Operational Performance in the Oil and Gas Industry through Asset Integrity Management

A Bentley White Paper

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Introduction

Can you, at the push of a button, demonstrate to your CEO that your assets are safe to operate?

Most oil and gas companies have a publicly stated commitment to process safety and asset integrity. Usually it is enshrined in corporate integrity systems and operating procedures. Operating safety audits have been in place for a long time. Most companies also meet the industry standards that are defined by comprehensive, detailed regulations such as API-510, 570, 579, 580, 581, ASME FSS-1, and PAS-55. They also understand the hazards and risks they face, their likelihood, as well as the consequences of failure. They are painfully aware of the damage to corporate reputation and enterprise value that inevitably ensues when there is a catastrophic failure involving loss of life or impact on the environment.

But consider for a second whether in your company asset integrity is more than a series of inspection tasks, corrosion analyses, and equipment monitoring tasks. Is your asset integrity management program helping you deliver world-class operational performance? Is your asset integrity management program aligned with your business objectives, and is it really helping you create strategic value?

Going beyond the concept of “Fitness-for-Service,” asset integrity management is a business-critical process that should help identify and shape opportunities for operational excellence. This paper explains how Bentley Systems, the leading company dedicated to providing comprehensive software solutions for sustaining infrastructure, and a world-renowned expert in reliability-centered maintenance and asset performance management, can help you develop and implement world-class operational performance through asset integrity management.

In a study of more than 40 operators conducted by management consulting firm McKinsey, the financial upside from operational performance could be up to 30 percent higher net present value. World-class operators extract more volume and operate at lower costs than average operators in comparable conditions. World-class operators achieve best practice facility reliability of 95 to 98 percent even at older facilities and have maintenance costs that are 30 percent less than the average. Moreover, the majority of their maintenance hours (more than 70 percent) are preventive jobs rather than reactive.
Current Practices

The generally accepted definition of asset integrity is the ability of an asset to perform its planned function effectively and efficiently for its intended purposes throughout its service life. In its abbreviated form it is often referred to as Fitness-for-Service or FFS.

The scope of asset integrity management programs is to prevent loss of containment and damage typically to critical structures, safety systems, electrical systems and controls, floating and subsurface systems, flexible lines and subsea connections, storage tanks and ballast tanks, as well as machinery and processing equipment. The focus is on identifying and reducing safety risks before they escalate (design integrity), maintaining effective hardware barriers (technical integrity) and working within operating barriers (operating integrity).

Current practices often follow these phases:

• Identification of critical assets or bad actors, particularly where the consequences of failure are high,
• Development of inspection and maintenance plans,
• Execution of inspection and maintenance plans and making it a process,
• Monitoring and managing deviations such as discrepancies in material conditions or overdue integrity tasks,
• Continuous improvement.

In the oil and gas industry, most inspection and testing plans focus on deterioration processes, which are inevitable in harsh and extreme conditions. The objective of most inspection and monitoring programs is to minimize business risks associated with safety and loss of production. Today the key question is how to reduce operating costs while maintaining acceptable levels of safety and reliability.

Mature Assets

The most striking aspect of the current situation is the maturity of the industry’s existing infrastructure. The stark reality is that many platforms and pipelines have outlived their original design life. According to Oil & Gas IQ, an industry information website, more than 50 percent of the offshore platforms that came online at the peak of production in the late ’70s and early ’80s have exceeded their optimal operational lifetime by up to 15 years, and with the continued demand for production, the majority of platforms are likely to significantly push this boundary further. In North America, some pipelines in operation consist of piping allegedly manufactured up to a century ago. Clearly, the industry is exposed to significant safety and environmental issues and has to work with its aging assets, controlling risks at all times through better policies and practices.
Aging Workforce

Along with mature assets the industry has an aging workforce. It seems that fewer young people are entering the oil and gas industry, and the average age of workers in North Sea oil fields currently stands at over 40. During industry downturns, workers with considerable expertise have been frequently laid off, which results in valuable asset-specific knowledge being lost forever. Scarce expert resources and limited knowledge need to be factored into risk assessments. Operators often attach lower priority to continuous learning and capability building, and their leadership teams can view training as a drain on time and resources.

Planned Versus Reactive

Another common feature of today’s operating environment is the reactive nature of the maintenance work. Corrective action and repairs account for the majority of the work orders that are generated. Based on hundreds of reliability improvement programs that Bentley has implemented throughout the world in various industries, it is clear and incontrovertible that reactive maintenance is three to four times more costly than planned maintenance. There is a clear correlation between poor and below average operational performance and the ratio of planned versus reactive maintenance.

