



A.I. Equipment Health Monitoring and Predictive Maintenance Technology

GrandView® smart manufacturing applications make equipment downtime a thing of the past

New cloud based, IoT enabled equipment health monitoring and predictive maintenance systems are the first of many exciting A.I.-based smart manufacturing applications to combine embedded human knowledge and advanced engineering automation to address long-term production challenges facing automotive, industrial, biopharma, and oil and gas manufacturing. These include:

- Machine downtime due to unexpected equipment failure caused by excessive vibration, heat, and usage.
- High replacement cost of parts due to a lack of real-time health insights that predict component failure.
- Long repair times due to a lack of preparedness caused by unexpected shutdowns.
- Inefficient, antiquated maintenance programs that drive up costs.
- Siloed data that create huge inefficiencies across the factory due to a lack of plant wide or region-wide equipment health status that assess equipment health

A.I GrandView® APM Health Monitoring and Predictive Maintenance Launches

A new technology solution launched this month is GrandView® Asset Performance Management (APM) which integrates AI powered fault detection, classification and predictive maintenance smart manufacturing applications on the Cloud and powered by the Metatron® IoT platform. GrandView® addresses some of the big issue facing manufacturers by providing:

- Factory-wide equipment health insights
- Real-time monitoring and prediction
- Data driven maintenance strategy
- Global visibility for all stakeholders at all levels of operation

By detecting, and analyzing real-time streaming and historical data, leveraging powerful predictive analytics, GrandView® saves manufacturers time and expense by reducing two of the leading losses for the manufacturing industry: **equipment failure, and downtime.**

GrandView® APM Drives Predictive Based Approach to Maintenance

Traditional health monitoring and predictive maintenance solutions are slow, require significant user intervention, are localized, take a long time to deploy and require significant IT resources and other costly support. In addition, traditional maintenance programs rely on out of date methodologies to schedule equipment maintenance and parts replacement. Today, manufacturers rely on three maintenance strategies. (1) Run-to-failure which maximizes equipment utilization at the expense of costly downtime. It is surprising to see a large number of companies still adopting this run it until it breaks approach. (2) Time-based maintenance scheduling maintains system uptime with potentially unnecessary and costly preventive maintenance or part replacements. (3) Condition monitoring manually and inefficiently collects and analyzes sensor data with domain expertise. These approaches are largely costly and inefficient. [Fig 2]

