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creating value from data

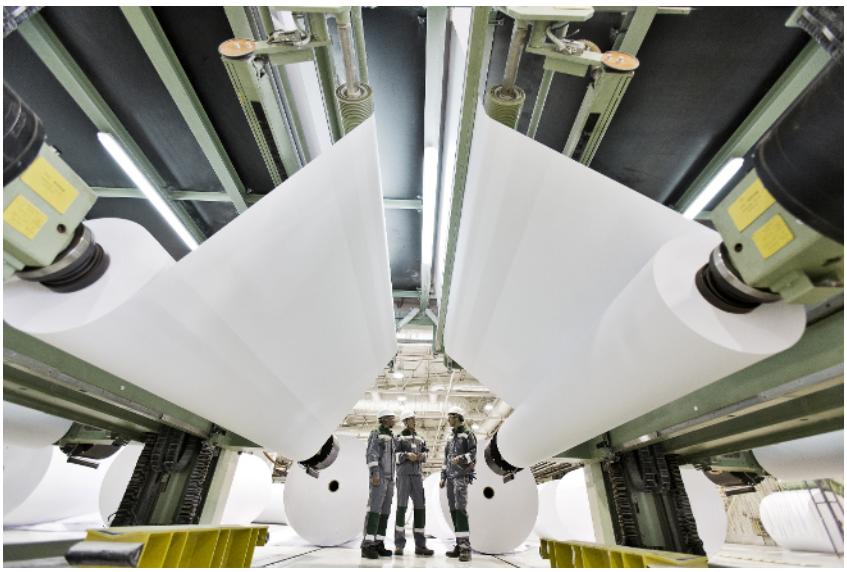
What does Artificial Intelligence have to do with Asset Maintenance?

Asset monitoring systems based on artificial intelligence allow industries to reduce unplanned downtime, reduce mean time-to-repair, and increase the return on investment of maintenance operations in both the manufacturing and process industries.

What do the manufacturing, utilities, transportation and other such industries have in common? They are all asset-intensive industries and rely on the efficient running of their machinery to be successful. Industrial equipment requires maintenance which can be quite expensive and time-consuming if not done properly or at the right time. Unexpected downtime can add to the total maintenance and operations costs of all manufacturing or production plants. Depending on the specific industry, total maintenance costs can represent between 15 to 60 percent of the cost of goods produced. This means that even modest improvements in the monitoring of asset health and performance can have a big impact.

US Annual Spending on Maintenance

Why have some industries fallen back in the race of proper asset monitoring and maintenance? The primary reason is the lack of real-time data to quickly detect issues and quantify the actual need for repair or maintenance of plant machinery, equipment, and systems. Maintenance scheduling has been and still is predicated on statistical trend data or on the actual failure of plant equipment. These traditional time-driven methods provide a simple guideline of "normal" machine life spans which are not fully reliable.



Traditional approaches are suitable when there is:

- **complete understanding of operation process**
- **time for rules implementation**

Traditional operation-monitoring methods such as hand-written rules and simple descriptive statistics can be effective in situations where there is a complete understanding of the operation processes and possible modes of machine failure. It is also suitable when there is sufficient time for rules implementation. However, both these conditions are rarely fulfilled in today's era of complex industrial machinery.

Additionally, such traditional approaches are usually unable to keep up with more sophisticated machinery and systems which produce highly dynamic and complex signals and data. This is partly because dedicated sensors only pick up the issues they were designed to detect, i.e. they will detect the vibration of a mechanical component or quality of a substance such as oil, but won't provide any information on other potential problems.

So what's changed and how do you take your monitoring and maintenance to the next level? With the rise of the Industrial Internet of Things and the increase in the connectivity of assets, data from sources such as sensors and control system software logs are now more readily available and easier to collect.

Technological advancements have almost eliminated issues such as storage and data transmission speed limits. Most importantly, machine learning and artificial intelligence-based systems have allowed for the analysis of data from existing sensors in ways which were not possible up until a few years ago. All these changes have made new ways of operations monitoring possible and are enabling predictive maintenance.

Operations monitoring and predictive maintenance have been aided by several software solutions and systems built on various technologies and algorithms. For example, IBM's Predictive Asset Optimization brings together various capabilities from IBM's subdivisions such as IBM SPSS and IBM Analytics to optimize asset maintenance. GE's Predix and Siemens Mindsphere platforms are also equipped with analytical capabilities for operations monitoring.

