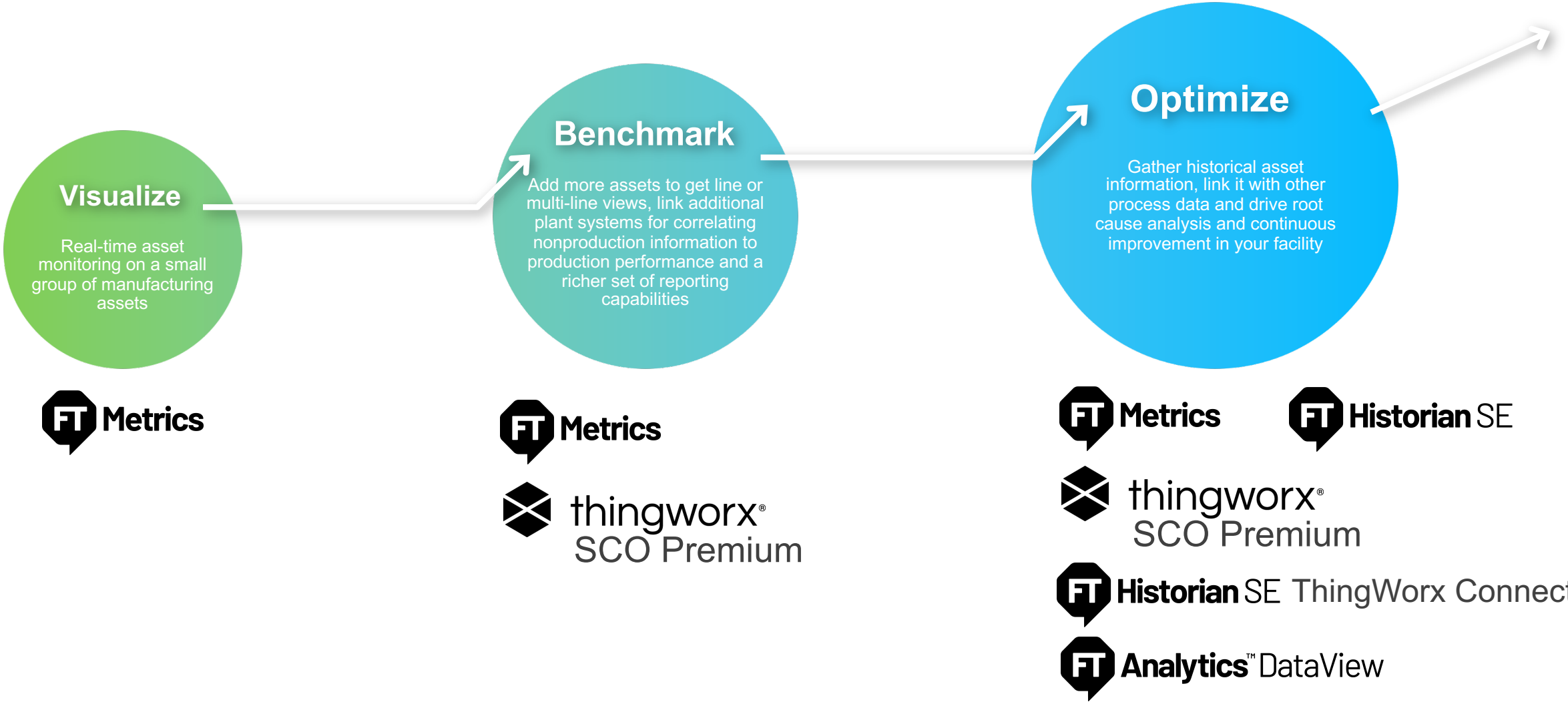
Enable a baseline environment for applying advanced analytics to achieve real-time continuous improvement

Elastic storyboards that support ad-hoc analysis of data for insights

Flexibility to add, remove, or change data sources to produce insights

Find commonality throughout data to auto generate insights

Scalable Tech Stacks



Where do I start?

"I'm not collecting any information, want to start tracking OEE."

- Identify a machine or line for a proof-of-concept to build an early, provable win.
- Implement **Visualize** proof-of-concept to start collecting and providing OEE on your equipment.

"I've got some data like a maintenance or lab system that I want to correlate with OEE."

- Implement **Benchmark** to collect OEE and related data
- Using the **Benchmark** solution, connect and correlate information to display to decision makers in your operations.

"I've got Historian and other data sources in the plant, but also want to start the move to predictive KPIs around OEE."

- Implement **Optimize** to collect OEE to provide the history to perform predictive KPIs.
- Using the **Optimize**, connect Historian and other data sources to integrate information. Provide actionable data to your plant operations.

What is the payoff?

Decreased manufacturing costs

- Less overtime, reduced labor costs, lower per-unit costs

Decreased overhead costs

Save time in collecting data and preparing reports

Deferred capital expenditures

Make your current equipment produce more

Increased capacity

More product, revenue and profit in the same amount of time

Just a1% increase in efficiency in a $50M/year plant running at 50% OEE is $1 million per year in increased production!

Conclusions

Automated Performance Monitoring enhance business results and reduce costs

OEE by itself is not enough
Detailed event data is required to understand root causes

You already have the necessary data in control/HMI systems

You would benefit from a system that:

- Uses your existing control system to get accurate and timely data
- Can give you OEE and the details necessary to improve it
- Can track other events of interest that may have nothing to do with downtime
- Presents data in a flexible way to those who need it

The sooner you start the sooner you can increase profitability!

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