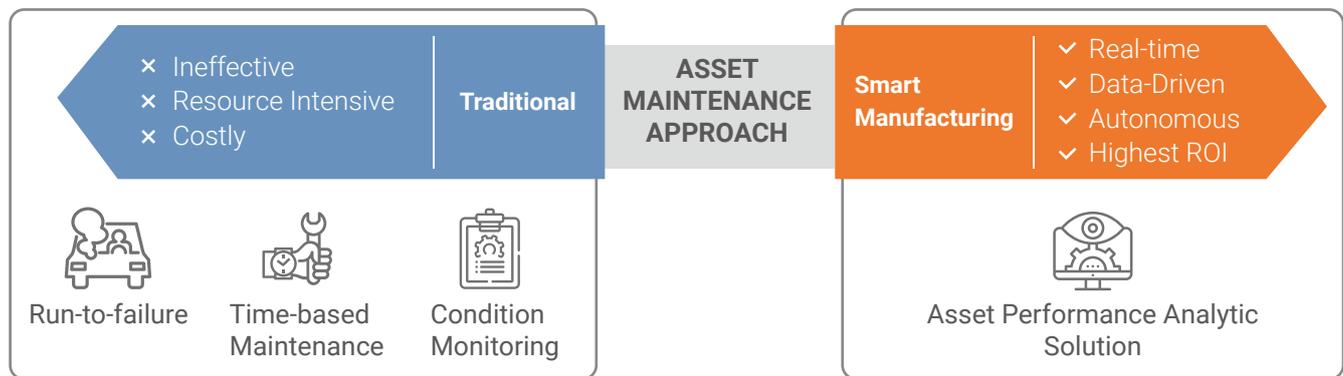


Fig 2. Predictive Based Maintenance Approach

Data Driven, A.I. Based Predictive Approach

Advanced AI powered smart manufacturing applications like GrandView® offer a predictive maintenance approach using predictive analytics to assess the health and performance of machines real-time, provide a health index and use real-time and historical data to predict the remaining useful life (RUL) of equipment. Understanding when machines will fail is a key part of AI based predictive analytics which uses machine learning to save manufactures valuable time and money factory wide. If engineers know how much longer an asset can continue to run, he/she can schedule maintenance and replacement parts at the most optimal time. This maximizes the utilization of the asset to take full advantage of its operating life. Second, maintenance is only performed when needed. Finally, and more importantly, manufacturers eliminate system downtime due to equipment failure.

