FROST & SULLIVAN

CONVERGENCE OF CONDITION MONITORING AND ASSET RELIABILITY MAXIMIZES OPERATIONAL PERFORMANCE

Integrated Asset Performance Management models reduce technology debt of customers

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FROST & SULLIVAN VISUAL WHITEPAPER

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Industry's Complex Relationship with Digitalization

WHAT IS HOLDING BACK THE SUCCESS OF DIGITAL TRANSFORMATION IN APM?

In process industries, fewer than 15% of assets are production-critical. These assets utilize machine protection and remote monitoring capabilities. However, the remaining 85% of assets are largely left out of automated monitoring. Achieving plant-wide visibility across all types of assets enables smarter and more efficient operational performance. Plant digitalization at asset level is the lowest hanging fruit, yet is still a highly under-leveraged benefit.

Digital technologies in the industry represent a **$1.5 billion market expected to top $4.0 billion by 2025,** expanding at more than 15% per year.

70% of companies have, or are working on, a **digital transformation** strategy, but **many companies still struggle with performance improvements.**

1. Morgan, Blake. Forbes, Dec 16, 2019. https://www.forbes.com/sites/blakemorgan/2019/12/16/100-stats-on-digital-transformation-and-customer-experience/?sh=7f01d6d33bf3

Challenges in Achieving Digitalization of Asset Performance Management

Data and Functional Silos

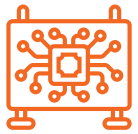
> "Everybody has their silos, vibration in their silos, operations folks in silos, looking at different pieces and process. Then you have process engineers, reliability engineers looking at different pieces. Our group is looking to put everything in one place in which we will pull the data."
>
> *—Maintenance Engineer, chemicals and fuels company*

Shrinking Skilled Labor Force

> "You are going to see an exodus of baby boomers from the industry. I'm in the last year of it. Awful lot of guys retiring in the next 5 to 6 years; lot of highly skilled people with lot of task knowledge are going to exit, and the industry is going to suffer because of it. You will have noticeable decline in production and reliability. This could lead to industry safety issues as well."
>
> *—Reliability Engineer, a leading global supplier of LNG*

Missing an Integrated View of Asset Health and Reliability

> "Our vibration specialist looks at specific machines. He has to go down to the control room to look at the data. It sends an alert to the technician. That's all. Ideally, our vibration technician could look at any machine from his/her room."
>
> *—Head of Maintenance, a leading Asian O&G company*



Technology and Digitization at the Expense of Process

> "We do not have a roadmap to instrument our non-critical [equipment]."
>
> *—Reliability team lead, major Texas LNG company*

The Impetus for Modernizing Industry

The main impetus is to manage the increasing number of devices and the exponential growth in generated data.

IIoT connected devices will triple from 2020 to 2025, from 3 billion to more than 9 billion.

Over 2/3 of businesses interviewed by Frost & Sullivan state their business data expands by 25% or more annually.

Converging reliability, engineering, and maintenance functions are creating new asset management models.

Along with efficiency, productivity, and safety, environmental performance, cybersecurity, and regulatory compliance are becoming critical facets of industrial asset management.

Industrial customers are moving from CAPEX-heavy models to OPEX-based solutions to help align resource expenditure with business growth.

Industrial businesses are racing to implement digitally enhanced solutions and customer experiences that create greater repeatable revenue streams and higher margins.

Challenge 1: Data and Functional Silos

Creating a common digital thread

Data volumes are increasing within customer organizations. They have a challenge of mountains of data, but molehills of insights.

Data trapped in functional silos, varied infrastructures and platforms, and unstructured data are the main reasons for underutilized data. Asset strategy, condition monitoring, inspection, analytics, and other data associated with machine health and performance are often captured in different data systems and cannot easily be integrated into a single pane of glass view.

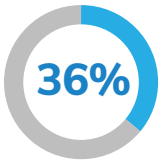
Legacy and unstructured data also struggle to communicate across systems and disparate sites, creating challenges for analysis and performance benchmarking.

Organizations are finding that simply compiling different data sources into a single data lake does not support more valuable insights because consistency is lacking in the structure of the disparate data sources, which prevents meaningful connections and outcomes.

MUCH DEEPER INSIGHTS CAN BE DISCOVERED IF EACH FUNCTIONAL PROCESS HAS A DEFINED AND CONSISTENT DATA STRUCTURE THAT CAN BE ALIGNED AND CONNECTED TO OTHER FUNCTIONAL PROCESSES.

