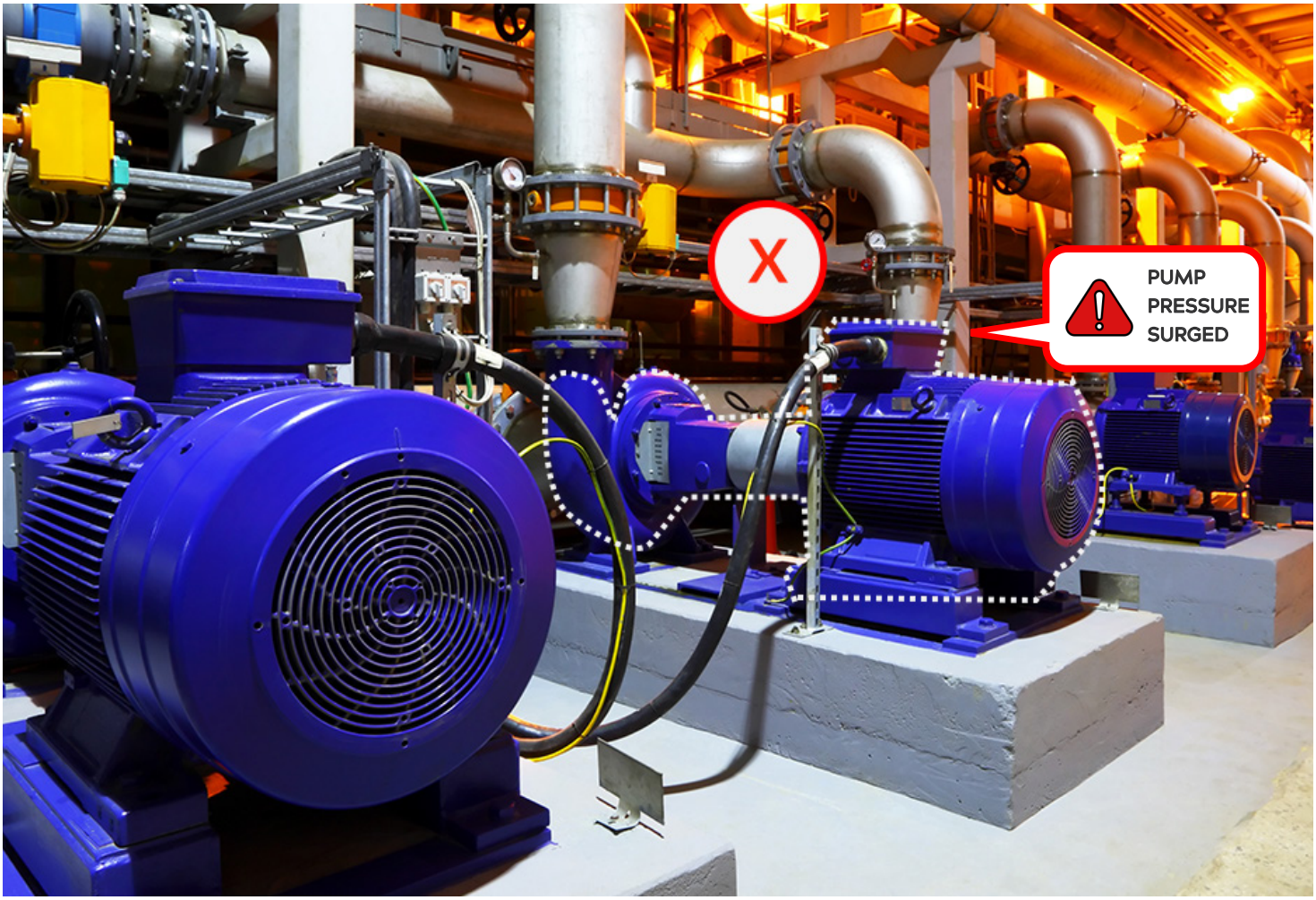
ei³ DOWNTIME: Measure to Improve

APPLY "DIGITAL SIX SIGMA" TO INCREASE EQUIPTMENT EFFICIENCY, SAVE COSTS, AND DRIVE CUSTOMER SATISFACTION



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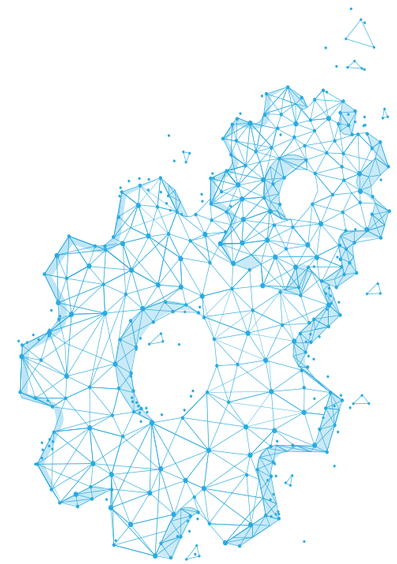
Downtime Means Failure