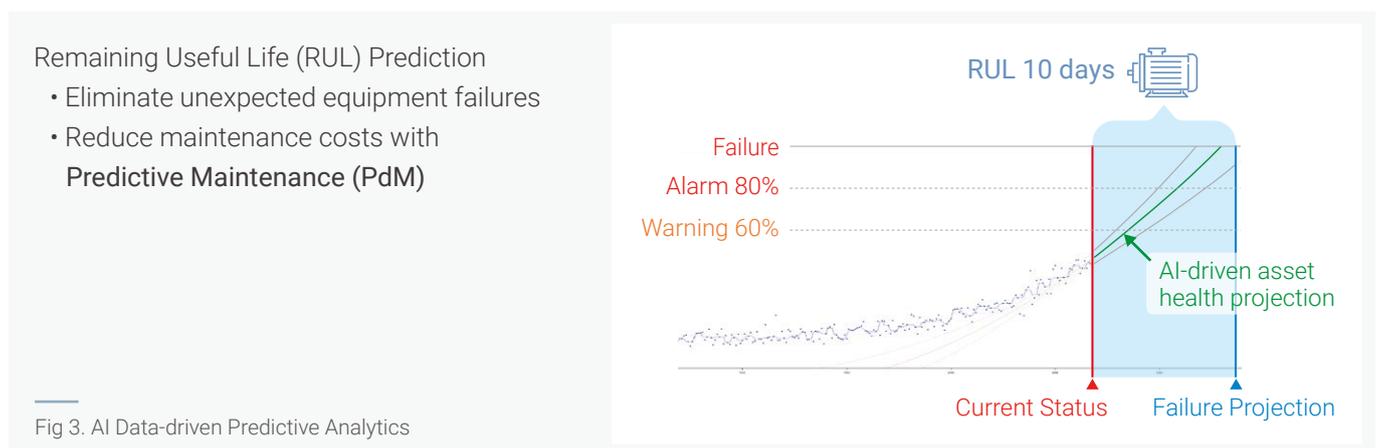


Fig 3. AI Data-driven Predictive Analytics

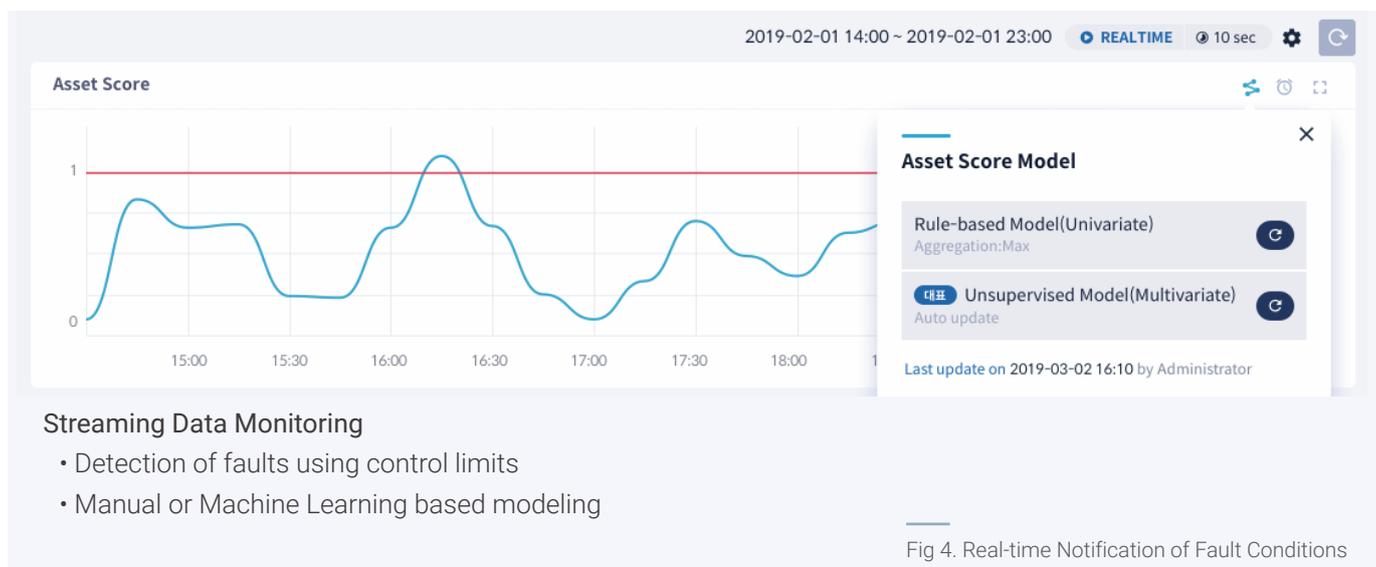
GrandView® APM lets users pinpoint the Remaining Useful Life (RUL) of an asset.

A predictive maintenance approach offers continuous optimization of assets and provides manufacturers with valuable, and actionable insights to make better decisions that improve engineering productivity, cut maintenance costs and extend the life of the asset.

Machine Learning Based Fault Detection

The GrandView® APM also includes real-time asset health monitoring and fault detection to identify faults using two methodologies:

