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Energy & Power

Embracing new technologies at the heart of risk mitigation

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Introduction

Risks at the intersection of technology and leadership are more critical than ever, especially in industries with inherent risks, such as the energy sector.

Energy leaders are tasked with not only managing these risks but also leveraging technological advancements to enhance their organizations' risk mitigation strategies.

This paper explores the importance of technological progress in risk management in the energy sector, drawing on historical context and contemporary practices to illustrate how leaders can foster a culture of safety and innovation.

The importance of risk mitigation in the energy sector

Risk mitigation is defined as the strategy of planning and developing options to reduce threats faced by businesses. In the energy industry, where operations are fraught with potential hazards, effective risk management is paramount, as it enables organizations to:

- Identify, assess, and prioritize potential risks
- Enhance decision-making processes for operational reliability
- Ensure compliance with regulatory requirements
- Promote a culture of safety, demonstrating care for assets and personnel
- Minimize the likelihood of negative events due to unforeseen failures

By prioritizing risk mitigation, leaders can navigate the complexities of their operational landscape while maintaining a competitive edge and safeguarding their employees and stakeholders.

A fear of change

There is a common thought that it is best to wait until others have performed the technological leap and proven new technology before taking the risk of investment and modifying the process.

Moore's Law observes that computing power has doubled in speed and halved in size roughly every 18 months for at least the last 50 years. This principle highlights the march of technology that has led to the modern mobile computers that we take for granted as part of everyday life in the 21st century.

Today's generations cannot visualize a world without the internet, smartphones, and other technologies. This rapid advancement has transformed consumer technology and the tools available for risk management in the energy sector.

Technological advances in risk mitigation

The adoption of new technologies has driven progress in nearly every facet of the energy industry, including risk mitigation.

Examples of key strategies include:

Facility design: Historically, facility design relied on manual processes involving drawing offices full of designers and extensive book-derived calculations. Today, powerful software and virtual reality tools allow for immersive walkthroughs, enabling better ergonomic assessments and design visualizations before construction begins.

Workforce training: Traditional training methods have evolved from classroom settings to immersive virtual reality experiences. These modern training tools simulate real-world scenarios, enhancing safety and operational readiness.

Plant control: Intuitive digital systems have replaced historic, analog process control methods at petrochemical and other industrial facilities. Modern control rooms can prioritize data based on urgency, allowing operators to focus on critical issues while smart systems manage routine processes.

Process optimization: The integration of technologies such as the Internet of Things (IoT) and predictive analytics has revolutionized process control optimization. Process optimization is significantly enhanced by AI through its ability to analyze vast amounts of data quickly and accurately, and to identify inefficiencies and other areas for improvement that may not have been immediately apparent. AI algorithms can model multiple complex processes, simulate various scenarios, and predict an outcome. This enables organizations to monitor operations in real time, identify inefficiencies, and implement data-driven strategies to enhance performance.

Operator care: Some of the most significant advances in the energy industry over the past few decades have focused on managing facilities and their equipment. Reliability is crucial for streamlined operations, and operator care checks have long been conducted as an early warning system for impending failure.

Key features of digitalized operator tools include:

- **Customized inspection checklists** tailored to guide operators through their daily, weekly, and monthly equipment inspections.
- **Real-time monitoring** that uses sensors and guided field checks to provide operators with real-time data on equipment mechanical health and performance.
- **Reporting and analytics** that provide comprehensive reporting tools to track field inspection results, identify trends, and generate actionable responses.
- **Integration with computerized maintenance management systems (CMMS)** to streamline work order management and maintenance scheduling for equipment interventions.

With the current generation of operator care tools, the industry has moved on from handwritten sheets of paper to portable electronic devices.

Imagine extracting the detailed information from the brain of the most skilled and experienced field operator and implanting that information into the entire operations team.

Operator care software, as an example, allows organizations to utilize structured, comprehensive, and detailed knowledge-based operator care rounds, enabling the wider business team to monitor and diagnose equipment issues effectively. Checks typically involve a predefined checklist or set of criteria to ensure that all critical aspects are evaluated consistently.

Reliability technicians can access operator care checks via handheld computers facilitating real-time equipment monitoring with systematic networking. Results are uploaded to a database and reviewed by equipment reliability specialists who can identify and track the progressive decline of anomalies. In addition, real-time data collection and analysis enables proactive, targeted maintenance, reducing the costs associated with unplanned downtime due to a catastrophic failure. Unplanned downtime now costs Fortune Global 500 companies 11% of their yearly turnover — almost US$1.5 trillion, according to one report.

The growing role of augmented reality in risk mitigation

Augmented reality is emerging as one of the most impactful technologies in risk mitigation.

There is often confusion between virtual reality and augmented reality. Virtual reality creates an artificial environment for users' immersive experiences, while augmented reality allows users to experience a real-world environment in two primary ways:

1. **Data overlay:** Augmented reality headsets can overlay data onto a visual landscape. In operational settings, for example, this could involve displaying pump parameters directly in the wearer's goggles while they inspect equipment in the field.