The idea of eliminating all downtime is as attractive as it is impossible. Machines experiencing downtime are dead capital — consuming attention and workspace without creating products that create revenue. Worse still, a broken machine may lead to missed client deadlines, ruining future orders. In short, unplanned downtime is any manufacturer's worst nightmare. On the other hand, planned downtime is required to ensure that machines receive the care and attention needed to continue production at the optimum speed and quality levels. Like anything else on the planet, machines need regular maintenance, and on some occasions, things will break and will also require unplanned maintenance.

OVER THE YEARS, MANUFACTURERS HAVE LEARNED TO EMPLOY STRATEGIES TO REDUCE THE AMOUNT OF UNPLANNED DOWNTIME DUE TO MACHINE ISSUES. THESE INCLUDE:

- Increasing planned downtime to reduce unplanned downtime: reducing maintenance intervals minimizes the risk of surprises that lead to unplanned downtime. But planned downtime is still downtime, so this strategy has its own cost implication.
- Preventative maintenance strategies: in critical applications, parts are exchanged based on hours-in-service or several actuations, even if the part is seemingly still working. This strategy is often employed when lives are at stake (think airplane maintenance).
- Redundancy: if you can afford it, have a back-up. If the primary machines go down, the back-up machine can take over, allowing you virtually seamless production while you can always tolerate the failure of a sub-set of your available machine park. This is a great strategy when continuous production is essential, but it has a huge capital cost impact.

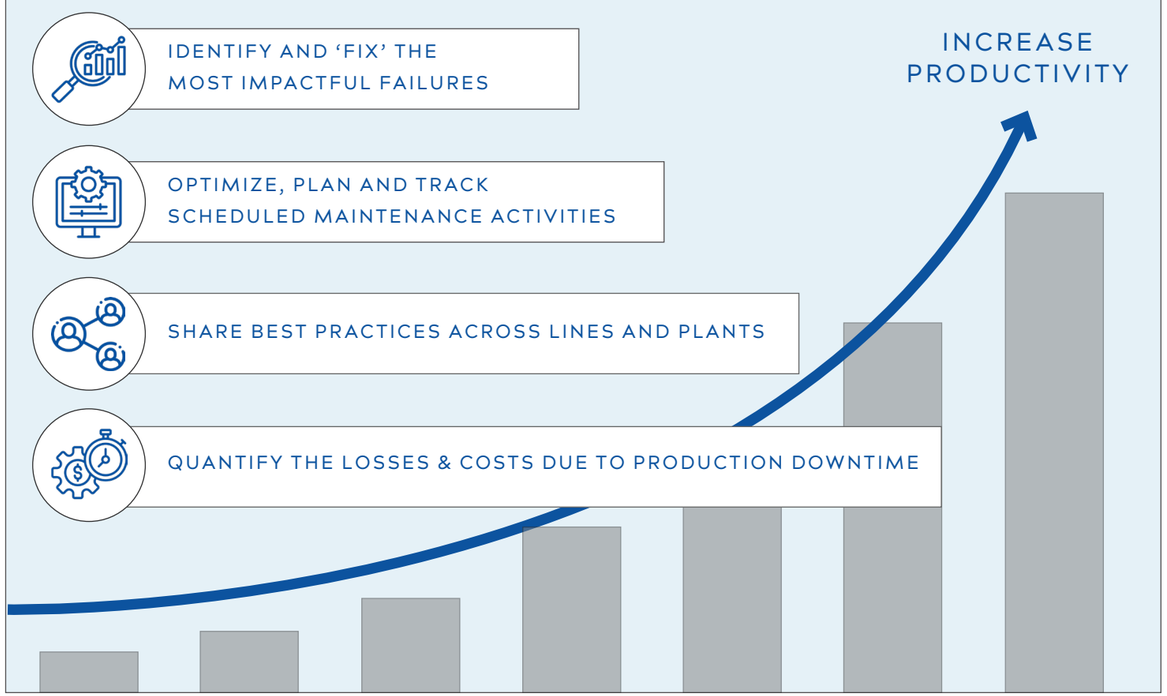


All of the strategies above reduce the problem of unplanned downtime by brute force—at cost penalties that are unacceptable to most industrial manufacturers today. In a quest for more intelligent approaches and finding that elusive optimal balance between cost, machine downtime, and production output (quality and speed), manufacturers have turned to process control techniques such as “Six Sigma” to capture insights into production processes and determine maintenance needs.