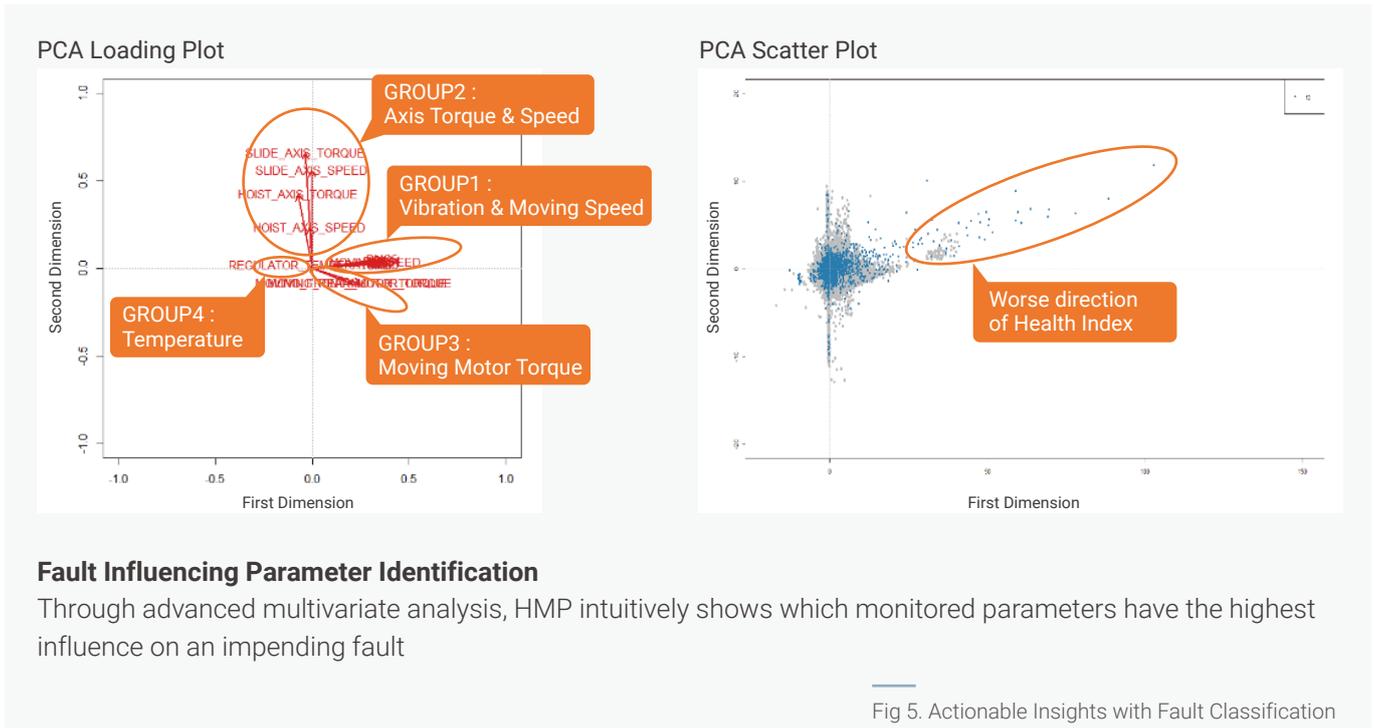
1. Traditional model-based monitoring, using control limits to detect issues. The setting and tuning of the control limits can be done either manually or by machine learning.
2. Drift/Shift detection – since some issues do not happen abruptly, but rather gradually, this capability tracks the performance trend of a parameter based on a set reference. This allows the solution to see gradual changes in the system and provide early warning of potential problems to engineers.



