



Empowering Operators and Frontline Process Engineers with AI-Powered Operational Analytics

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Executive Summary

Today's industries face mounting challenges in assuring the best operational performance of assets, both mechanical and process assets. Managing asset performance is the key element of controlling the operational risk that varying situations can present. The frontline workers—particularly the process operators with Distributed Control System (DCS) cockpits are for the most part, unprotected when sudden unexpected disturbances occur. Rarely do they have the levels of training in engineering and analytics, or the appropriate tools, to be able to respond quickly and easily.

However, it is contingent on their understanding the situation and rectifying it as soon as possible to stabilize the process and avoid safety, environmental and production disruptions that can occur when equipment operates beyond design and safety limits. Recognizing these challenges, AspenTech presents a solution which enables operators and frontline process and production engineers to quickly analyze and understand the causes behind unexpected production events.

The Business Challenge

Manufacturing is in a position where consistent and regular operations improvements have secured better process performance. However, without advance notice, unexpected events can disturb the operation—especially when they are occurring on a regular, or even semi-regular, basis. Such disturbances can result in prolonged quality, yield and safety issues that take skills a great deal of time and intense effort to understand and rectify. Process and production engineers can avoid costly problems down the road by analyzing and understanding unexpected events before they snowball into larger issues.

In many cases, frontline workers, such as operators, may be lacking the advanced skills and appropriate tools to quickly analyze and promptly stabilize disturbance conditions. They will most likely parse through trends looking at individual sensors one at a time or try pecking and poking to discover two-dimensional pattern changes in an attempt to uncover the cause of prevailing problem conditions. Of course, all this takes time, causing delays, lengthening the disturbance, exacerbating the consequences and often resulting in rushed, ill-advised decisions.



For capital intensive industries, such uninformed or poorly informed judgments and decisions can lead to a reduction in product throughput of 3-8 percent, ultimately amounting to worldwide manufacturing losses of over \$10B USD annually.

Minor Issues Are Often Symptomatic of a Larger Problem

The reality is this—minor issues that go unresolved can escalate over time into major problems, which can adversely affect process performance, damage equipment, and increase the risk of environmental, health and safety issues. An early understanding of the underlying issues causing the process disturbances is vital to instill confidence that operators are armed with the right tools to develop the knowledge that allows them to take the appropriate action.

Such disruptive events are clearly what we call the “NOT OK” conditions. Typically for these conditions, frontline workers need to comprehend, and take action to correct the causal issue. “NOT OK” conditions can start with simple out-of-bounds process measurements, including feed drop, temperature and/or pressure spikes, and quality changes such as feed density. If allowed to continue, seemingly minor changes can lead to operational issues, such as column flooding, that may cause unwarned product off-spec conditions and emissions discharges, leaks and flaring. In the worst of cases, process disturbances may lead to the most critical types of events: asset breakdowns or environmental, health, and safety issues, all of which can create larger and more devastating impacts on business performance.

Deviations from expected behavior can result in excessive wear-and-tear on machines and early equipment failures. Deviations in the process behavior can lead to what we call process-induced degradation and damage—the cause of which may just be an incorrect setpoint entry. It’s well established that such unexpected “NOT OK” conditions are tied to the aforementioned revenue losses in manufacturing worldwide.



The Solution: AI-based Analytics Easily Accessible Across an Organization

New cloud-based applications, such as Aspen Event Analytics™, can deliver powerful, intuitive, easy-to-use analysis and visualizations to help your team take action at the root of the problem, quickly.

SaaS—Cloud-Based Solution

Aspen Event Analytics is AspenTech's one-of-a-kind, cloud-based, self-service analytics solution, designed for frontline workers such as operators and process engineers. It requires no software downloads or installations; it is evergreen and accessible from any device.

Connect to any Historian

Combine the analytical power of Aspen Event Analytics with Aspen Cloud Connect™ to enable streaming of data from any historian. Aspen Cloud Connect is designed to integrate with any historian in the marketplace, which drives a compelling narrative for Aspen Event Analytics "plug and play" capabilities.

Arm Your FrontLine Workers with the Superpowers of a Data Scientist

This new innovation addresses the complexity of data analytics with a lightning-fast solution that simplifies the user experience. Aspen Event Analytics inserts directly into day-to-day plant operations to arm frontline workers with extraordinary data analytics for solving both minor and critical operational disturbances.

The technology also allows users to cast a wide net across a multitude of process and mechanical sensor signals that could contribute an understanding to the disturbance event. It identifies and focuses on the variables that have immediate impact on the event signature and eliminates the ones that do not contribute to the event characteristics.

Aspen Event Analytics empowers operators and frontline process engineers to better handle abnormal conditions and increase process safety and uptime.