The core of “Six Sigma” is based on the notion of thoroughly collecting process variables and then analyzing that data with statistical tools to create a deep understanding of the manufacturing process. Applied to the more narrow area of downtime tracking, this allows operators to develop a thorough understanding of downtime events, including their root causes and consequences.Operators may be surprised to find that preventing some downtime events carries a higher cost than the effects of just letting that event happen. Vice versa, faced with the facts on consequential costs of other downtime events, operators may no longer shy away from some more costly preventative maintenance strategies.

CREATE A THOROUGH UNDERSTANDING OF DOWNTIME EVENTS

When done well, accurate downtime tracking allows operators to maximize Overall Equipment Efficiency (OEE) and plant productivity, in balance with the cost of their maintenance strategy.



Downtime Tracking by Hand Does Not Work

When Six Sigma was conceived as a method of tracking and improving industrial processes, it was literally based on an army of “Six Sigma Belts” equipped with pens, stop-watches, and clip-boards. Placed at strategic locations throughout the manufacturing plant, these spies were checking process settings, measuring quality parameters, and recording processing times— filling in paper-based spreadsheets along the way.

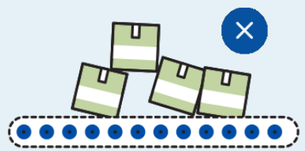
Much of this has since been taken over by process controls that record process parameters automatically. Many manufactures have employed tools (such as those offered by ei^3) to collect that data into central locations for analysis. Curiously enough, downtime tracking has often not made the step into the digital age:

Even today, most operators are required to document machine downtime manually, maybe in a spreadsheet. This is tedious and inaccurate and virtually guarantees to misreporting of data.

MANUAL REPORTING MAKES IT DIFFICULT TO GAIN INSIGHTS VITAL TO IMPROVE UPTIME AND MAINTAIN YOUR COMPANY’S REPUTATION

Operators are often rushed to resume production, and this means they don’t capture enough details about the downtime.

Worst yet, some operators might record less than the full downtime or none at all, making it difficult to analyze the causes and true machine uptime with production.



Manual downtime tracking also allows operators to hide excessive downtime periods caused due to laziness or stress without the management realizing this. Something transcribed on a piece of paper can be lost if it is not stored correctly or if a computer file is placed in the wrong folder or deleted mistakenly. So in summary, the data captured from manual downtime methods can be inaccurate and misleading. What’s a six sigma practitioner to do?

The Industrial IoT Provides an Ideal Solution

The Industrial Internet of Things (IIoT) provides an optimal approach to accurately capturing machine run time, track downtime, record downtime reason codes, and perform the analysis needed to optimize production in a practical and cost-efficient manner. In a word, it enables "Digital Six Sigma."

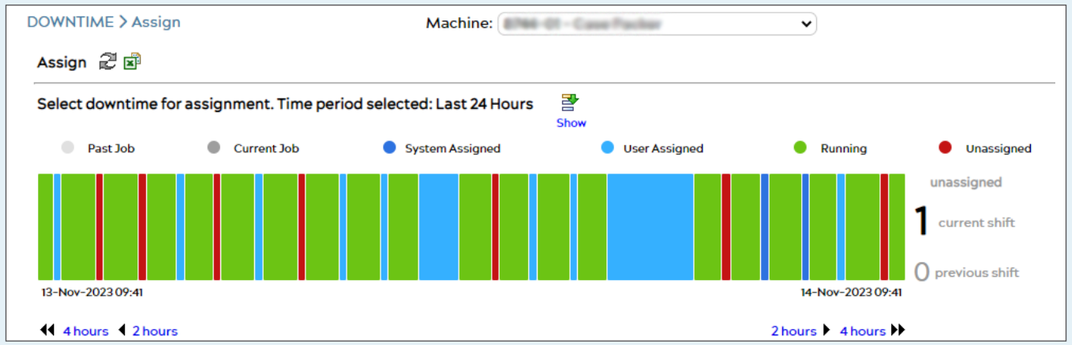
For example, the popular DOWNTIME app from ei³ makes it easy for companies to capture and analyze machine downtimes automatically from the machine control PLC. ei³'s powerful analytics and visualization tools provide a Pareto analysis of downtime for one machine - or the entire floor. It also computes MTBF and MTTR of equipment. ei³ analytics follow established best practices and give manufacturing managers the insights they need for their operations. Most importantly, DOWNTIME helps managers decide how, when, and where to focus their resources on time and money to get the best ROI of continuous improvement programs aimed at increasing asset utilization and reducing downtime events.

With ei³'s DOWNTIME, manufacturers can analyze the influence of various factors, such as shifts, jobs, tools, and recipes, to pinpoint if it is a machine malfunction or difficulty making a specific product or just an operator who could benefit from some additional training. After improvements are made, the app shows how the investment has paid off.