ORGANIZATIONS RECOGNIZE THE CRITICALITY OF DATA

7 in 10 state that data drives at least **25% of planning**



Over a third of companies use **data** to drive a **majority** of their **strategic decisions**

Challenge 2: Shrinking Skilled Labor Force

Aging workforce imperative drives the need for IP retention and central knowledge repository

Of significant concern in the asset management community is the threat of losing the experience and technical know-how of older technicians and tradespeople approaching retirement. Without usable knowledge-management solutions, the asset intelligence built by organizations throughout years of operations is about to walk out the door.

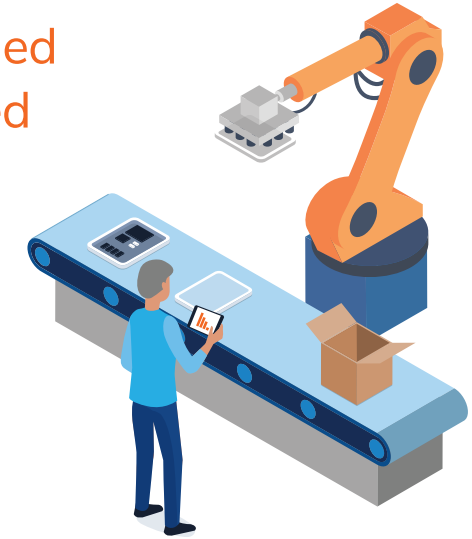
This would result in the next generation having to relearn hard lessons. The problem translates across geographically dispersed sites, where critical learning gained during asset failures or near misses cannot be distributed effectively to relevant assets and resources.

Organizations recognize the value of intelligence gleaned through the first-hand experience of on-site operations, processes, and maintenance. An enterprise-wide knowledge management system structured for asset-specific intelligence is rapidly becoming a competitive edge that continues to evolve in line with technology and process advances.

CODIFYING KNOWLEDGE THROUGH ANALYTICS IS KEY TO RETAINING KNOWLEDGE AND CONSISTENTLY APPLYING IT ACROSS THE ASSET FLEET.

CHALLENGE: MASSIVE RETIRING OF EXPERIENCED WORKFORCE IN THE INDUSTRIAL SECTOR

25% of skilled and experienced maintenance workforce is **eligible for retirement**



50% of skilled maintenance professionals **expected to retire by 2030**

Source: Bently Nevada

Challenge 3: Missing an Integrated View of Asset Health and Reliability

Connecting day-to-day asset management to enable holistic oversight and understanding of risk, performance, and priorities

Unplanned downtime is industrial and energy's #1 production enemy. The value of a holistic representation of current asset health is understood but is currently unattainable for most. It is necessary to move beyond a traditional asset health view based solely on individual monitoring feeds.

Isolated views of current operational vibration, temperature, acoustics, and other measures do not provide an accurate representation of the asset's risk profile. The current siloed asset management functions create an inability to combine this operational data with asset strategies, vintage, equivalent age, and any other current physical inspection data. Silos also impede compliance with maintenance plans and the ability to fully estimate asset health and risk of failure.

STRIVE FOR VISIBILITY ACROSS EQUIPMENT AND STRATEGIES

FOCUSING ON FOUNDATION DATA REQUIREMENTS AND CONNECTIONS IS ESSENTIAL TO SUPPORTING THE SEAMLESS CONSOLIDATION OF DISPARATE DATA SOURCES INTO DEEPER ASSET HEALTH INSIGHTS.

*Includes health, inspection, performance and emissions analytics

Challenge 4: Technology and Digitization at the Expense of Process

Process first, enabled by technology, people, and data

Pressure from board-level decision makers to realize the efficiency, productivity, and effectiveness gains promised by digital transformation has resulted in a technology-driven approach for many organizations. Significant investment in technology needs to show high returns, though there could be a disconnect between digitization activities and the practical processes required to optimize asset maintenance.

Problems have also surfaced from the failure to recognize the dynamic nature of the foundation data required to enable effective technology application. For example, there is a significant investment in work management solutions required to move from on-premise to the cloud and consolidate across entire businesses. While streamlining related functions, such as accounting and supply, is valuable, it does not correlate directly to significant asset performance improvement. Better performance happens through better data content management.

Furthermore, through discovery, organizations are learning that asset master data requires constant updating. Asset management functional silos must be connected with a focus on ensuring that related asset master data is updated as part of the overarching process.