AI Based Fault Classification Highlights the Root Cause of Problems

GrandViews' fault monitoring tells a user when an issue occurs, its fault classification quickly evaluates the reasons for the issue letting manufacturers understand the root cause of the problem. It allows them to take quick, corrective action. GrandView® APM Uses two Levels of fault classification:

Multivariate analysis (PCA) and intuitive charting show which parameters have the highest influence on the fault. [Fig 5]

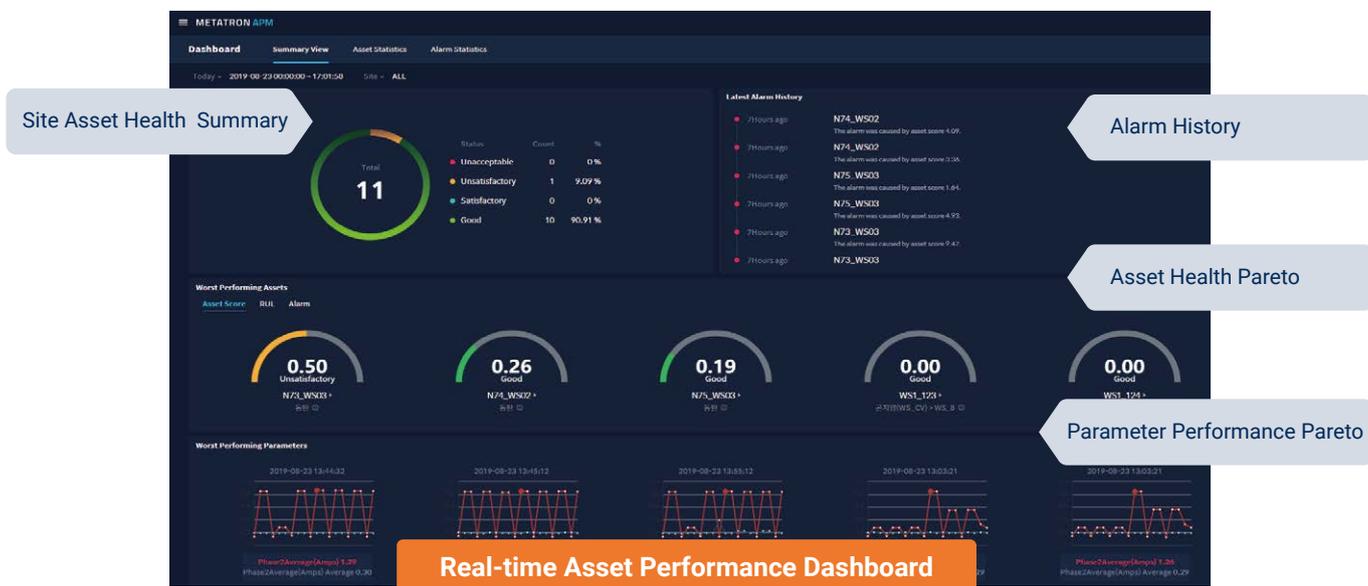
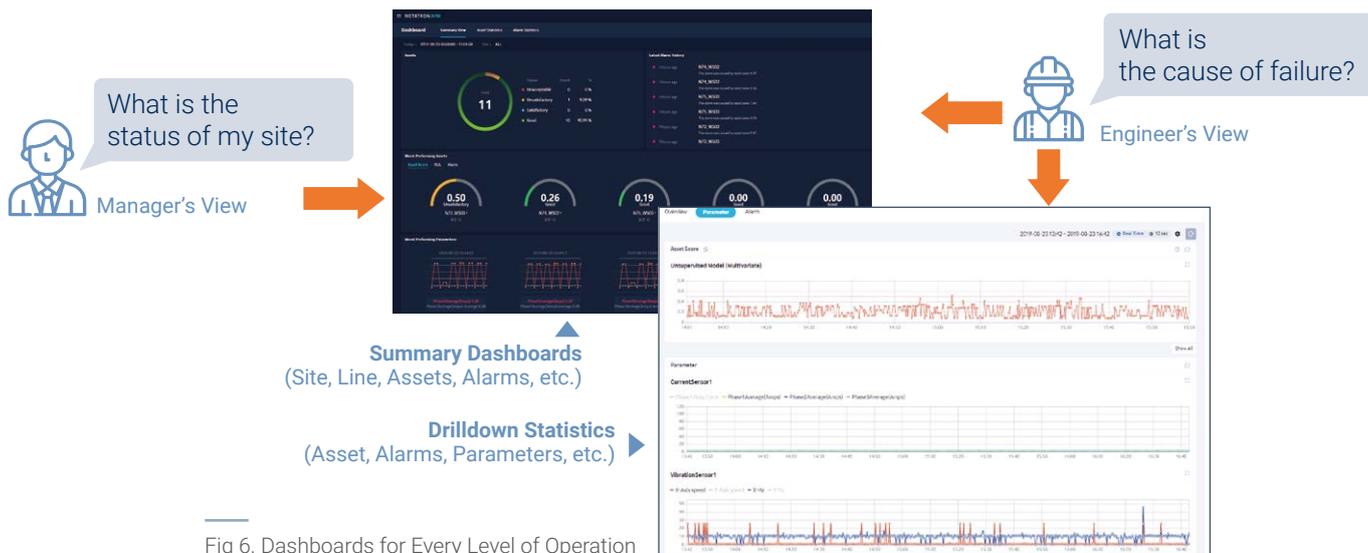


Rule Based - With historical data and domain knowledge, users can train GrandView® APM to look for specific failure modes and patterns that provide the exact reason for the fault (i.e.: alignment issue, unbalanced motor, lubrication issue, etc.)

Powerful Visualization Creates Dashboards for Every Level of Operation

Whether you are an operator, engineer or executive, GrandView® APM seamlessly integrates with all other factory data management systems to provide the ultimate data visualization experience. GrandView APM plant wide, real-time monitoring maintains the health of equipment and web-based visualization improves decision making. GrandView APM collects, contextualizes, and analyzes data to enable role-based dashboarding for all users across the factory. Benefits include:

- Summary dashboard of all your assets to provide a quick understanding of your plants' overall performance – from one plant or multiple plants around the world
- Pareto of asset performance to help you quickly focus on troubled areas
- Simple one-click drill down to get detailed insights on all monitored assets
- Intuitive charts and graphs to provide clear statistics and visualization on asset health status
- Asset remaining useful life (RUL) information to help you create the most optimal maintenance plan possible



GrandView® APM for OSAT Manufacturing - Some Use Cases

Predictability in Outsourced Semiconductor Assembly & Test Manufacturing (OSAT)

GrandView® APM has been helpful with overhead hoist transports, ubiquitous in manufacturing spaces of all types. Users often have hundreds of overhead hoist transports on each assembly line, where they are prone to belt cutting, motor speed reductions, and other errors that lead to failure. More importantly, downtime can cause losses of millions of dollars. Monitoring vibration data allows the GrandView® APM system to send an alarm one full hour before failure, preventing accidents and saving money. Additionally, GrandView® APM enables the user to easily set gold standard hoists for the entire factory floor. That ensures all transports are operating to that standard after any maintenance, and that the user is notified of any deviation from that standard. The RUL of each individual overhead hoist transport can be monitored to maximize maintenance efficiency.