KEY FEATURES

See Downtime As It Happens

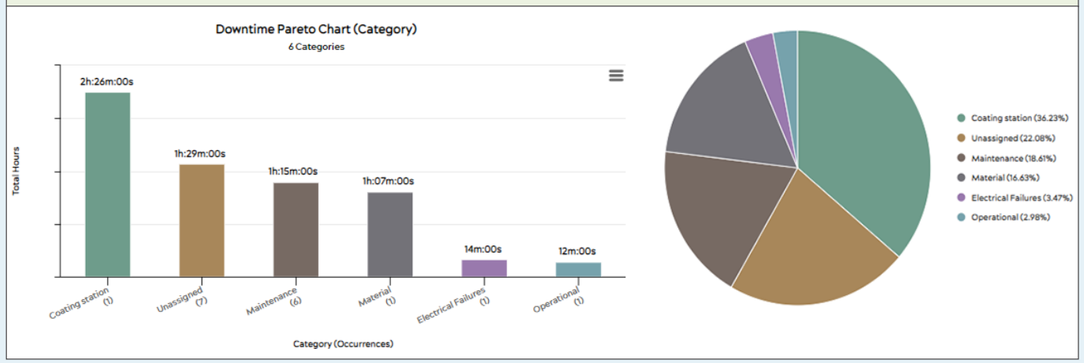
ei³'s easy to use interface allows operators to quickly visualize machine downtime and verify the downtime reasons assigned by the system. The operators are free to add additional information about downtime events, as well as to add or correct reason codes where necessary. The data is immediately aggregated and compiled into real-time Pareto charts.



Automatic Analysis

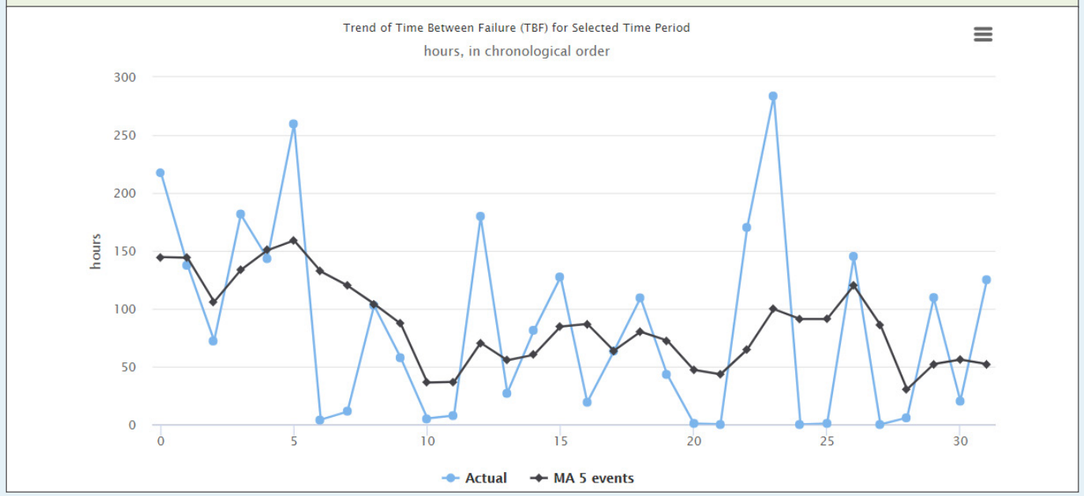
Separate the "Important Few" from the "Trivial Many." Get to the root cause of the most damaging downtime events — and correct these!

The Pareto Chart created is based on automatic downtime tracking and operator feedback. Operators can quickly assess the most impactful downtime reasons and focus their attention on fixing these.



Generate Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR) Reports

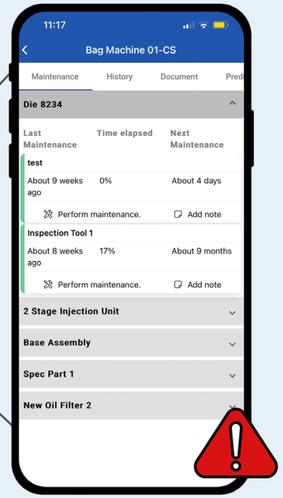
Understand how long and how often a particular error code (or set of codes) occurs on a machine and how long it takes to repair it.