Those that have been down the digital transformation path know that evaluating technical solutions should not be based purely on a flat list of functional requirements. Rather, they should be assessed based on their fit to a defined process. The desired process leads the technology selection, which must then be supported with content and drive engagement through user experience.

GOALS OF DIGITAL TRANSFORMATION LEAD TO TECHNOLOGY INVESTMENTS IN EFFICIENCY, PRODUCTIVITY, AND EFFICACY

TYPICAL ENTERPRISE ASSET MANAGEMENT (EAM) INVESTMENT CAN COST $1 TO $2 MILLION PER YEAR.

Solution: Integrated APM

Your key to success and competitive advantage

Integrated APM is an organizational approach that combines people, processes, and technologies to deliver asset performance improvement. Key pillars include asset condition monitoring (ACM), asset strategy management (ASM), analytic insights, and asset inspection, which are seamlessly connected with work management process and technology.

Integrated APM

ASSET CONDITION MONITORING

Integrated APM leverages sensors and data to understand asset health, enabling intelligent operations and maintenance decisions, reduced downtime, and increased output.

ASSET STRATEGY MANAGEMENT

Integrated APM creates a connective strategy and digital thread across an organization's enterprise asset management ecosystem. This connection provides daily asset management oversight, improving the ability to respond to changing environments and operating contexts.

ANALYTIC INSIGHTS

Integrated APM providers recognize that successful APM implementations are much more than just technology. Analytic Insights weave through the organization's data silos to ensure meaningful insights are generated into one holistic view to generate purposeful and scalable business outcomes.

ASSET INSPECTION

Integrated APM providers build on many forms of data sources to ensure the APM approach considers the verification of material quality and performance metrics. The connection of siloed datasets around asset inspection, both digital and image-based, ensures a comprehensive validation of the outcomes and integrity of APM for the operators' knowledge base.

Critical Capabilities Offered by Integrated APM Vendors

INTEGRATED APM

Reliable asset management requires sound condition monitoring, a risk management strategy, and responsive investment planning.

REMOTE MONITORING AND SUPPORT

Industry-leading full portfolio of condition monitoring and protection solutions that are holistic and incorporate services such as machinery health monitoring, diagnostics, and consulting services.

DEEP INDUSTRY/ DOMAIN EXPERTISE

Having a partner with deep vertical market expertise is a non-negotiable requirement. The vendor should have an expansive range of asset failure models. This enables codifying algorithms to perform predicitve asset management.

HIGH-SPEED EDGE HISTORIAN AND CORE ANALYTICAL CAPABILITIES

80% of a plant's data is generated at the edge layer. Computing and analyzing data at point of generation drives operational responsiveness. Further, an edge-to-cloud strategy further enables digital advancements.

CLOUD-BASED ASSETS LANDSCAPE VISUALIZATION

The shift to embrace cloud elastic architectures is critical to scaling enterprise-level asset performance as tech stacks of asset performance, condition monitoring, and reliability converge.

FLEXIBLE, HIGH-SPEED DATA INTEGRATION AND ANALYSIS

This is the ability to combine data from multiple sensors, edge data and strategy systems and EAM systems; apply sophisticated analytics; and improve efficiency from asset to enterprise (even across the ecosystem).

Solution Provider Snapshot: Bently Nevada System 1 Integrated APM

Bently Nevada's System 1 Integrated APM delivers asset performance improvement, asset health management, and plant safety to asset-intensive industries.

Through a single platform, System 1 Integrated APM connects the traditionally siloed functions of asset condition monitoring, asset reliability strategy, and maintenance work execution with a common digital thread. This creates a holistic and integrated APM ecosystem. Bently Nevada acquired asset strategy development capability through the acquisition of ARMS Reliability.

Unlike other technology providers, Bently Nevada partners with asset owners and operators and renders deep subject matter expertise and condition monitoring capability, a broad asset reliability experience, and relevant training curriculums through a global network of offices.

Sustained customer success is central to Bently Nevada, where technology is supported with domain expertise, relevant content, and execution experience to ensure that the solutions provided are implemented effectively, deliver value, and are continuously improved to stay relevant within the context of evolving business challenges.

Bently Nevada is shaping the APM industry through sophisticated technology, asset expertise, and advisory services. Seamlessly connecting work execution with asset condition, health, and strategy creates an integrated ecosystem that empowers organizations to demonstrate compliance, reduce risk, manage costs, and deliver predictable, sustained performance.