Auto and Industrial Manufactures Detect Faults in Real-time

In addition to the benefits with overhead hoist transports, the GrandView® APM technology has enabled auto industry users to dynamically detect faults in real time. In studies with two top auto makers, sensor data was fed directly into the GrandView® APM system, where it was collected, analyzed, and compared to both historical data traces and other real-time traces to best identify anomalies. GrandView® APM used vibration data to identify faults in a drivetrain and to classify them in real time, saving engineers the trouble and time of diagnosing faults, which can often take weeks or months. When testing the drivetrain or other vital automobile parts, GrandView® APM allowed problems to be narrowed down quickly to specific causes, such as broken bearings, misalignment, imbalances, and lack of lubrication.

With equipment domain knowledge, **Rule-based Fault Classification** is possible to provide clarity on asset failure

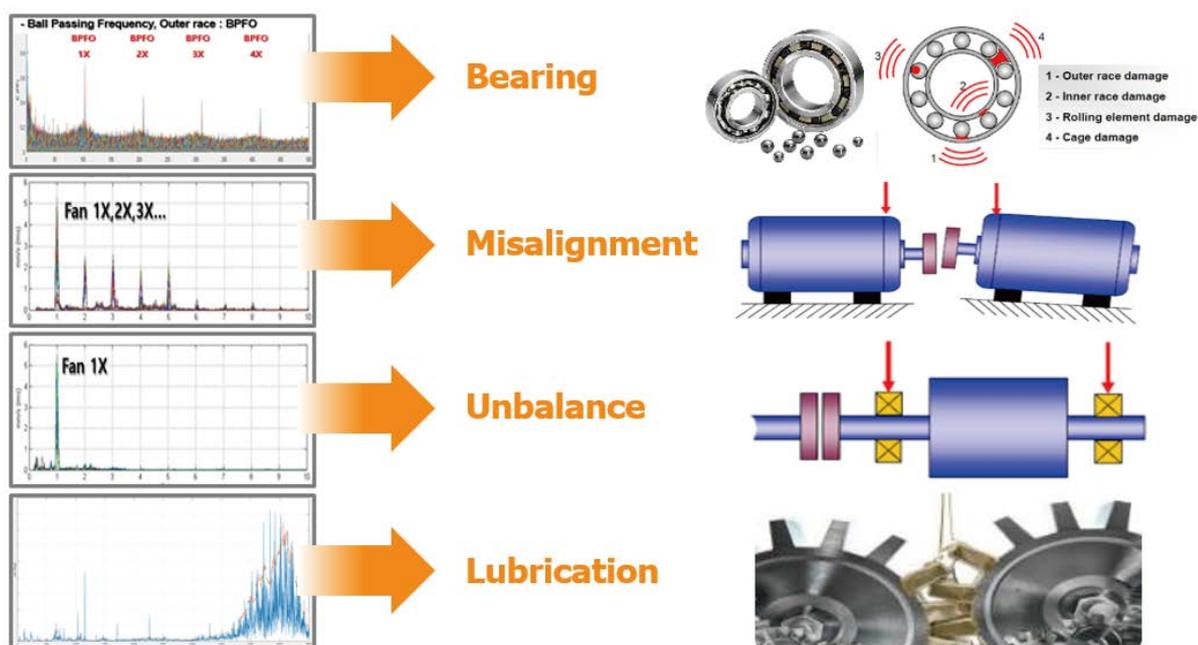


Fig 8. Actionable Insights with Fault Classification

Pump Manufacturers Detect Anomalies, Predict Remaining Useful Life to Optimize Pump Performance

Users of GrandView® APM can customize their dashboards to monitor their equipment, from the entire floor at once down to the individual sensor data on a single machine. A top semiconductor company implemented the GrandView® APM system to monitor its vacuum pumps. The individual RUL of each pump can be viewed on the floor map or as a chart. The bottom left window shows the alarm trends for all pumps as recorded by the dynamic fault detection system, and the last window shows how select pumps are comparing to the golden pump (top performing reference pump) established by the user.

