



SENSEYE PREDICTIVE MAINTENANCE

Efficiency Elevated: The Strategic Role of Predictive Maintenance in the Pharmaceutical Industry

Find out more: [siemens.com/senseye-predictive-maintenance](https://www.siemens.com/senseye-predictive-maintenance)

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Introduction

It is imperative that the pharmaceutical industry maintains exact standards of quality, safety, and efficiency. Unplanned downtime, quality lapses, and inefficiencies not only disrupt operations but also have far-reaching consequences for patient safety, regulatory compliance, and profitability.

Predictive Maintenance (PdM) is transforming pharmaceutical manufacturing by enabling companies to shift from reactive to proactive strategies. By leveraging advanced analytics and real-time data, PdM ensures equipment reliability, minimizes costs, and enhances operational efficiency.

This whitepaper explores how PdM addresses the unique challenges of pharmaceutical operations. It provides a step-by-step guide to overcoming cultural, technological, and data management hurdles, while showcasing the transformative potential of solutions like Senseye Predictive Maintenance.



Challenges in **Pharmaceutical** Operations

The pharmaceutical industry operates in a high-stakes environment where unplanned downtime, quality issues, and inefficiencies can lead to significant financial losses and reputational damage. Addressing these challenges requires innovative solutions like Senseye Predictive Maintenance, which helps pharmaceutical companies optimize equipment performance, maintain compliance, and improve operational efficiency.

1. Complexity and Fragmentation of the Value and Supply Chain

Pharmaceutical supply chains are intricate, involving multiple stages from sourcing raw materials to distributing finished products. Delays or disruptions in any part of the chain can result in production stoppages and missed delivery targets, costing companies millions.

To put this into perspective, inefficiencies in supply chains cost the pharmaceutical industry an estimated \$50 billion annually. Senseye Predictive Maintenance minimizes these inefficiencies by ensuring critical equipment remains operational, preventing bottlenecks, and improving the overall flow of materials and products. Platforms like Senseye Predictive Maintenance further enhance operational stability by integrating condition monitoring data into supply chain processes, allowing companies to avoid costly delays.

2. Quality Management

Maintaining product quality is essential in the pharmaceutical industry, where even minor deviations can lead to regulatory penalties, customer mistrust, or product recalls. A single recall can cost a company up to \$8 million, not including long-term damage to brand reputation.

Senseye Predictive Maintenance mitigates this risk by providing continuous condition monitoring of key parameters like pressure, torque, and temperature. This ensures equipment operates within strict tolerance levels, safeguarding product quality. For example, Senseye Predictive Maintenance establishes a unique “digital fingerprint” for each asset, enabling precise, asset-specific monitoring rather than relying on generic templates or OEM specifications.

3. Resource and Cost Efficiency

Unplanned downtime is among the costliest issues pharmaceutical manufacturers face, with downtime expenses averaging \$260,000 per hour. These interruptions not only disrupt production schedules but also waste valuable materials and labor.

Senseye Predictive Maintenance addresses this by helping maintenance teams focus on repairing or replacing equipment only when necessary. This approach reduces maintenance costs by an average of 25% and extends equipment lifespans by 30%, leading to significant savings over time. By aligning maintenance activities with production schedules, Senseye ensures resource efficiency and prevents unnecessary operational disruptions.

4. Data Silos, Security, and Compliance

Pharmaceutical operations generate vast amounts of data, but much of it remains siloed across different systems. At the same time, the industry’s strict regulatory environment requires robust data security and traceability.

Senseye Predictive Maintenance integrates data from various sources, breaking down silos and enabling comprehensive operational insights. These systems anonymize sensitive production data where possible, maintaining regulatory compliance while providing actionable insights for maintenance teams. This ensures that Senseye Predictive Maintenance is a secure and valuable addition to the pharmaceutical operational ecosystem.

5. Potential Costs from Unexpected Recalls

Unexpected equipment failures can result in contaminated batches or production delays, potentially leading to product recalls. Such recalls are not only financially draining but also harmful to a company’s reputation.

Pharmaceutical companies using Senseye Predictive Maintenance experience 45% fewer product recalls than those relying on reactive maintenance strategies. By proactively identifying and addressing potential failures, Senseye Predictive Maintenance significantly reduces the likelihood of costly disruptions.

The Broader Impact of PdM on Pharmaceutical Operations

The pharmaceutical industry operates under immense pressure to maintain efficiency, ensure regulatory compliance, and guarantee high-quality production—all while keeping costs under control. Predictive Maintenance (PdM) offers a transformative solution by leveraging advanced analytics and real-time data to predict and prevent equipment failures before they occur.