User-Configurable Automatic Alerting

via SMS, e-email, pager

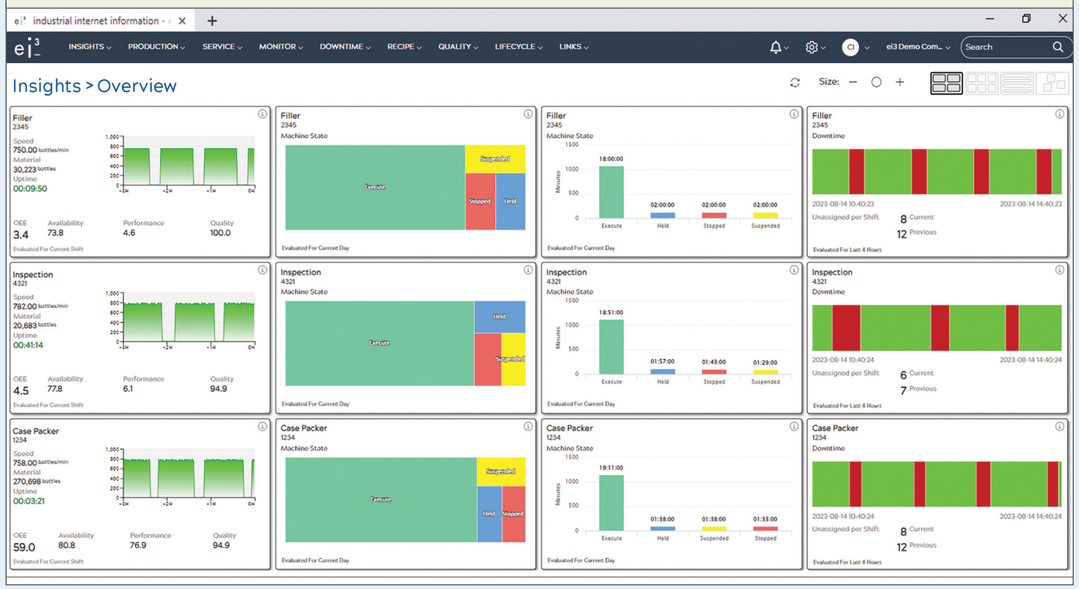
Use custom alerting to notify yourself or your teams of events that need attention. For example, a particular maintenance alert may create an automatic SMS notificaiton to the maintenance crew. This reduces the time it takes for the operator to contact the supervisor who then reaches out to the maintenance team.



Fully Expandable Using a Range of RESTful API Choices

for data integration, custom-built apps and dashboards, or ANDON displays

ei³ brings innovation and experience to create informative shop floor displays.
The Andon Display below shows machine downtime, speed, and good material produced.



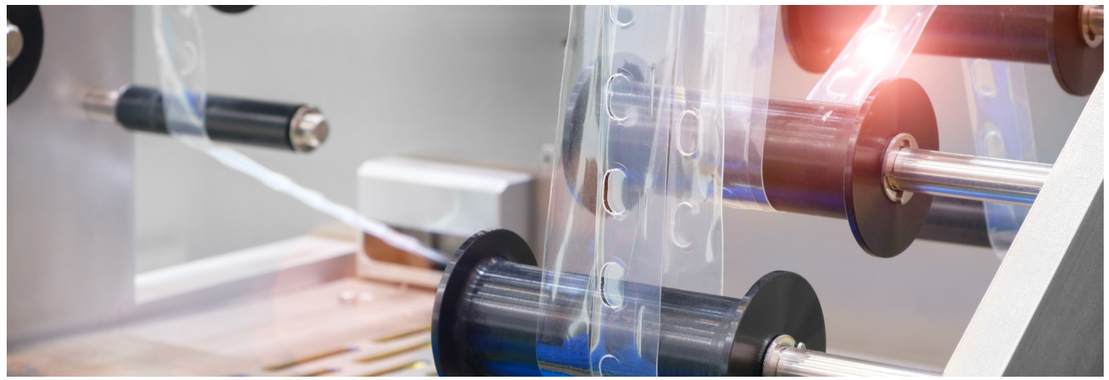
Learn How Manufacturers Use ei³'s DOWNTIME as an Indispensable Tool, Helping Them Fulfill Orders on Time While Saving Money and Enhancing Their Operational Performance

USE CASE 1

Faster Changeover Time For Package Printing

Package printers know all too well how important it is to minimize changeover time. Whether the machine is a rotogravure or flexographic press, sheet-fed or web-fed, moving production from one job to another is a big undertaking. Cylinders need to be swapped out, inks must be changed, and critical parts cleaned. Machine builders make bold claims about the speedy changeover features they embed into their equipment design. But once on the floor, how can the printer know how much time these changeovers take? A major US-based manufacturer of package printing uses ei³'s DOWNTIME to hone in their operations by carefully tracking and studying downtime reasons to optimize operations.

