



Achieve Unparalleled Batch Control and Business Agility in an Increasingly Competitive Pharma Industry

Take advantage of AI/ML in a GxP environment to get a better handle on your manufacturing and business data to optimize yield and predict anomalies

Introduction

Digital transformation is changing how biotech and pharmaceutical companies operate. Increased competition and an enhanced regulatory landscape are forcing drug manufacturers to eliminate waste, create efficiencies and squeeze every last bit of productivity out of existing processes. The benefits can be enormous. A three percent increase in usable yield could increase revenue by millions of dollars.

But pharmaceutical manufacturers face continuous variability in products and processes that poses significant challenges when trying to achieve a state of process and quality control, new efficiencies, and a reduction in waste. There are literally thousands of parameters and factors that go into making a consistent product. A tweak to one process can snowball down funnel and produce undesirable outcomes—creating waste and degrading quality.

The ability to capture and monitor manufacturing data and turn it into actionable data is critical. Unfortunately, this is easier said than done. Biotech and pharmaceutical companies need a better way to contextualize and analyze the mountains of manufacturing data that they produce and get it to work for them in a way that enables informed, real-time decision making for agile businesses.

This white paper explores:

- The difficulty of analyzing manufacturing data in real time
- Why existing data analysis tools fall short
- A new AI/ML powered approach to data analysis in a GxP environment that:
 - ◇ Enables real-time monitoring
 - ◇ Provides insight into historical data
 - ◇ Quickly and accurately detects outliers
 - ◇ Speeds discovery
 - ◇ Unlocks root cause analysis
- The benefits of an AI/ML powered data analytics solution
- How the Aizon Bioreactor Application fills these gaps

Lots of Data, Not Enough Time to Analyze it

There's no way around it, optimizing manufacturing operations requires complex analysis of large amounts of different types of data. Fortunately, the manufacturing process generates massive amounts of data from operators, instruments, equipment, and systems. The transformation of that data into information through real-time analytics allows operators to better monitor and control each batch, detect anomalies and make in-process tweaks to optimize yields.

Most biotech and pharmaceutical companies today do not yet have industrial-grade, scalable data analytics infrastructure in place to take advantage of this information. There's simply no efficient way to cut through the noise, analyze the pertinent data they need, create actionable information that decision makers can use to improve manufacturing processes and scale that across the global enterprise.

It's clear that companies need a tool that gives them complete visibility and control into each batch and allows them to understand, control and improve manufacturing processes in real time. Only then will biotech and pharmaceutical companies enable lean manufacturing processes that optimize yield, detect and eliminate anomalies and better compete in an increasingly competitive and regulated industry.

Lack of GxP Big Data Analysis Tools Leads to Process Knowledge Gaps

Digital biomanufacturing, artificial intelligence (AI), machine learning (ML) and cloud technologies have made it a lot easier to manage and analyze complex data sets in real time. Modern manufacturing processes require continuous monitoring, the use of Process Analytical Technology (PAT) and fast analysis to predict Critical Quality Attributes (CQA) and recommend the right process parameters for an optimum yield while the process is still running at its best throughput time.

These new tools promise to reduce costs and provide critical process knowledge to consequently design efficient and cost-effective processes. In order to achieve implementation success, AI/ML tools must be validated and meet regulatory requirements so they can be used in a GxP environment. This has led to a proliferation of inadequate data analytics tools for the biotech and pharmaceutical industry. Mainly horizontal solutions intended for general manufacturing use, today's tools are bloated, include features and functionality not useful for pharma processes and are not scalable across multiple lines and sites.

Using the wrong tool for the job prevents biotech and pharmaceutical companies from effectively analyzing extensive parameters and batches in any meaningful way. This lack of visibility and context leads to reduced process understanding and can result in a failure to deliver consistent product, despite the information that is already available.

The pressure of direct competitors in drug development forces multidisciplinary teams to follow the minimum requirements with their manufacturing processes. This destroys any incentive to come up with innovative methods for extracting the knowledge from process data. In fact, working with biological entities in bioreactors implies a real challenge for modern manufacturing since critical process parameters inherently present high variability. For this reason, obtaining real-time knowledge is increasingly necessary in continuous manufacturing to avoid process deviations that could lead to low efficiency or rejected batches.