This shift from reactive to predictive strategies is not just a technological upgrade—it is a critical evolution for a sector that cannot afford downtime.

Historically, maintenance in the pharmaceutical industry resembled firefighting—addressing breakdowns only after they disrupted production. While scheduled maintenance introduced a proactive element, it often led to increased labor and downtime costs. Today, predictive maintenance technologies provide the foresight needed to anticipate issues and mitigate them before they escalate. For pharmaceutical companies, where a single equipment failure can result in compliance breaches or compromised product integrity, PdM has become a necessity.

Enhanced Equipment Reliability

PdM improves overall equipment effectiveness by ensuring machinery operates at optimal performance. Companies implementing PdM report an average 15% increase in equipment efficiency, translating to more consistent production and fewer delays.

More efficient use of equipment and resources

PdM can help maintenance teams reduce unnecessary maintenance and extend equipment lifespans by identifying developing issues earlier. This can support more efficient use of equipment, materials and maintenance resources.

Scalability Across Global Operations

PdM systems are scalable and adaptable, making them ideal for global pharmaceutical companies with operations across multiple facilities. By treating each asset as unique, systems like Senseye Predictive Maintenance enable companies to maintain high standards of equipment reliability across diverse regions and regulatory environments.



Predictive Service Assistance helps prevent shutdowns and **optimize maintenance**

Ensuring production continuity and optimizing maintenance are critical priorities in manufacturing plants. Avoiding costly shutdowns caused by undetected electrical failures in motors and developing effective maintenance strategies are essential to maintaining operational efficiency.

How PSA Helped

Predictive Service Assistance (PSA) continuously monitored motor performance, preventing unplanned shutdowns. When a sudden error in the frequency drive signaled a motor issue, PSA alerted the maintenance team immediately. A Siemens Field Service Engineer remotely accessed the PSA dashboard, quickly diagnosing an electrical fault by analyzing historical and real-time data. The motor was replaced without delay, minimizing downtime and ensuring production continuity.

Impact and Challenges Solved

This quick response minimized production losses and reduced maintenance time and costs, addressing budget constraints and labor shortages. Remote assistance also enabled the issue to be investigated without an on-site visit.

Key Outcome

PSA ensured the rapid repair of a critical motor, maintaining efficiency and minimizing disruptions, proving its value in keeping operations running smoothly.



Success Case - Silicone Valves

- Industry - Pharma
- Machine Type - Filling Line

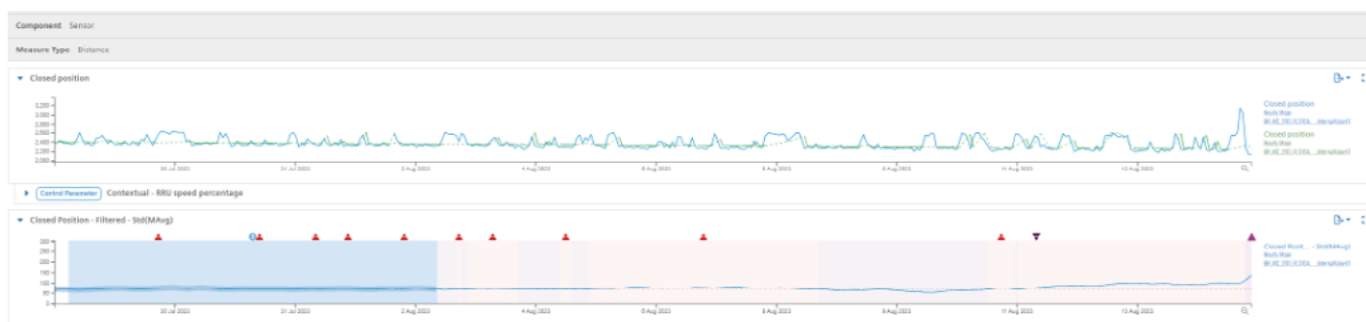
An increased change in valve closed position indicating valve degradation which would affect product quality and lead to unplanned downtime.

- The Issue - Valve closed position drift increasing
- The Action - Replaced the Valve
- 168k Units saved in breakdown reduction and product loss

The Result:

“The Senseye PdM application is monitoring the change in closed position of our silicone valves on the vial filling line. If one of the valves fails, this causes unplanned downtime and product scrap due to rework. With such advanced notification of valve failure, this allowed the maintenance team to plan in the replacement of the degrading valve, during a planned maintenance shutdown, which avoided many hours of downtime and a huge amount of product waste”.