Use the existing press controls as the source of data: ei³ has a vast library of proven data collection solutions to monitor industrial printing machines — web-fed and sheet-fed. The running and production status of these machines is recorded in the ei³ cloud by monitoring data values from within the existing press control systems. Every major press manufacturer has a PLC controller or computer management system with readily accessible stop codes that are ready for integration into the cloud. These stop codes have different names, such as Error Codes and Stop Reasons, but in the end, they are digital signals that indicate why the press stopped. ei³'s DOWNTIME analyzes these industrial press downtime reasons and maps those individual machine codes into customer-defined downtime reasons in the time tracking database.



Map the downtime reasons into a standard structure: The downtime reason mapping is essential because it gets the diverse values from all printing machines into a system of “apples to apples” comparison. For example, on a web press, one thing that disrupts production is a web break — that’s where the printed sheet tears in the machine, requiring the machine to be re-thread or worse, ink cleaned up. Everyone in this industry knows what a web break is, but it is called different names by different press manufacturers. Even more confusing is that the web break will have different codes in the press PLC controllers. When using ei³, these web break events all map to the same downtime reason that the machine owner calls “web break.” This allows for a report to be run to see the MTBF and MTTR by press maker, showing which machines are easier to restart. The same report organized by job may show which substrates break more often helping drive purchasing decisions.

Allow operators to add their knowledge: Machine operators add tremendous value to DOWNTIME by adding their own codes and comments. With their eyes on the machine, operators observe and comment on downtimes that originate from the machine controllers. More importantly — many downtimes are the result of someone pushing the stop button. The operators use ei³ apps to enter their reasons for pushing stop — for example, job changeover, company meeting, lunch break, etc. With this information comparisons are made using ei³ reports. The changeover times are evaluated by press OEM, by shift, by the customer, and other significant differences. These downtime reports are used to drive continuous improvements.

The result:

> After using the solution for six months on a plant floor, the manufacturer was able to measure a 5% reduction of machine downtime in total.

This reduction was driven in part by the creation of an uptime focused culture. Reporting on accurate measurements motivated everyone to change their work. For example, operators began to pre-stage their job changeovers by positioning the right printing cylinders in advance. They also began to look harder for ways to avoid web breaks by letting purchasing know which suppliers provided better films — which was associated with a press-time based ROI. After the first six months, the amount of downtime continued to reduce. This ongoing reduction was driven by the continuous improvement teams who use the ei³’s DOWNTIME Pareto features as a part of their Plan-Do-Check-Act process.

USE CASE 2

Understanding The Real Cost of Downtime in Plastics Processing

Milacron, a global leader in the manufacturing, distribution, and service of highly engineered equipment within the plastics technology and processing industry, was first-to-market with “M-Powered,” a full suite of IIoT applications based on ei³. With ei³’s DOWNTIME Application, Milacron users can identify the issues causing setbacks, outages, and downtimes, and how they impact a machine’s OEE.

Among Milacron’s clients are many suppliers to the automotive industry, such as Ford, GM, Mercedes, or BMW. The automotive industry is among the most demanding in terms of “just in time delivery” and any delay in getting parts from suppliers to the assembly line is costly; High penalties are in place to incentivize suppliers to eliminate these delays to the largest extent possible.

One such supplier has fully embraced the M-Powered downtime application to manage production schedules, account for real customized downtime reasons, and manage changeover schedules. These features go beyond those provided through conventional Manufacturing Execution Systems (MES), giving them a competitive advantage, and delivering real measurable process improvements every day:

- Better team coordination based on the real time insights on jobs, machine state, and schedules allowed to identify warning signs and reduce overall downtime.
- Daily reports to the team began to show an increase in productivity, improved uptime, quality, and customer satisfaction.

The result:

> For three years in a row, this tier 2 supplier was able to reduce unplanned downtime by 5% — increasing available production time by a total of 15%. On a machine floor of 60 machines that equates to finding 10 more machines to make saleable parts.

USE CASE 3

Milacron Taking Their Own Medicine: M-Powered at Milacron Plants

Milacron has several facilities that manufacture parts for their injection molding machines all around the world. The Mount Orab facility located in Southwest Ohio has over 100 different production machines on the shop floor (including original Milacron metalworking machines), and like a typical manufacturing facility is always looking for ways to optimize their machine capacity.

Taking a bit of their own medicine, Milacron executives decided to apply M-Powered to the Mount Orab facility. In late 2019, the team began connecting a wide variety of machines to the M-Powered system, such as an Arc Welder, a Mori Seki grinder, a Campbell grinder, a Milacron Magnum grinder, a Weingartner whirler, and a 1955 Milacron grinding machine. When the M-Powered team states that it can connect all types of equipment, it means exactly that — all types of equipment.

