Addressing Barriers to Advanced Analytics and Predictive Maintenance

Manufacturing companies, particularly those entrenched in the Operational Technology (OT) landscape, encounter a complex array of challenges when it comes to adopting data analytics, condition monitoring, and predictive maintenance solutions. These challenges stem primarily from the inherent complexities of integrating these advanced technologies with existing systems and processes. Additionally, the OT environment is characterized by a diverse range of equipment and machinery, often from various manufacturers, making standardization and data harmonization difficult to achieve.

> Many manufacturers rely on legacy systems that were not designed for seamless integration with modern analytics platforms, presenting significant hurdles in establishing connectivity and data interoperability.

Beyond technical barriers, manufacturing firms also grapple with organizational challenges. There may be a lack of necessary expertise to interpret and act on data insights effectively, as data analytics often require skill sets that traditional maintenance teams do not possess. Budget constraints further complicate the adoption process, as it involves significant investments in both technology and workforce training. Manufacturers must also manage change resistance among employees who are accustomed to conventional practices and may be skeptical about transitioning to data-driven decision-making. Security concerns add another layer of complexity, as increasing connectivity between OT and IT can expose systems to cyber threats. Together, these challenges create a formidable obstacle course that manufacturers must navigate to fully leverage the potential of analytics, predictive maintenance, and condition monitoring for enhanced operational efficiency, reliability, and competitiveness in the digital age.

Lack of a Clear Strategy

Lack of a clear strategy is a common obstacle many organizations face when attempting to adopt data analytics, condition monitoring, and predictive maintenance solutions. Without a well-defined plan, companies may struggle to identify specific goals, priorities, and the measurable benefits they hope to achieve. This creates ambiguity about where to start, which systems to invest in, and how to align new initiatives with overall business objectives.

A deficiency in strategic planning can lead to fragmented efforts, redundant investments, or missed opportunities to leverage data effectively. Organizations may also find it difficult to secure executive buy-in or allocate resources efficiently without a clear roadmap to demonstrate the potential return on investment. Ultimately, without a structured approach, the adoption of advanced maintenance technologies can become disjointed, slow, or ineffective, hindering the ability to realize significant operational improvements and long-term value. Establishing a clear, strategic foundation is essential to guide phased implementation, ensure alignment across departments, and maximize the impact of data-driven initiatives.

Strategy Development

Creating a strategy for adopting data analytics, condition monitoring, and predictive maintenance involves a structured approach that aligns technology initiatives with business goals. Here's a step-by-step process to develop an effective strategy:

1. *Define Business Objectives:*
   Start by understanding the key goals of your organization – whether it's reducing downtime, minimizing maintenance costs, improving asset reliability, or enhancing safety. Clear objectives help to prioritize initiatives that deliver measurable impact.

2. *Assess Current State:*
   Conduct a thorough review of existing assets, infrastructure, data maturity, and technology systems. Identify gaps, redundancies, and areas where data collection or integration needs improvement.

3. *Engage Stakeholders:*
   Collaborate with maintenance, operations, IT, finance, and executive teams to gather insights, ensure alignment, and foster buy-in. Stakeholder input helps shape a comprehensive approach that addresses different needs.

4. *Identify Use Cases and Priorities:*
   Determine which assets or processes will benefit most from predictive analytics and condition monitoring. Focus on high-impact, quick-win projects first to demonstrate value and build momentum.

5. *Develop a Roadmap:*
   Create a roadmap with a phased approach that includes short-term pilot

projects, mid-term expansion, and long-term scaling plans. Define milestones, resources needed, and success metrics for each phase.

6. *Invest in Data and Technology Infrastructure:*
   Plan for the necessary hardware, sensors, connectivity, and analytics tools. Establish data governance practices to ensure quality, security, and compliance.
7. *Build or Develop Skills:*
   Identify skill gaps and invest in training or hiring to build expertise in data analytics, machine learning, and IoT technologies.
8. *Establish Governance and Change Management:*
   Create policies for data management, security, and ongoing maintenance. Develop change management initiatives to ensure adoption across teams, including communication plans and training.
9. *Measure and Refine:*
   Continuously track KPIs aligned with business objectives. Use lessons learned from initial projects to refine processes, improve models, and expand capabilities.
10. *Executive Support and Communication:*
    Secure ongoing support from leadership and communicate progress regularly to maintain momentum and demonstrate tangible benefits.

By following these steps, your organization can establish a clear, actionable strategy that maximizes ROI from data analytics, condition monitoring, and predictive maintenance initiatives, and ensures long-term success.

Legacy Systems

Legacy systems refer to outdated or older technology and equipment that are still in use within an organization. In the context of manufacturing and the Operational Technology (OT) environment, these systems present several challenges when organizations attempt to adopt modern data analytics, condition monitoring, and predictive maintenance solutions.

The Legacy System Challenge

Legacy systems in manufacturing are characterized by several significant challenges that hinder their integration with modern technologies. One key issue is limited connectivity; these older systems often lack the capability to connect to current networks or the internet, which makes it difficult to share data with newer analytics platforms or cloud-based solutions. This restricted communication capability prevents real-time data exchange and hampers efforts like condition monitoring and predictive maintenance.

The use of proprietary protocols and interfaces is another characteristic that is commonly found. Many legacy systems rely on outdated communication standards that are not compatible with industry-standard protocols used today, complicating efforts to seamlessly integrate them into contemporary hardware gateways and applications.

> Legacy systems often have a rigid architecture – designed for specific functions in a specific era – lacking the flexibility needed to adapt to evolving manufacturing needs, technological advancements, or process improvements. This lack of flexibility makes modernization efforts more complex and costly.