Increasing change in the valve close position >100 MICRONS



Benefits of PdM in Pharma

Maintenance technologies provide the foresight needed to anticipate issues and mitigate them before they escalate. For pharmaceutical companies, where a single equipment failure can result in compliance breaches or compromised product integrity, PdM has become a necessity.

- Increased Asset Uptime: Real-time monitoring of critical machinery ensures uninterrupted operations.
- Reduced Maintenance Costs: Early detection of wear and tear minimizes expensive emergency repairs.
- Enhanced Energy Efficiency: Optimizing machinery performance lowers energy consumption.
- Optimized Scheduling: Efficient planning prevents unscheduled downtime, saving time and resources.
- Improved Safety and Compliance: Preventing failures reduces workplace hazards and ensures regulatory adherence.
- Extended Equipment Lifespan: Regular condition monitoring prolongs the operational life of assets.
- Increased Production Quality: By catching potential issues early, PdM ensures consistent



Core PdM Techniques for Pharma Assets

Predictive Maintenance integrates a range of monitoring techniques tailored to the specific needs of the pharmaceutical industry such as:

- **Vibration Analysis:** Identifies wear or misalignment in machines like tablet presses, enabling repairs during scheduled maintenance.
- **Thermography:** Detects overheating components in systems such as clean-in-place (CIP) processes, preventing contamination risks.
- **Ultrasound:** Pinpoints leaks or bearing defects in utilities, reducing the likelihood of downtime.
- **Oil Analysis:** Tracks wear particles in lubricants, ensuring smooth operation of equipment like granulators.
- **Motor Circuit Analysis:** Monitors electrical systems for faults in motors driving mixing or coating equipment.

Applications of PdM Across Pharma Operations

Predictive Maintenance delivers significant benefits across various critical areas of pharmaceutical manufacturing:

- **Black Utilities:** Ensuring consistent supply of energy, water, and air reduces production risks and maintains quality standards.
- **Clean Utilities:** Reliable maintenance of sterile systems prevents contamination and upholds regulatory compliance.
- **Production Lines:** PdM ensures uninterrupted operations of blending, granulation, and compression equipment, maintaining product quality and consistency.
- **Packaging:** Avoiding failures in blister packers or labeling machines ensures efficient, compliant, and traceable packaging processes.

Solving Critical Issues with PdM

Predictive Maintenance addresses challenge that traditional maintenance approaches cannot resolve:

- **Downtime Reduction:** Anticipating failures keeps production lines operational.
- **Cost Control:** Avoiding emergency repairs and production halts reduces costs.
- **Regulatory Adherence:** Meeting stringent pharmaceutical standards is achieved through reliable asset performance.
- **Production Quality:** Maintaining equipment health ensures the integrity and compliance of the final product.

PdM as a Foundation for Artificial Intelligence (AI) Advancements in Pharmaceutical Manufacturing

While PdM is only one part of AI-driven advancements in pharmaceutical manufacturing, it plays a critical supporting role. By ensuring reliable and efficient equipment performance, PdM creates a stable operational environment that enables AI technologies to focus on transformative areas like drug discovery and development.

AI harnesses predictive modeling and simulations to analyze extensive biological and chemical datasets, enabling faster and more accurate identification of potential drug candidates. By ensuring high levels of production efficiency through predictive maintenance (PdM), pharmaceutical companies can seamlessly integrate AI innovations, accelerating the delivery of new therapies to market without compromising quality or compliance standards.

A key recent advancement in PdM platforms, in particular Senseye Predictive Maintenance is the integration of Generative AI (Gen AI), which brings transformative capabilities such as:

- **Knowledge capture:** Preserving years of expertise and institutional knowledge.
- **Copilot chatbots:** Offering instant, context-aware support to onsite staff.
- **Translation services:** Bridging communication gaps between global teams.

These innovations significantly enhance the impact of PdM on pharmaceutical operations, driving efficiency, collaboration, and innovation across the industry

Readiness for Predictive Maintenance in Pharma

Predictive Maintenance offers transformative potential for the pharmaceutical industry, particularly in optimizing equipment reliability and ensuring uninterrupted research and development processes. However, achieving readiness for PdM requires more than just implementing advanced technologies; it demands cultural alignment, openness to change, and robust data management strategies. These factors are critical in addressing the challenges that impact the industry's ability to fully leverage PdM.