The basic formula was to reduce downtime, improve OEE (overall equipment efficiency) and take steps to validate the efficacy of the product for more machines in the manufacturing environment. The machines were allowed to run for a few months to develop the baseline of productivity on the machines. The management team then trained the operators for the specific equipment on the M-Powered system to illustrate the ability to monitor the machine's performance and availability on a daily basis. The first month after training, the Mount Orab management team was able to see nearly immediate improvements in the machine availability.

"M-Powered helps Milacron accurately detect and record downtime events and make the data easily available for analysis, thereby encouraging collaboration and fact-based decision-making — not gut feel.

— Edward Jump
M-Powered IIoT Digital Analytics Leader at Milacron

Like most machine shops, the Mount Orab team planned out a structure of their downtime events that would impact and not impact OEE. Planned downtime events included In Process Check, Tool Check, Part Changes, and Setups, while unplanned events included items like Maintenance, Material Issues, Meetings, Personal Needs, and Tooling Issues. By and large, significant improvement was observed in the first two months following the training period, compared with the previous baseline period.

So, what changed? The operations teams were held accountable to their results from a single source of truth, and reasons for machine stoppages were called into question. The operations team knew their goals for availability, and they understood what they needed to achieve these results. By and large, the focus of the M-Powered tool was driving improved productivity through a reduction in downtime events. The M-Powered team normally tell a new customer they will experience between a 5-10% OEE improvement in the first year, but the improvement in Mount Orab was exceptional, showing that significant manufacturing gains are still possible in even the most mature facilities.

Machine by Machine Improvement:

- Arc Welder – 30% Improvement in Availability
- Mori Seki Grinder – 33% Improvement in Availability
- Campbell Grinder – 25% Improvement in Availability
- Milacron Magnum Grinder – 40% Improvement in Availability
- Weingartner Whirler – 15% Improvement in Availability
- 1955 Milacron Grinder – 33% Improvement in Availability

The screenshot below is of the M-Powered Application reporting on the increase in a Mori Seki grinder's various performance metrics between December 2019 and March 2021.

USE CASE 4

Binging Engineering and AI Together Towards Eliminating Downtime

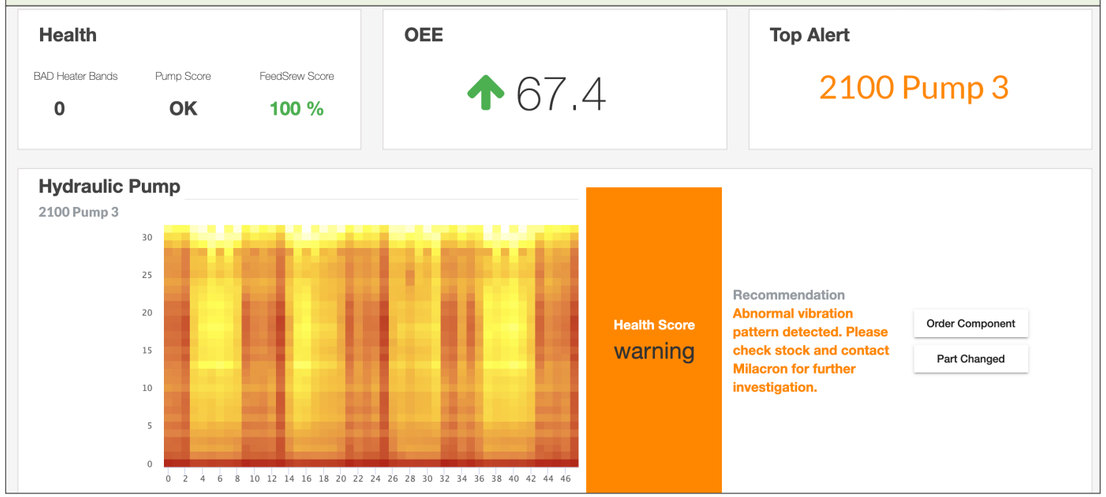
Milacron regularly analyzes downtime data shared by their customers and operators as vital input to making the machine design inherently more resilient against downtime events.

An in-depth analysis of downtime events across a large fleet of machines revealed specific machine parts found as root causes for clusters of downtime. These were then subjected to predictive maintenance solutions. For example, hydraulic pumps are the heart of molding machines, pushing oil throughout the system to deliver performance. Failures result in expensive and extended downtime to flush the system; this in turn could lead to performance loss if any other components suffer residual effects. In total, three components that had a disproportionate impact on downtime events were identified as high priority items.

ei³'s data scientists, along with Milacron's engineering team, applied a combination of complex mathematics, AI, and machine learning to understand and model the failure patterns exhibited by these components. ei³ established the combination of data signatures that, when put together, show the estimated useful lifetime of each part. These insights are relayed back to Milacron operators through easy-to-understand dashboards.