2. **Remote viewing:** The immersive nature of augmented reality enables personnel to see things remotely, without the need to be physically present at a particular location.

Augmented reality technology provides innovative solutions for field technicians by delivering real-time data visualization and guidance without the need to remove protective equipment. Traditionally, technicians needed to remove gloves to press buttons on handheld devices. With augmented reality glasses, information can be viewed in the eyewear and commands can be given verbally. This enhances safety and efficiency, allowing for immediate access to critical information and remote expert assistance. The latest augmented reality systems also enable the direct overlay of equipment parameters onto the technician's device.

This technology opens a realm of possibilities. The headsets provide the console technicians (who monitor and control the plant) and reliability team with access to a live field view from the technician's perspective. Additionally, technicians can easily navigate through a series of useful safety and advice functions, including:

Operator task automation: Technicians can receive guidance and documents directly on their lens screen. A live view of equipment parameters allows real-time data to be visualized from connected devices and transmitted to the operator.

Video capture and playback: Technicians can view work procedures by watching videos recorded by professionals performing the respective tasks.

Assistance request: Technicians can request assistance from an expert during complex activities. Experts can access the technician's head-mounted display camera remotely and use video chat to offer advice. In the event of an accident, the system can detect an injured lone technician and pinpoint their precise location for emergency response teams.

Geo-locating and asset visualization: These features enable the technician's position to be identified from the control room, allowing them to receive directions to their intended destination. In the event of an accident, geo-location helps the system locate technicians equipped with augmented reality wearables and guide them to a safe assembly point.

The role of AI in asset integrity management

Reliability-centered maintenance is a critical component of any world-class maintenance management program in the energy sector. Yet, historically, its value and efficacy have been overlooked by some because it is perceived as overly complicated or difficult to implement.

These challenges are exacerbated when operational facilities rely on traditional methods of data capture and analysis, making it difficult to retrieve the information required to optimize reliability-centered maintenance.

However, the Industrial Internet of Things (IIoT) WiFi the integration of internet-connected devices and sensors within industrial settings to collect, analyze, and exchange data — has transformed what is possible in all aspects of mechanical integrity, including reliability-centered maintenance. The principles have become easier to implement, as facilities have rapid access to asset intelligence.

This improvement is due to various components, including:

- **Sensors and devices:** Sensors and devices harvest data from machinery and the environment, monitoring parameters like temperature, pressure, humidity, and machine performance.
- **Connectivity:** Collected data is transmitted securely to centralized systems using protocols, including Wi-Fi, cellular, and low-power wide-area network allowing long-range communication.
- **Data processing and analysis:** Data is processed and analyzed in real time or through batch processing, using advanced analytics like machine learning and AI.
- **Visualization:** Analyzed data is visualized through dashboards and reporting tools, allowing operators to monitor performance, identify trends, and detect anomalies.
- **Automation and control:** Processes can be automated based on the insights gained from data pattern analysis. For example, predictive maintenance can be implemented to schedule repairs prior to equipment failure, potentially reducing downtime.
- **Feedback loop:** A feedback loop can be created where data from operations informs future decisions, optimizations, and improvements, leading to a continuous enhancement of processes.
- **Integration with other systems:** Integration with enterprise systems, such as enterprise resource planning and supply chain management, provides a holistic view of operations and improves efficiency.

Digital twins used to identify potential asset weakness

Digital twins in the energy sector powered by AI and machine learning are virtual representations of real-world assets used for simulation, real-time monitoring, and predictive analysis. Examples of these assets include power plants, grids, and renewable energy systems.

By integrating sensors, machine learning algorithms and predictive analytics, a digital twin provides insights into the behavior and health of an asset, enabling proactive maintenance and reducing downtime.

For example, in the industrial asset inspection world, large groups of inspection data can be displayed in a visual format by overlaying the results onto a digital twin model of the facility. This enables the viewer to identify impending failures and weaknesses in a facility in physical relation to other items, leading to efficient maintenance planning for further inspections and repairs to plant equipment.

Information technology and operational technology convergence creates a more secure environment

Information technology and operational technology convergence — the coordinated integration of both systems — is also improving risk mitigation in the energy sector. IT systems are used for data-centric computing and enable connectivity with existing management system platforms. In contrast, OT systems monitor in-field events, processes, and devices, adjusting industrial operations accordingly.

Until now, organizations have grappled with two worlds. There is the traditional physical world which consists of mechanisms, heavy manufacturing systems, and other industrial equipment. Then there is the digital world using servers, storage, networking, and devices used to run applications, process and manipulate data, and even make critical decisions using artificial, rather than human judgment.

These two worlds have traditionally occupied separate domains, shared minimal meaningful data or control, and relied on oversight from staff with distinctly different skill sets.