It's clear that biotech and pharmaceutical companies need an industry-specific tool that gives them a cost-efficient, seamless way to analyze complex data sets in real time to automate yield optimization, improve anomaly detection and avoid process deviations.

AI-Powered Data Analytics in a GxP Environment

Biotech and pharmaceutical companies can leverage the power of AI and ML in a GxP environment to address data analytics issues uniquely related to pharmaceutical manufacturing processes. Such a solution needs to enable real-time monitoring across multiple bioreactors; provide insight into historical data; quickly and accurately detect outliers; speed discovery; unlock root cause analysis and integrate seamlessly with other business systems.

Enable Real-time Monitoring

All stakeholders that comprise the multidisciplinary team, in addition to operators, should be able to closely monitor any running process by visualizing all the selected variables in real time while controlling for unexpected deviations—and this should be achievable across any number of bioreactors in a GxP environment. Integration of data from multiple sources and systems is needed to break silos of data and gain a holistic view. Being able to keep track of all the relevant parameters in real time ensures better control over the whole process and each individual batch—providing operators and other stakeholders with enough time to take corrective action.

Real-Time Monitoring in Action:

- Improve batch control and process safety by making use of the different visualization tools that use P&ID, traffic lights and line graphs.
- Use customized real-time graphs to keep track of the most relevant parameters and ensure the process runs correctly and safely.
- Gain a better understanding of each step in the process by continuously visualizing its behavior from start to finish.
- Introduce advanced analytics in process monitoring to detect multivariate deviations that are difficult to identify and monitor each variable independently.

Provide Insight into Historical Data

Teams also need a solution that allows them to gain a broader view of the process by visualizing data for the whole batch. This historical context provides a deeper understanding of how the batch is proceeding and whether or not any actions are required. In addition, being able to work with historical data allows experts to gain insightful information about best and worst batches, the trends to look for in the future and the ones to avoid. Simple visualization of data is the first step to gain further knowledge about any process.

Historical Data Analysis in Action:

- Get a better picture of how well the current batch is progressing compared to past batches.
- Visualize historical data to learn about how different CPPs and other related parameters affect CQAs in the past, further improving the process knowledge gain.
- Identify wanted and unwanted trends to look for in the future and improve the overall efficiency of the process without impacting safety and quality requirements.

Quickly and Accurately Detect Outliers

The reason to use AI/ML during process execution is to detect anomalies and predict outliers at scale by analyzing the relationship between process parameters. Operators can be alerted when an unseen combination of variables occur. Operators can control for specific variables in real time, monitor a combination of them and get alerted when the process, even if within specifications, is behaving unexpectedly.

Outlier Detection in Action:

- Use AI/ML to identify unexpected process reactions that human capabilities cannot detect.
- Perform a multivariate monitoring of the process to predict deviations even when within specifications.
- Understand and visualize the variables that may impact deviations so you can react in time.

Speed Discovery

An AI/ML powered data analytics solution in a GxP environment can save substantial amounts of time by allowing process experts to compare past batches with just a few clicks. This allows them to gain statistical insights from selected batches and variables while enabling faster data analysis and richer Process Quality Review (PQR). The ability to do this quickly and seamlessly supports process knowledge generation, a critical aspect in the road to optimizing pharma manufacturing.

Discovery in Action:

- Visualize and compare different batches to detect deviations and gain insights on what makes your “golden batch” golden.
- Carry out a deep analysis of manufacturing data with advanced statistical tools and learn about how each batch develops and behaves with respect to the rest.
- Prioritize analysis by relevance.

Unlock Root Cause Analysis

In addition to batch monitoring and visualization, your solution should provide the experts with a series of advanced analytics tools and the necessary contextualization to get a more holistic view of any process and the actionable information to resolve any issues that are uncovered. This requires the ability to find previously hidden, non-linear dependencies and casualties between the selected parameters and insights into how every variable affects the process and each other while highlighting the synergistic effects of one another. The solution should also allow users to reduce the dimensionality of the process and identify the parameters that explain most of the variability.