Strategies for Modernization in the Face of Legacy Systems

Modernizing legacy systems requires a strategic approach that balances operational continuity with technological advancement. One effective method is gradual, incremental upgrades, where companies replace specific components or integrate modern technology into existing systems. This allows for improvements in functionality without the need for complete overhaul, minimizing disruption, and spread-out costs. Implementing middleware solutions can facilitate communication between older equipment and new systems, enabling seamless data extraction, integration, and normalization, without requiring extensive hardware changes.

Another common strategy is retrofitting legacy equipment with IoT sensors and devices. This approach provides additional data collection capabilities and connectivity options, helping bridge the gap between outdated and current technologies. For organizations seeking tailored solutions, engaging technology consultants or specialists in legacy system integration like SMS is invaluable. They

can offer expert advice and develop custom solutions that align with the organization's specific needs.

Additionally, developing a long-term roadmap is essential – gradually phasing out unsupported systems and investing in scalable, flexible platforms that can accommodate future technological changes will ensure ongoing operational efficiency and growth.

Addressing the challenges presented by legacy systems requires a thoughtful approach that balances operational continuity with technological progress, ultimately enabling organizations to unlock the benefits of modern data analytics and predictive maintenance solutions.

Cost

Cost concerns are a significant barrier for many manufacturers considering the implementation of advanced analytics tools and predictive maintenance systems. The initial investment can be substantial, covering not just the acquisition of software and hardware, but also the costs associated with upgrading existing infrastructure, integrating new technologies with legacy systems, and training staff to effectively utilize these tools.

A primary concern is the immediate allocation of financial resources without guaranteed short-term benefits. Organizations may find it challenging to justify such investments to stakeholders or decision-makers, especially when faced with competing budgetary priorities. The perceived risk of not achieving a clear and rapid return on investment can make companies reluctant to commit to new technology expenditures.

The full value and ROI of advanced analytics are often realized over the long term through improved efficiencies, reduced downtime, and better asset management. However, quantifying these benefits in advance can be difficult, leading to hesitancy in approving the necessary capital expenditure. This is particularly true in industries with tight margins, where financial risk must be carefully managed.

To mitigate these cost concerns, companies can start with smaller projects that demonstrate the tangible benefits of analytics-driven approaches. These projects can help validate the effectiveness of predictive maintenance and condition monitoring, providing the evidence needed to convince stakeholders of the long-

term financial gains. Also, exploring flexible pricing models, such as subscription-based services or phased deployments, can help spread out costs and reduce the initial financial burden, making it easier for companies to embark on the digital transformation journey.

These initial projects typically focus on a limited set of high-value assets or critical processes, allowing organizations to test the technology in a controlled environment and gather valuable insights.

This approach provides several key advantages. It allows companies to evaluate different technologies and vendors, identifying those that best align with their operational needs and objectives. By focusing on specific use cases with the potential for significant impact, such as reducing equipment downtime or extending asset life, organizations can generate measurable benefits that illustrate the value of these technologies to stakeholders.

However, there are some drawbacks to implementing small projects and pilots. Relying heavily on pilot projects without transitioning to full-scale implementation can significantly limit a company's ability to realize the full benefits of digital initiatives like advanced analytics and predictive maintenance. These small-scale efforts often provide only limited returns, while ongoing costs for technology, training, and management continue to accumulate without delivering substantial operational or financial value. This slow progression can hinder the organization's ability to optimize critical processes, reduce downtime, and improve safety – areas where broader deployment could have a measurable impact.

PILOTS

As projects yield positive results, they serve as compelling case studies for larger implementations. The success of a pilot can help build confidence among decision-makers and stakeholders, providing the evidence needed to justify further investment. This gradual approach reduces the perceived risk and helps secure buy-in from all levels of the organization, including those who may have been initially skeptical about the new technologies.

Additionally, a continued focus on pilots can create organizational frustration and fatigue, as teams may view these initiatives as experiments rather than strategic priorities. This hampers building momentum for widespread digital transformation, leaving the company at a competitive disadvantage. Fragmented data in isolated pilot environments can also limit holistic analysis and decision-making. To truly capitalize on the investment, organizations need a clear strategy for scaling pilots into integrated, enterprise-wide solutions, establishing a pathway that links initial proof concepts to long-term, sustainable value and growth.

Conclusion

In summary, manufacturing companies face numerous technical, organizational, and financial hurdles when adopting advanced data analytics, condition monitoring, and predictive maintenance solutions. Legacy systems, data silos, lack of expertise, and security concerns all contribute to a slow or fragmented transformation process. Establishing a clear, well-structured strategy is essential to overcoming these challenges, defining specific objectives, assessing current capabilities, involving key stakeholders, and developing phased roadmaps that incorporate achievable milestones. By doing so, organizations can smoothly transition from pilot projects to broader deployments, ensuring that each step delivers measurable value and aligns with long-term operational goals.

However, it's vital to recognize the risks associated with over-reliance on pilots. While small-scale initiatives can demonstrate tangible benefits and build confidence, they often fall short of unlocking the full potential of digital transformation if not scaled effectively. Continued focus solely on pilots may lead to limited ROI, increased costs, and organizational fatigue, ultimately hindering the competitive edge that comprehensive analytics and predictive maintenance can provide. To succeed, companies must develop a clear roadmap for scaling pilots into integrated, enterprise-wide solutions, transforming initial proof-of-concept successes into sustainable, long-term operational improvements that drive meaningful growth and resilience in today's rapidly evolving manufacturing landscape.

The barriers are real – but so is the opportunity.

If you're ready to evaluate where your operation stands and take the next step toward predictive maintenance at scale, we're here to help.

Contact us to start the conversation or learn more at sms-inc.net.