The result:

Operators are alerted in time to replace parts before they go bad — preventing suboptimal machine performance, long lead times, and ensuring more productive uptime.



Conclusion

Downtime is a costly combination of people, parts, unnecessary maintenance operations and unmade product. The first step to solving any problem is defining the problem. Machine data tells a story of drifting component, process variations, and sequences that can identify unique signatures. For downtime, knowing when, where, and how downtime occurs is essential to knowing how to prevent it. With ei³ DOWNTIME, we've made tracking that process easy and user-friendly so you can get to the bottom of your downtime issues and have a better understanding of how to improve your process.

Building upon this solid foundation, we also deliver a range of predictive analytics solutions that allow you to closely monitor machines or significant cost components for wear-and-tear and predict failures before they impact production. Furthermore, we quantify the wear-and-tear impacts so the operators can weigh these extra costs against an early part replacement cost. This allows operators to make smarter, fact-based decisions on how to operate machines, when to replace parts, and drive efficiency across all operations.

How Do I Connect My Shop Floor to ei³'s DOWNTIME Application?

CONNECT

Our edge device, called the Amphion, connects to your equipment's PLC or database. Once plugged in the machine's control cabinet, the Amphion will interrogate the machine controllers 24x7, accurately detecting and recording downtime events.

MEASURE

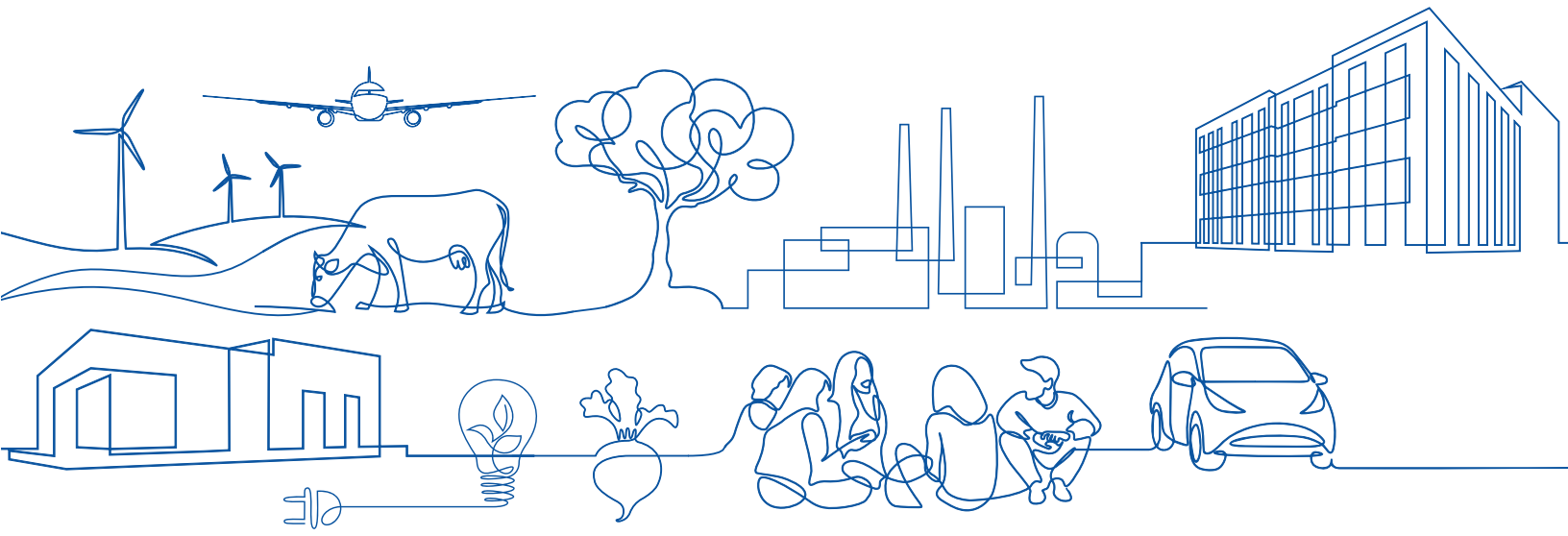
Based on your configuration, the event gets categorized automatically. If it can't be, your operator can classify it using HMIs or webpages. Using our robust and superior features, you can analyze your plants KPIs and generate Pareto reports to perform root cause analysis.

IMRPOVE

With this information your team can roll out continuous improvement programs and track progress based on data — not gut feel.

Visit www.ei3.com

Contact us to get a demo of our DOWNTIME application. Understand the benefits of real-time downtime triggers and the power of analytics and reporting tools to improve operations, save costs, and increase profits.



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