Root Cause Analysis in Action:

- Quickly identify the root cause of your deviations with advanced tools so you can react in front of deviations.
- Find the root cause of manufacturing issues by looking at processes from a different perspective.
- Unlock the power of AI/ML to find hidden patterns in the data.
- Visualize and discover the causality and dependence between process variables to find hidden insights.
- Generate models based on past failed and successful batches to identify their multivariate pattern and control the development of all future processes deriving from these patterns.

Integrate with Other Business Systems

Useful data exists in other business systems such as Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Quality Management System (QMS), Laboratory Information Management System (LIMS), Building Management System (BMS), Manufacturing Execution System (MES), Supervisory Control and Data Acquisition (SCADA) and Distributed Control System (DCS) among other solutions. The ability to pull data from these systems into a central platform provides much needed additional context and enriches decision making.

Automate Yield Prediction and Anomaly Detection

Yield is used to measure the expected specification and quality of the intermediate and final products. A sequence of multiple operations are chained during the batch or continuous manufacturing make yield prediction extremely complex. AI/ML can be used to analyze this information at scale, making it much more consumable and actionable. Therefore, the relevant factors involved in the yield can be predicted based on the on-going measurements, with enough time in advance to recommend actions to ensure the expected result.

A second AI analysis based on a continuous monitoring of detected anomalies becomes a crucial step to keep the final yield under control. Both mechanisms (yield prediction and anomaly detection) turn out to be a systematic control for adaptive processes which require a high accuracy and rigor in the final specifications.

The Aizon Bioreactor Application

Aizon's Bioreactor Application is a pre-built solution designed to meet the complex needs of modern pharmaceutical production for upstream processes. Designed to work with both continuous and fed-batch bioreactors, Aizon's application provides a new, more efficient way to analyze process data that takes into account real-time batches, finished batches and multivariate parameters inside the upstream process—including external, previous or downstream manufacturing steps.

The Bioreactor Application provides an easy and fast way to use any real-time sensor from a manufacturing site. It scales across multiple bioreactors—providing a central dashboard for site managers and other stakeholders to make real-time decisions and predictions about batch and continuous processes. It can also pull in critical data from other data systems—further enriching decision-making beyond just manufacturing processes.

Aizon's Bioreactor Application is the first solution designed to industrialize AI/ML for bioprocessing and covering modern manufacturing needs in a GxP environment ready for compliance with 21 CFR Part 11. As such, all the functionalities have been designed to allow the user to guarantee all the applicable data integrity requirements from the industry. Furthermore, Aizon's software development life cycle (SDLC) follows GAMP 5 recommendations, ensuring GxP compliance throughout the platform. This is an exciting moment to introduce pioneering tools into a pharma industry that is undergoing digital transformation established in Pharma 4.0.

Rethink Real-Time Data Analysis

Biotech and pharmaceutical companies are under increasing pressure to go lean and create efficiencies throughout their manufacturing processes. Visibility into batch processes provides the necessary context manufacturers need to automate yield optimization and anomaly detection, but existing data analysis tools are ill-equipped to handle the large and complex data sets produced by manufacturing processes. The Bioreactor Application is Aizon's response to the challenges and opportunities the pharma industry is facing today. It is a ready-made application that allows users to monitor a process in real-time, visualize historical data, and apply AI/ML to discover the root-cause of their manufacturing inefficiencies.

Connect with us at info@aizon.ai to connect with the Aizon team and learn more about how you can use the Aizon Bioreactor Application to automate yield optimization and anomaly detection.

About Aizon: Aizon is a software provider that transforms manufacturing operations with the use of IoT, cloud, advanced analytics, artificial intelligence, and pharma 4.0 technologies focused on optimizing pharmaceutical and biotech companies. The Aizon analytics platform seamlessly integrates unlimited sources of structured and unstructured data to deliver actionable insights across all manufacturing sites. Aizon offers an intuitive way to gain meaningful operational intelligence with data by enabling real-time visibility and predictive insights in a GxP compliant manner with end-to-end data integrity. Aizon is based in San Francisco, California and also has a European office in Barcelona, Spain.