Today, as the paths of the IT and OT worlds converge, advances in technologies such as the Internet of Things (IoT) and big data analytics are enabling the digital information world to view, comprehend, and influence the physical operational world.

When implemented properly, this convergence can merge business processes, insights, and controls into a single, parallel, cyber-secure environment.

Asset integrity management helps insurer's view "the bigger picture"

Technology in asset integrity management has advanced exponentially over the past few decades, providing field technicians in both operations and asset integrity with increased access to the benefits of AI (see Figure 1).

The road to the current solutions available to industry can be mapped as below:

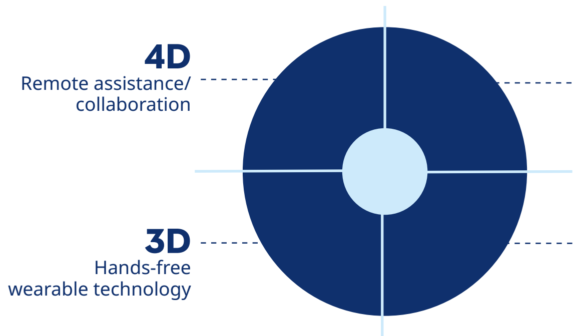
1D – Mobile navigation of a plant's assets to view operating or inspection data, process flow diagrams, and attachments in the field on a handheld device.

2D – Interactive devices that not only allow a user to access data but interact with and influence it in the field, and then upload it upon return to the office.

3D – Wearable technology, including hands-free technology that can automate workflows and visualize all asset data, job assignments, and schedules.

4D – Remote collaboration for multimedia conferencing, remote assistance, and training.

01| The four dimensions of mobility for AIM



Source: *Antea Software*

Insurers have a strong interest in the asset integrity management systems used at client operational facilities. Data from these systems, condensed into dashboards, can help insurers visualize the condition and performance of assets quickly and accurately. This information can allow insurers to assess risks more accurately, leading to data-driven decisions regarding policy terms, coverage limits, and premiums.

With a holistic understanding of asset integrity, insurers can adjust premium pricing based on the actual risk profile of the insured assets. Organizations with robust, monitorable asset integrity management practices may benefit from an optimized total cost of risk, while those with poor asset management may face higher costs.

In the event of an incident, asset integrity management data offers granular insight into asset performance in the events leading to the failure. This information may help insurers to assess claim validity, determine indemnity, and expedite the claims process. A well-documented asset integrity management program can also lead to more accurate loss quantification.

These practices can also help organizations comply with industry regulations and standards, reducing the risk of regulatory penalties and associated claims.

Embracing technology in risk management is essential for the energy industry

Integrating technology into risk management practices is not merely a trend for the energy industry — it is a necessity. Leaders in the sector have a role to play in propagating a culture that embraces technological advancements.

This goal can be achieved by:

- Encouraging continuous improvement and innovation at all levels of the organization.
- Providing training and resources to equip employees with the skills needed to implement and use new technologies.
- Promoting collaboration between teams to share insights and best practices in risk management.

As the industry moves forward, there needs to be a commitment to using the benefits of these technologies to enhance safety, efficiency, and reliability in operations. This will ultimately assist in fulfilling the responsibility leaders have to employees, stakeholders, and the communities that they serve.

Glossary

This glossary includes key terms and concepts discussed in the paper:

Asset integrity management (AIM): A systematic approach to ensuring that assets perform their intended function effectively and safely throughout their lifecycle, focusing on risk management and compliance.

Artificial intelligence (AI): The simulation of human intelligence processes by machines, particularly computer systems, which can include learning, reasoning, and self-correction.

Augmented reality (AR): A technology that overlays digital information onto the real world, enhancing the user's perception of their environment, often used in operational settings for real-time data visualization.

Digital twin: A digital replica of a physical asset, process, or system that can be used for simulation, analysis, and monitoring, providing insights into performance and health.

Industrial Internet of Things (IIoT): A network of interconnected devices and sensors in industrial settings that collect and exchange data to improve operational efficiency and decision-making.

Loss prevention: Strategies and practices aimed at reducing the risk of loss or damage to assets, often through proactive measures and risk assessments.

Predictive analytics: Techniques that use statistical algorithms and machine learning to identify the likelihood of future outcomes based on historical data, often applied in maintenance and operational contexts.

Reliability-centered maintenance (RCM): A maintenance strategy that prioritizes the reliability of assets by focusing on their functions and the consequences of failure, ensuring that maintenance efforts are directed where they are most needed.

Risk assessment: The process of identifying, evaluating, and prioritizing risks associated with an asset or operation that informs decision-making and risk management strategies.

Risk engineering: A discipline that focuses on the identification, assessment, and management of risks in engineering projects, particularly in the context of safety and compliance.

Smart glasses: Wearable technology that provides augmented reality experiences, allowing users to access real-time data and guidance while maintaining hands-free operation.

Visual data analytics: The graphical representation of data to facilitate understanding and insights, making complex information more accessible and actionable.

Meet the team

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