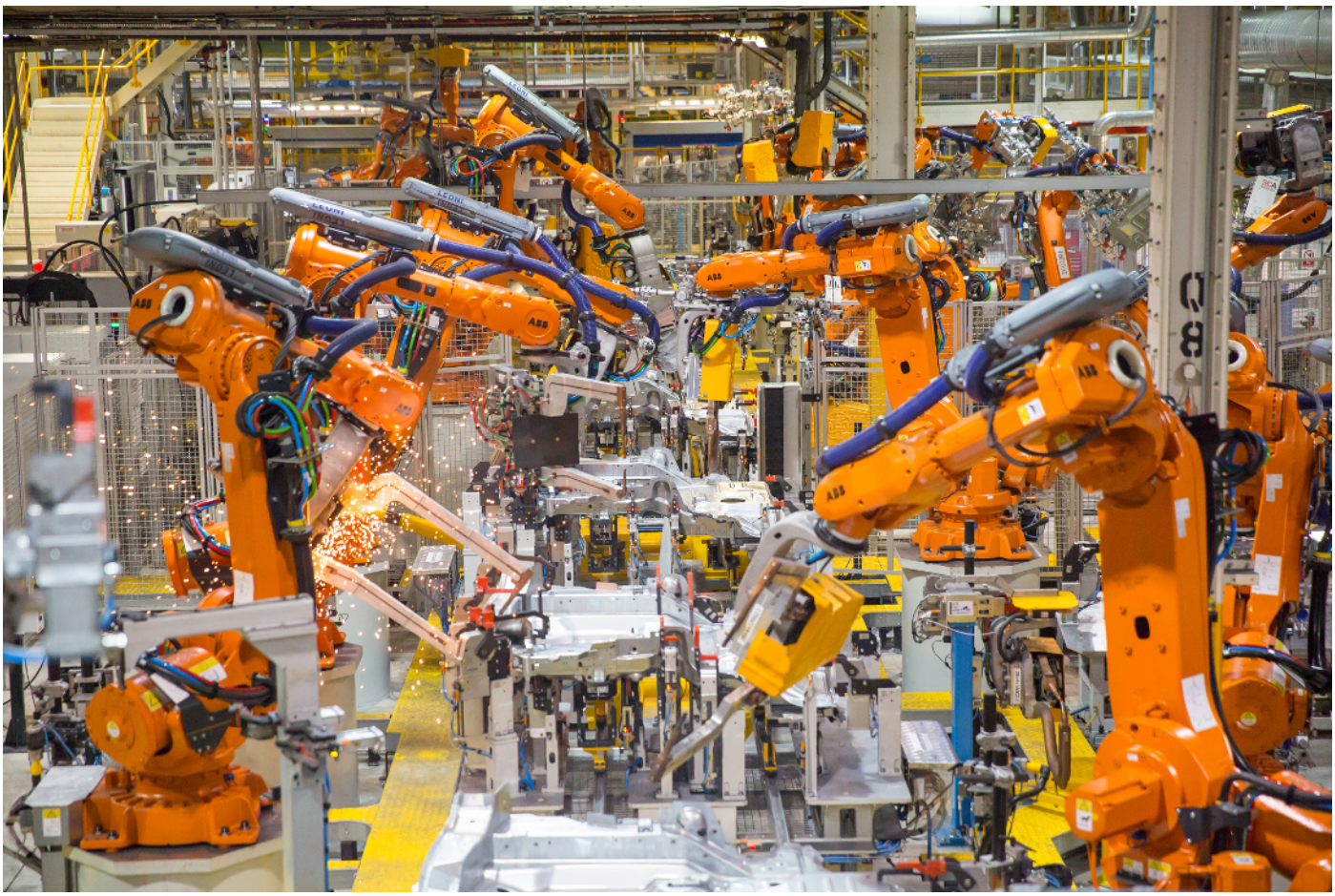
Yazzoom's YANOMALY

Yazzoom has taken these analytical capabilities to a higher level and offers them as a comprehensive solution called Yanomaly, an AI-based unsupervised anomaly detection system which can be 'plugged into' any data monitoring platform.

YANOMALY

Yanomaly is a specialized software solution developed to monitor time-series sensor data and/or control system event logs originating from machines and production lines.

It can even monitor machines and allow for early detection of technical issues. It also speeds up the diagnostic process of finding the root cause of machine failure and as a result, reduces the mean-time-to-repair. Designed to be integrated with existing data monitoring or IoT platforms, Yanomaly will run wherever the data monitoring platform runs, in the cloud or on premise, as such avoiding any new data security or privacy concerns.



False alarms from monitoring solutions can lead to time wasted in investigating non-existent problems and ultimately to distrust of the system. Yanomaly has a proven track record in minimizing these false alarms not only because of the performance of its various anomaly detection algorithms, but also because of the unique techniques it uses for anomaly analysis.