Downward Spiral

A typical management response in today’s challenging economic conditions is to cut maintenance costs or at least contain them. This is achieved through reducing hours worked, overtime, or labor. There may be short-term gains in profitability but inevitably there is a lagging effect on reliability, which drops a percentage point or two. When this happens, reliability starts to go into a downward spiral, which is very difficult to reverse without a concerted effort. Risk factors increase rapidly and protection barriers degrade significantly and uncontrollably. Asset integrity is placed at risk and the likelihood of a failure cannot be adequately captured in a single key performance indicator or metric.

Shutdowns/Turnovers

The objective of most asset integrity management programs is to minimize downtime. Unplanned outages can be extremely damaging financially but even planned shutdowns or turnovers can be very costly and make a big difference to profitability. Often shutdowns are very complex due to dependencies and interrelated risk factors. While shutdowns cannot be completely avoided, they can be managed so that only essential work is undertaken, risks are managed, and the impact on production is kept to what is truly necessary.
Sources of Risk

The primary causes of safety issues are not obvious, according to one major oil exploration and production company. The company conducted an historical analysis of its operations and concluded that its risk assessments were too generic. It needed to go into further detail and formalize a structured integrity management system. Over several years and across a broad range of operating conditions, the company found that asset integrity was mostly affected by:

- Maintenance-related processes,
- Design weaknesses,
- Decision processes.

People and processes were at the heart of most asset integrity issues rather than fatigue cracks or corrosion. Making sure that the right decisions are made by the right people with access to the right information is fundamental. Clearly, inspection and maintenance processes are key to improving integrity and safety while reducing operating costs.

Identifying Opportunities for Asset Integrity Management

Bentley is a world leader in reliability-centered maintenance strategies as well as asset performance management. It has developed asset integrity management programs for leading oil and gas companies that have produced excellent safety and integrity records while achieving world-class operational performance. Measured in terms of reductions in unplanned downtime and increases in output and production levels, Bentley has a proven track record of increasing profitability for operators. The competitive advantage of its asset integrity management offerings lies primarily in combining risk-based inspections and corrosion inspection management with data management in a single asset integrity system. This helps to reduce risk and provide visibility for timely and accurate decision making.

Complete Asset Integrity System and Process Spans the Entire Asset Lifecycle

The process of assuring asset integrity spans the entire asset lifecycle and requires leadership to drive integrity throughout the organization. Assets are designed and built so that risks are as low as reasonably practical; in operation, assets operate within integrity windows and are maintained within the technical barriers.

With Bentley’s AssetWise APM system in place to support the integrity process, transparency in the data (including historical data) is ensured, as is the availability of that data, as required, for day-to-day work and reporting. In addition, with this single system, speed is achieved by removing manual interfaces. Lastly, with AssetWise APM data quality is ensured, through one version of the truth that is readily available, and interaction between departments is stimulated, thus improving the relationship between departments and defining clear roles and responsibilities.
Risk-based Inspection

Risk-based inspection (RBI) is a methodology used to reduce risk through the application of a strategic inspection program, which optimizes inspection resources. Its key facet is the detailed analysis of risk factors and the development of action plans that are aligned with the relative risk. Using this pragmatic methodology, the frequency of inspections changes based on risk. Thus, the interval between inspections is lengthened for systems that have lower risk. This approach to inspections can significantly reduce costs and ultimately reduce the occurrence of safety and environmental incidents.

In line with API-580 for risk-based inspections, Bentley’s AssetWise APM is an RBI solution that provides:

- An understanding of the design premise of an asset,
- A process for assessing assets to identify high-risk areas,
- A consistent method of risk analysis for operation of each asset,
- A tool to perform a consistent, structured risk analysis,
- A methodology and tool to design and maintain an inspection program based on the identified risk, and to analyze inspection results in order to determine scope, method, and timing of future inspections,
- A consistent manner in which to manage the risk of asset failures,
- A method and tool to review and update the strategy,
- A method to understand roles, responsibilities, training, and qualifications,
- A tool to keep documentation and record keeping in order.

Bentley’s risk analysis tools evaluate probability of failure, as well as the economic, safety and environmental consequences of failure. Risk analysis results are used to identify the type and frequency of inspection tasks, ensuring that the inspection activity is designed to reduce the risk, i.e. the likelihood of the failure mode. Bentley’s solution provides extensive capabilities to manage condition monitoring and thickness measurements, calculate corrosion rates, execute and report on visual inspections, and link to process data. It monitors actual deterioration, compares these results to expected results, updates inspection intervals, and allows for engineer/inspector overrides. Inspection results can be analyzed to determine where design changes might be made to reduce likelihood and/or consequences.
Reliability-centered Maintenance

Based on principles similar to risk-based inspection, reliability-centered maintenance analyzes condition and performance data to determine which maintenance tasks to perform and when for more complex machinery when there are many failure modes and consequences. The objective is to optimize maintenance procedures according to the function of the machinery in its operating context according to a failure modes and effects analysis. Rather than time-based or usage-based maintenance procedures or breakdown repairs, the goal is to detect the onset of failures before they happen and prioritize maintenance work where it will have the optimum impact — that is, the right work is triggered at the right time. The most rigorous reliability-centered maintenance methodology is RCM2. Bentley has world-renowned expertise in RCM2 with its Aladon Network of independent reliability practitioners that dates back to the origins of the methodology and its founder, John Moubray.