1. Site Culture: Laying the Foundation for PdM Success

In pharmaceutical research and development, a site's culture plays a pivotal role in determining the success of PdM initiatives. A forward-thinking, collaborative culture fosters innovation and embraces new maintenance paradigms. However, many organizations face resistance to change, often rooted in traditional maintenance practices and a lack of understanding of PdM's strategic value.

Encouraging Cultural Readiness:

- **Promote Awareness:** Highlight how PdM reduces unplanned downtime, safeguards research and development timelines, and cuts costs. Providing real-world examples from leading pharmaceutical companies can illustrate the tangible benefits of PdM.
- **Engage Stakeholders:** Involve cross-functional teams early in the PdM planning process to ensure alignment of goals and shared accountability.
- **Cultivate a Growth Mindset:** Encourage employees to view PdM as an opportunity to enhance operational efficiency and innovation rather than as a disruption to existing workflows.

2. Attitude and Receptiveness: Overcoming Resistance to Change

Adopting PdM requires a fundamental shift from reactive to proactive maintenance. Resistance to this shift often stems from fear of the unknown, perceived risks, or a lack of trust in new technologies. Overcoming these barriers involves demonstrating PdM's value and building confidence in its application.

Building Receptiveness:

- **Education and Training:** Equip teams with the knowledge and skills to understand and effectively implement PdM systems.
- **Quick Wins:** Start with small-scale PdM implementations that deliver measurable results, showcasing the potential for broader success.
- **Leadership Advocacy:** Strong advocacy from leadership underscores the importance of PdM and creates a supportive environment for its adoption.



3. Data Management Challenges in Pharma Research and Development

Effective PdM relies on high-quality data for accurate predictions. However, the pharmaceutical industry faces significant challenges in managing vast amounts of data, ensuring data quality, and integrating information across disparate systems. These challenges mirror broader data management issues prevalent in research and development.

Key Data Management Challenges

Data Silos

Data silos hinder the integration and analysis of critical information needed for PdM. In pharmaceutical research and development, these silos often result from fragmented organizational structures, technological incompatibilities, and cultural barriers.

Solutions:

- Deploy advanced data integration platforms.
- Foster cross-functional collaboration to ensure seamless data sharing.
- Adopt standardized data formats and interoperable systems.

Data Security and Compliance

Pharmaceutical data, including patient information and proprietary research, is highly sensitive, requiring stringent security and compliance measures. Failure to comply with regulations like GDPR can result in substantial penalties and reputational damage.

Solutions:

- Conduct regular security audits.
- Train employees in data security protocols.
- Implement advanced cybersecurity measures, such as encryption and multi-factor authentication.

Data Quality Integrity

Inconsistent, incomplete, or unreliable data can undermine the effectiveness of PdM models. High-quality data is especially critical in an industry where errors can affect patient safety and regulatory outcomes.

Solutions:

- Employ robust data validation and governance frameworks.
- Use automated tools for data cleaning and analysis.
- Cultivate a culture of data integrity through continuous monitoring and quality checks.

Achieving readiness for PdM in the pharmaceutical industry is not just a technological challenge—it is a strategic imperative. By fostering cultural readiness, encouraging openness to change, and addressing data management challenges, the industry can unlock PdM's potential to enhance operational efficiency, accelerate innovation, and deliver life-saving therapies to market more rapidly.