SYSTEM 1 CONNECTS SILOED PROCESSES TO OPTIMIZE ASSET HEALTH AND PERFORMANCE

Seamless digital connection to demonstrate compliance, reduce risk, manage costs, and deliver predictable, sustained performance.

Bently Nevada a Baker Hughes business

ARMS RELIABILITY

Integrated APM in Action

PETROBRAS

CHALLENGE

- Digital transformation was challenging because of the expansive network of assets across one of the world's largest O&G companies.
- Asset optimization was often done independently by division or facility, creatingdata silos and obscuring visibility.

SOLUTION

- Integrated APM solution in collaboration with Bently Nevada, a long-time partner with deep industry knowledge.
- Provided cloud-enabled analytics and remote solutions, plus edge capabilities.

OUTCOMES

- Visibility across assets and organization.
- Extended equipment lifecycle and reduced maintenance costs.
- More than 100x processing power of standard industry solutions.
- Future-proof against regulatory changes, new technologies, and the Great Crew Change.

ICON WATER

CHALLENGE

- The company needed to develop strategies for 700,000 assets and package-related work orders in a rapid time frame.
- Demonstrate best practices in asset management to comply with ISO 55000 regulations.
- The reliance on individual employee knowledge for maintenance activity had to be reduced.

SOLUTION

- Revolutionized approach to Asset Strategy Management (ASM) by leveraging consulting support & ARMS Reliability's proven methodology.
- Achieved project deliverables faster as a result of access to one of the industry's largest component strategy libraries.
- Automated maintenance plan grouping using the OnePM rule-based engine.
- Maximized project value and established a culture of reliability through ARMS Reliability consulting and post-implementation support.

OUTCOMES

- Developed strategies for 700k assets within 14 weeks.
- 90% time saved in strategy development.
- 20,000 activities loaded into new Oracle EAM system.
- ISO 55000 compliant.

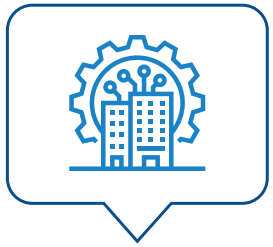
Call to Action for Industrial Enterprises Optimizing Digital Transformation Outcomes

Businesses in the industrial sector have spent billions adding sensors to equipment and systems, managing and utilizing data, and trying to derive actionable insights that optimize digital transformation efforts through APM. Industrial players should now turn to the next stage of Digital Transformation through integrated APM strategies.

KEY STEPS INCLUDE:

CONSIDER A PARTNER SUCH AS BENTLY NEVADA

Bently Nevada combines industrial software and consulting expertise along with critical capabilities such as APM services and sensing and protection.

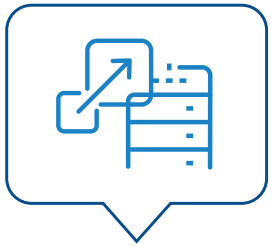


DIAGNOSE THE CURRENT SITUATION

Where is data trapped in silos?
Are some aspects of the business more modern than others?
How many platforms and home-grown systems are at play, and how much does it cost the business to have these disparate solutions?
Are asset strategies, workflows, and apps tightly integrated to ensure consistent outcomes?

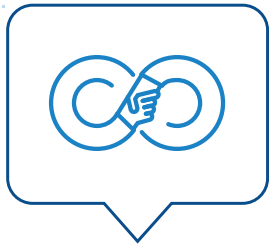
MODERNIZE INFRASTRUCTURE AS A STARTING POINT

Ensure sensor ubiquity and connectivity and integrate IT insights into OT activities. Understand the positive impact your business can have by pivoting from an episodic/time-based maintenance strategy to a reliability-centered maintenance strategy.



LEVERAGE ADVANCED ANALYTICS

Ensure there is a smart—and secure—layer across the organization through a unified platform that consolidates and makes sense of disaggregate information. This would create true asset health, an organizational risk profile, and compliance insights.



EXPAND ACROSS AND THEN BEYOND THE FACILITY

A long-term strategy should not stop at the business' front door. Where can field equipment, end-user, supplier, and logistics data play a role if integrated intelligently?

Growth is a journey. We are your guide.

For over six decades, Frost & Sullivan has provided actionable insights to corporations, governments and investors, resulting in a stream of innovative growth opportunities that allow them to maximize their economic potential, navigate emerging Mega Trends and shape a future based on sustainable growth. Contact us: Start the discussion

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