Focus on the Event Patterns that Matter

The Aspen Event Analytics data processing engine provides a differentiating advantage by enabling frontline workers to rapidly uncover and focus on the relevant patterns in an event. It eliminates the need to randomly dig into trend charts or manually model events. Typically, a significant amount of time is spent researching and cross-referencing time periods in historical data to find examples of similar events. In many cases, additional time is spent digging deep into operator logs to find documented resolutions to previous occurrences. Because this can be a lengthy and expensive process overall, it's easy to see how corners might be cut, events misdiagnosed, and the wrong restorative action taken, potentially resulting in wasted maintenance costs and production losses.

Aspen Event Analytics does much of this heavy lifting for end users. For instance, users are not required to declare specific patterns up front, because the technology contains a key group of event patterns for which it searches automatically and present the results—with no user effort required.

In addition, Aspen Event Analytics automates everything for the user, from the collection of data from any historian, to event diagnostics and event fingerprinting, to matching other historical signatures, and finally, live monitoring for recurrences to ensure that prompt notification and document resolution are occurring in a timely, regular manner.

Aspen Event Analytics is a true turnkey, self-service event investigation and diagnostic solution, which allows companies to solve common recurring “fires” and snuff out the “embers” of events that can eventually lead to more devastating consequences.

The technology enables companies to respond to recurring “fires”—snuffing out potentially devastating “embers” before they do lasting harm.



Aspen Event Analytics Methodology

Uncover a Unique Event Fingerprint

Aspen Event Analytics uses a three-step workflow to address the need to provide frontline workers with the right tools to perform advanced diagnostics of plant disturbance events.

First, the user selects to create a new Event Agent and provides any known information such as the one or more examples of the event, an estimation of how often the event occurs, the average length of the event, and candidate tags around the process boundaries.

Once defined, Aspen Event Analytics executes its analytics engine and parses through each tag trend information. Aspen Event Analytics distills the data to the relevant sensor tags that show a strong correlation within the defined event period.

For each selected trend, Aspen Event Analytics provides contextual details such as the shape of the trends it has revealed, time to develop, amplitude changes within trends in the event, and so on. This information provides the opportunity for end users to better understand the unique variations in all the trends that contribute to the fingerprint of an event.

Use the Unique Fingerprint to Identify Past Occurrences

In the next step, users define search parameters for Aspen Event Analytics to execute a historical search for other occurrences of the precise signature of a selected event. It scans the user requested historical time range to identify events that meet the search criteria and the Event Fingerprint. The technology also assigns a metric that measures the percentage by which every found event fits the initial selected event signature; and a measure of how close an event matches the source event signature. Finally, once all events are reviewed, end users can choose to accept their event matching results and create a new Event Agent.

Continuously Monitor Using Live Event Agents

After creating a new Event Agent, users can optionally deploy it online to monitor for event recurrences. The Event Agent extracts the configured tag data at a set frequency and evaluates the shapes in incoming tag data against the Event Signature stored in the Event Agent. If the patterns match the Event Signature, the Event Agent triggers a notification, with predefined user instructions on how to resolve the event condition. The Event Agent is a living thread of user documentation, enabling the automation of knowledge. When the root cause of an event is successfully solved and discovered, the user can decommission the Event Agent.