Bentley’s reliability-centered maintenance methodology is enabled by its AssetWise APM software to drive maintenance procedures and to sustain them. Its AssetWise APM puts in place a business process for managing the performance and reliability of assets throughout their operating life. Bentley’s APM implementation methodology is an industrial-strength approach aligned with asset management standard PAS 55 and ISO 55000. This instills a proactive process for managing change, ensuring that people develop competency, understand their roles and responsibilities, and are accountable as measured through leading and lagging key performance indicators.

Bentley knows, from undertaking many asset integrity management programs, that every organization is unique and has its own priorities and challenges. What is certain is that small, marginal improvements in maintenance processes lead to significant upside in terms of productivity, cycle times, and, ultimately, profitability.

Data Management

Many companies struggle with the data management required to implement risk-based inspection (because they have separate RBI and inspection data management systems) and reliability-centered maintenance (because of the massive amounts of data thrown off by monitoring devices and sensors). Bentley’s AssetWise APM addresses both functional requirements in one enterprise system.

Bentley’s AssetWise APM provides a comprehensive dashboard of health indicators that empowers your inspection and maintenance teams to make timely and accurate decisions. Instead of spending time collecting and manually analyzing data, engineers can focus on adding value through engineering work. Health indicators can be gathered, calculated and compared, and then inspection and maintenance teams are alerted when action needs to be taken. Bentley’s AssetWise APM consolidates and processes condition data to provide a holistic view of asset health. It correlates multiple predictive and online tools to help improve decision making and problem solving. Rule-based indicators eliminate repetitive manual calculations, and automate complex analyses to determine the asset’s true picture of asset health. Sophisticated graphing
tools allow users to trend readings and also see potential failures and corrective actions on the same graph. Management dashboards provide graphical displays of the key performance indicators (KPIs) that are most important and gauges provide at-a-glance indication of performance and compliance to targets, with drill down for more details.

**Case Study: Shell**

Shell needed to consolidate risk-based inspection (RBI) and corrosion inspection management software (CIMS) applications. IT Portfolio Management required a reduction of duplicate systems deployed in individual regions. Shell needed to deploy the solution across 92 countries where it does business. It chose AssetWise APM Integrity Management, which combines risk-based inspections, corrosion management, and data management in a single system to reduce risk in technical integrity and failure management. In addition, Shell chose Bentley for efficiency – to improve data access and store multidisciplinary knowledge in an asset-shared database. Lastly, Shell chose Bentley for IT cost reduction, including base load cost for software maintenance and support, scripting, release management, and licenses.

Bentley’s AssetWise APM software addressed Shell’s functional and technical requirements:

- Corrosion Management Framework (CMF) – threats, degradation mechanisms, barriers, barrier management;
- RBI – semi- and full-qualitative risk assessment, reliability strategy development, interval determination, remaining life, next inspection date;
- CIMS – tag/subtag measurement locations/points, corrosion rates, alarms, isometric viewing;
- Online data collection (ODC) – integrity operating window excursions;
- SAP PM integration – maintenance plan item interval updates, new notifications and work orders from CIMS alarms.

Shell is rolling out Bentley’s AssetWise APM to greenfield and brownfield operations and will replace various home-grown applications with an off-the-shelf enterprise software solution.
Advantages

The advantages of asset integrity management are clear:

- Optimization of inspection and maintenance resources,
- Minimization of downtime and planned outages,
- Loss prevention,
- Compliance with regulations and industry standards,
- Mitigation of health, safety, and environmental exposures.

AssetWise APM delivers all the functionality required to support a complete risk-based inspection and corrosion inspection management processes in a single product, ensuring you have the information you need to prove that your assets are safe to operate.

Summary

The role of asset integrity management has never been more crucial to the oil and gas industry. As the industry pushes the boundaries of exploration into ultra-deep water and long-distance transportation, operating companies will be exposed to even more complexity in even more hazardous and extreme conditions. Inevitably, this will mean new technology and operational risks. But even in existing oil fields, aging assets, assets in operation beyond their designed service life, increasing complexity, and skills shortages mean there are many opportunities to improve operational performance and profitability through a commitment to reliability and safety. Comprehensive and strategic asset integrity management programs comprising risk-based inspection and reliability-centered maintenance offer a path to capturing financial upside while meeting or exceeding corporate responsibilities to health, safety, and the environment.

As you reflect on what is and what could be, remember that executive commitment to addressing asset integrity is an essential, and possibly transformative, step to achieving world-class operational performance.