The highly automated semiconductor industry has also seen great success with the implementation GrandView® APM systems. In chip manufacturing, there are typically thousands of vacuum pumps on each process line, each producing their own data traces. GrandView® APM's can monitor all the data simultaneously, in real-time, to detect anomalies and send alarms for faults. Additionally, GrandView® APM enables the user to easily set the golden reference - the most productive pump. Finally, the RUL of each individual pump is monitored to maximize maintenance efficiency.

GrandView Availability

GrandView® APM is available on SK Telecom's metatron IoT data analysis platform, which provides a platform for powerful predictive data analysis, offering manufacturing insights to customers globally.

GrandView® Key Features

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- Real-time health monitoring maintains equipment and other factory assets
- Predictive maintenance reduces costs and downtime as maintenance occurs when needed
- Fault classification prioritizes issues for quickest handling
- Real-time, fault detection, includes early alarm system to prevent failures from occurring
- Data analysis of historical data pinpoints root cause of production issues impacting yield
- Predictive analytics calculate remaining useful life (RUL) of equipment, extends life of machine
- Rapidly connect factory assets to allow engineers to develop and deploy models within 24 hours
- Time-series data base ensure high speed transfer and processing of unlimited data
- AI/ deep learning time series data modeling and data prediction
- Easy data integration to ERP, MES & supply chain management systems
- Massive IoT optimized data engine (5G Ready, etc.)

GrandView® APM Eliminates Downtime, and Risk in Manufacturing

AI-based GrandView® APM creates a way to not only take the risk out of manufacturing, but also to reduce risk for all industrial manufacturers, including those in the electronics, energy, automotive, steel, and pharmaceutical sectors. Through the use of sensors for each step of the production process, equipment and outputs are monitored in real time by an adaptive intelligence (AI) that provides a fault detection system, early warning alarms to prevent failure, and remaining useful life (RUL) calculations for all manufacturing equipment. Downtime is drastically cut, because maintenance is only performed as needed and where needed. In addition, of course, the GrandView® APM system is highly adaptable to a wide range of industries, enabling smarter manufacturing from the steel and automotive sectors to semiconductors and energy. Manufacturers across all sectors are catching on to this trend. According to a 2017 Gartner

Group study, the number of IoT devices installed across the world was 8.4 billion. By 2020, that number will more than double to 20.4 billion IoT devices deployed in the market.

GrandView® saves manufacturers time and expense by addressing two of the leading losses for the manufacturing industry: equipment failure, and downtime. For more information or to learn more contact Stewart Chalmers at stewart.chalmers@bistel.com

Benefits of Data-driven Predictive Maintenance



¹ <https://www.mckinsey.com/business-functions/operations/our-insights/manufacturing-analytics-unleashes-productivity-and-profitability>

² <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/process-and-operations/us-cons-predictive-maintenance.pdf>

Markets Served

- Automotive Manufacturing
- Industrial Manufacturing
- Pharmaceutical Manufacturing
- Oil & Gas Manufacturing
- Semiconductor Manufacturing
- Flat Panel Display Manufacturing
- Electronics Assembly
- PCB/SMT Manufacturing

Contact

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About BISTel

BISTel is the leading provider of Equipment Engineering System(EES), IoT Edge computing solutions and AI enabled smart applications. BISTel help customers improve quality, yield and engineering productivity leading to improved operational efficiencies, reduced production costs and better business performance. BISTel's real-time, intelligent manufacturing solutions enable manufacturers to connect to and gather data from any data source, detect faults before they occur, optimize process flows, analyze large data and quickly identify root cause failures to mitigate risk. Founded in 2000, BISTel has more than 350 employees operating in the USA, China, Southeast Asia and the EU.

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