Improving **productivity** with Senseye Predictive Maintenance

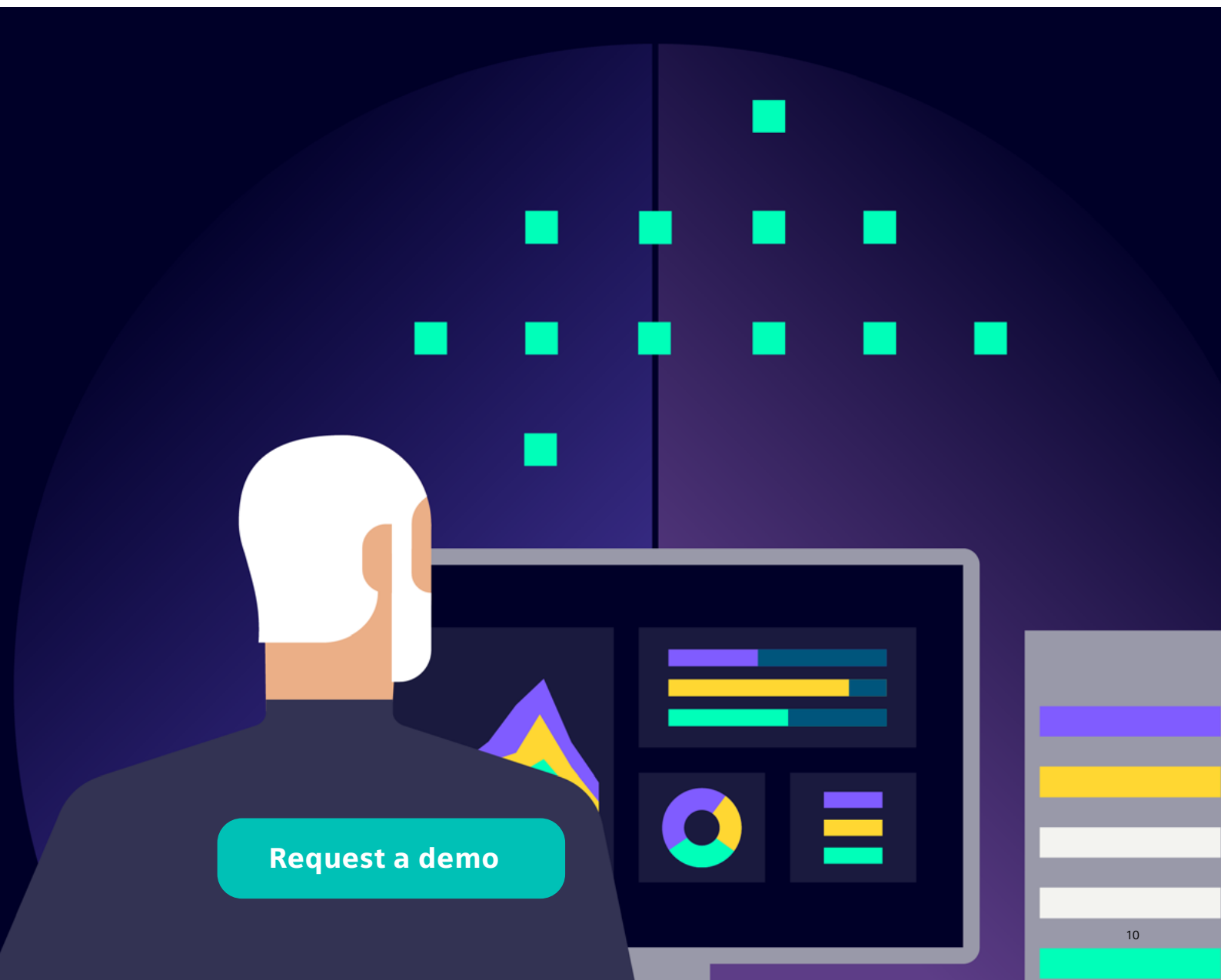
Digitalizing your organization is challenging, whatever stage you're at. From retrofitting and connectivity through to condition monitoring and predictive maintenance, Siemens offers solutions across all industries, from SMEs getting started on their digital transformation journey to multinational enterprises looking to enable predictive maintenance at scale.

Senseye Predictive Maintenance gives you visibility and insights into all your assets, from single machines to full plants to help you reduce downtime, increase knowledge sharing and accelerate digital transformation across your organization.

PdM means firms can service machines before they break down, not after, eliminating the need for exhaustive, costly preventative maintenance schedules.

By bringing in PdM, clients have shown the following:

- Up to 85% improvement in downtime forecasting accuracy
- Up to 50% reduction in unplanned machine downtime
- Up to 55% increase in maintenance staff productivity
- Up to 40% reduction in maintenance costs



[Request a demo](#)

Appendix

DIGITAL TRANSFORMATION AND INDUSTRY 4.0 IN PHARMA MANUFACTURING: THE ROLE OF IOT, AI, AND BIG DATA Sanket J Soni* 1, Ankit Kumar N Patel2

Extracts from "Trend Detection Podcast: Pharmacy and Predictive Maintenance with Chris Smith

<https://siemens.fm/public/podcasts/e95c2cadcac1ca85a383cc14d7220e76f2ec4a630713105180c33fc475dcb7e0/episodes/b4b7ae1299b300567b13d0a5421b0d75/details>

<https://assets.new.siemens.com/siemens/assets/api/uuid:8ee59c19-1c37-4516-a290-2844096f1cff/Readiness-Report-2023-original.pdf>

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