Furthermore, Yanomaly is an AI-powered anomaly detection system which can work simultaneously with a rule-based system and also complements dedicated sensors. The integration of this technology has helped its customers in various industries such as process and manufacturing, and as well as machine-builders.

Supervised vs Unsupervised

Supervised machine learning uses data with clearly labeled examples for learning so that it can detect and predict anomalous events. But for anomaly detection on industrial data, which can be noisy, complex, and have only few examples of failures, the unsupervised approach is usually preferable: the system learns and models what is 'normal' based on the available, unlabeled data, and will detect any and all deviations from this model.

The amount of data needed for machine learning to learn depends on the specific process. For example, a production process with a cycle-time of a few seconds will require a smaller data sample compared to one with a cycle-time of a few hours or weeks. To achieve optimal results, a good rule of thumb for any anomaly detection system is to use a time span of data that includes all important normal operating modes and circumstances. This ensures that not only will it represent the normal process behavior but also incorporate external factors and changes, e.g. fluctuating temperature or humidity, and raw material properties tolerances.

Because its specifically developed for industrial equipment and covers all data types including control software logs, Yanomaly detects problems earlier compared to traditional and other machine learning-based monitoring solutions, allowing it to find more subtle and complex issues with less false alarms.

Software Event Logs

Many modern machines are controlled by complex software ranging from PLC programs to supervisory control systems running on servers. This is especially true for complex machines and smart manufacturing lines. By analyzing the event logs that are written to file or to database by such machine software, deviations from normal software execution can be found. The machine learning technique used to monitor software with the help of event logs is called process mining. It is already widely used in the IT world of data centers, but is now also gaining acceptance in the world of machines and production lines.

Because each company's situation and needs can vary, Yanomaly is built to be deployed both on-premise (aka "the edge") or on various cloud platforms. Unlike many complete data platforms that offer data acquisition, storage, visualization, and alarm management, Yanomaly was built from the ground up to easily integrate with the existing data monitoring platforms, allowing it to add its capabilities to even legacy SCADA systems. This allows for a smaller project scope and also minimizes the need for re-training system operators as in the case of a completely new system which altogether makes it a cost-effective yet powerful solution for both small and large scale operations.

Univariate vs Multivariate

Univariate approaches examine sensor signals individually and attempt to discover unusual behavior in resulting real-time values, statistics or patterns in the data, e.g. oscillations. However, because they only look at a single data source at once, they cannot learn that the characteristics of a signal might depend on the state of another one or on the context of operations.

Multivariate algorithms use a combination of multiple signals in their analysis, and allow for the detection of more complex events. To capture all potential anomalies, both univariate and multivariate analysis must be used which is what Yanomaly does.

Use Case:

AGFA Specialty Products uses monitoring systems to guarantee optimal quality and process safety in its chemical production process. In addition to the written rules and alarm systems it uses, AGFA decided to leverage the latest advances in machine learning and artificial intelligence by integrating Yanomaly into their monitoring system. Yanomaly enabled predictive maintenance in AGFA by providing early warning of potential process issues several weeks in advance compared to existing tools.

Reduce downtime

Reduce mean time-to-repair

Increase ROI

Conclusion: Artificial Intelligence-Based Anomaly Detection Systems Enable Better, Smarter And More Economical Asset Management

An anomaly detection system is highly beneficial for industrial systems. For Operation Departments, it offers early warnings, the chance to take preemptive measures, and assists in problem diagnostic. When choosing a solution for anomaly detection, it is important to consider performance both in terms of detection of actual anomalies and the level of false alarms raised. Another key deciding factor is how the solution can be deployed and integrated with existing infrastructure and systems.

Yanomaly is a flexible solution which is compatible with nearly all kinds of data and sensors. It speeds up the diagnostic process of failures and can run both on the cloud or on-premise. For businesses who strive to gain a competitive advantage, considering the integration of an anomaly detection system such as Yanomaly is an important decision, and one that could make all the difference.

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About Yazzoom

Since 2011, Yazzoom has been providing advanced software and R&D services to various industries.

The company's main objective is to realize value for its customers and improve their processes by pulling their expertise in machine learning, artificial intelligence, anomaly detection, algorithmic software development, data mining, advanced process control and signal processing.

With its headquarters in Ghent, Belgium, the company is active worldwide and has offered valuable services to its customers in various sectors such as chemical, automotive, energy, pulp & paper and steel industries.Over 80% of the company's customers are public limited companies such as AGFA, Engie, Tenneco, Reynaers, Smurfit-Kappa, and Umicore.

The people at Yazzoom are strong believers of high standards of corporate, social and environmental responsibility.

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