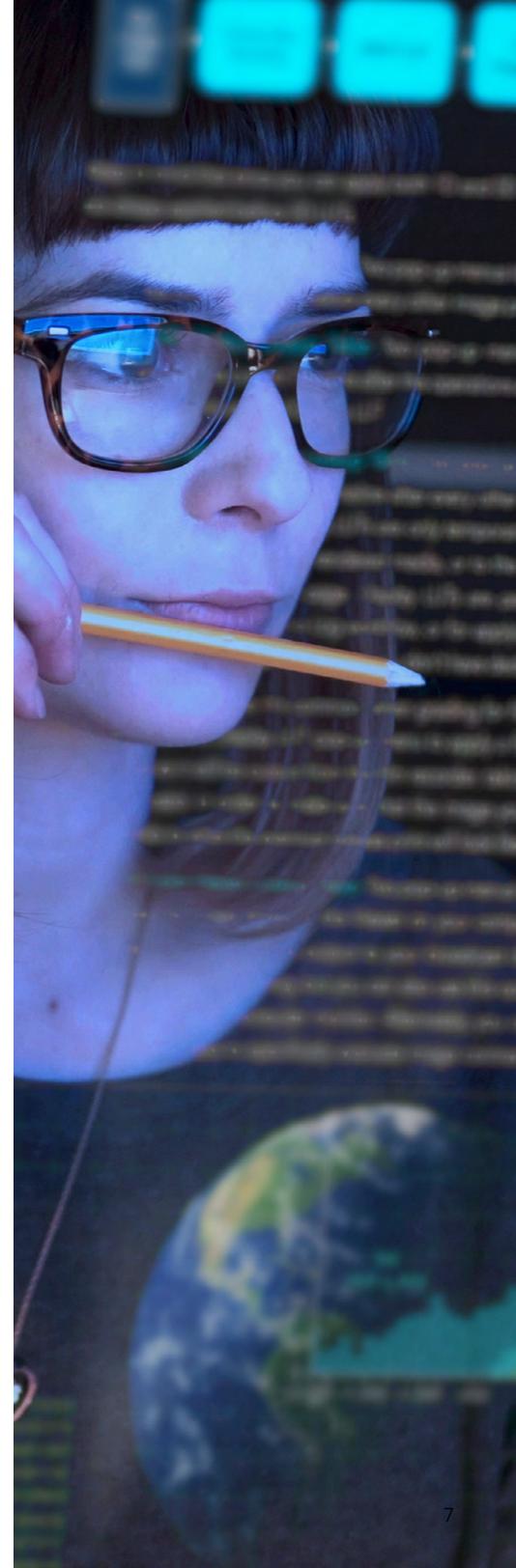
Aspen Event Analytics Use Case

Rapidly Investigate and Address Unexpected Events

An operator on night shift managing the compressor operation receives a sudden, inexplicable distributed control system (DCS) alarm. The reason why the alarm went off and what to do about it puzzles the operator. At this point, many erratic compressor discharge pressure alarms occur and the operator knows if they're left unattended, dire consequences may follow. It is critical for the operator to use process and equipment knowledge to rapidly investigate and diagnose the cause, and then take the appropriate action to bring the process back into normal operating mode.

Without delay, the operator connects to the Aspen Event Analytics SaaS installation in the Cloud—as easy as going to any website. The operator collects and dispatches the appropriate trends of data related to the event disturbance with a suggestion of approximately where the event appears to start. The Aspen Event Analytics application then proceeds to identify the precise event fingerprint.

Using deep machine learning pattern and shape analysis, Aspen Event Analytics finds discernable diverse data patterns that indicate specific process changes, such as step changes, correlated shapes, amplitude and time variations. The collection of such patterns is returned to the operator as the key characteristics of the event fingerprint. As a result, the characteristics of the fingerprint may stimulate the operator to develop insights that identify the underlying root cause of the observed disturbance.



Where the operator cannot establish a root cause, other inquiries may help, such as “has been an issue in the past, is it new? How did we solve it before?” After approving the event fingerprint, the operator proceeds to scan history to find similar event signatures that happened in the past. If other signatures of the same event exist, Aspen Event Analytics returns them with the dates of the occurrences. Consequently, the operator may look back into notes, management systems, etc., to find how the issue was solved last time. When the scan of history does not find similar events, the operator knows this is a new event.

Once complete and understood, the operator readily creates and deploys a new online Event Agent. Such an Agent will monitor on all shifts for all operators 24/7, so that they are notified immediately. The operator can embed any developed knowledge and experience into the Event Agent.

As a result, if the event ever reoccurs in the future, the next operator on the floor has immediate access to all the information the current operator has included. Future operators can also augment an Event Agent with their own specific experience and expertise, enabling automated knowledge sharing.

Aspen Event Analytics promotes enterprise digitalization by addressing asynchronous communication, and the automation of knowledge to improve the productivity level of all operators.





Conclusion

Consistent with sibling applications in the AspenTech APM (Asset Performance Management) portfolio, Aspen Event Analytics performs a specific task against a distinct use case for definitive users. Rather than a generalized tool kit requiring deep engineering and data science skills, it suits the needs of current personnel in a process manufacturing environment, in this case the frontline workers—process operators and plant engineers. Aspen Event Analytics enables those frontline workers to rapidly scour the possibilities of what happened in an event without detailed deductive knowledge or previous experience, and gain a thorough understanding of what changes in operating conditions were likely to produce the outcomes.

Such signatures of the event are automatically highlighted by Aspen Event Analytics as patterns in the trends or the sensor tags that matter—those with a consequential contribution to the development of the particular event and its outcome. The worker easily converts discovered signatures that automatically warn if the event reoccurs. Such an application is necessary in today's world where users must act now rather than wait for deep analysis by more experienced and trained staff. Aspen Event Analytics enables process operators to quickly understand what's going on as it is happening in an unexpected disturbance, placing them in a position to take correct action to stabilize the process and avoid production losses, or worse, safety or environmental Issues.

About Aspen Technology

Aspen Technology (AspenTech) is a leading software supplier for optimizing asset performance. Our products thrive in complex, industrial environments where it is critical to optimize the asset design, operation and maintenance lifecycle. AspenTech uniquely combines decades of process modeling expertise with machine learning. Our purpose-built software platform automates knowledge work and builds sustainable competitive advantage by delivering high returns over the entire asset lifecycle. As a result, companies in capital-intensive industries can maximize uptime and push the limits of performance, running their assets safer, greener, longer and faster.

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