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IDC TECHNOLOGY SPOTLIGHT

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This IDC Technology Spotlight examines digital barrier management (DBM) technology, a relatively new and dynamic approach to barrier management for improving operational risk management within oil and gas companies. The paper also looks at the role of Tech Mahindra in this important, emerging market.

The Value of Digital Barrier Management for Oil and Gas Companies

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Introduction

The increasing complexity of infrastructure and facilities requires safety and operational risk management processes to advance in the current environment. More than 80% of process hazard analyses performed do not comply with the current interpretations by the U.S. Occupational Safety and Health Administration, much less industry best practices. In 2019, Debra Phillips, vice president of API Global Industry Services (GIS) was quoted on oil and gas safety: "With strong industry leadership, we continue to enhance our approach to training, prevention, and continuous improvement — incorporating advanced technologies, materials, and practices as we strive toward our industrywide goal of zero incidents." However, many strategies in place to combat hazards were created decades ago and do not take into consideration the intricacies of modern facilities.

AT A GLANCE

KEY STAT

Workplace fatalities in the oil and gas industry (including mining) increased 26% to 112 in 2017, up from a low of 89 in 2016.

KEY TAKEAWAY

Current processes to mitigate hazards consist of a series of manual checks and inspections that lack a dynamic approach to establishing safeguards.

State of Conventional Barrier Management

Hazards are abundant in oil and gas operations, and risk management, as it relates to safety, is at the forefront for managers. In the most recent count, workplace fatalities in the oil and gas industry (including mining) increased 26% to 112 in 2017, up from a low of 89 in 2016. Accidental blaze is the fourth leading cause of deadly accidents in the industry.

Current processes to mitigate such hazards consist of a series of manual checks and inspections that lack a dynamic approach to establishing safeguards.

These conventional approaches to barrier management are better known as the "bow-tie model" and the "Swiss cheese model." Safety-critical elements (SCEs) are identified for different barriers, and health of different barriers is visualized/monitored through these models. However, health is not monitored on a real-time basis, and hence this visualization is not dynamic.

Pain points of current barrier management systems are as follows:

- Operational risk information that is available only in silos
- Lack of transparency
- Inability to optimize work execution to mitigate risk
- Lack of management of safety-critical equipment impacting accident hazards

The Swiss cheese model, for instance, identifies different barriers as "slices," but different means and controls to prevent hazards fail in such a way that the hazard may proliferate through the various "holes" in the slices. Traditionally, these are a combination of hardware barriers and human barriers. Hardware barriers are subject to degradation over time, and human barriers are vulnerable to human error. A substantial amount of multifaceted monitoring is necessary to avoid risk.

A key weakness of conventional approaches is that barriers are often put in place during the design phase for the facility and will degrade over time. These isolated barriers will often require an inspection over the course of a few years and may not consider the dependencies or interconnections with other aspects of the program.

Safety Solution Buyer Perspective

As the saying goes, the oil and gas industry moves at the speed of safety. Safety and asset performance management (APM) are the top 2 concerns of asset managers. Lack of knowledge of potential risks and liabilities is the leading source of that concern and is a component of safety-related decision making. Real-time visibility of operational risk is essential for proactive planning of mitigation measures.

In addition, detecting process issues early gives managers time to correct operational conditions before incidents occur, causing lost production, time, money, and reputation and, most importantly, endangering lives. It is critical to understand the importance of leading indicators due in part to the aforementioned interconnectivity of assets and processes in a facility. Most managers are attuned to the fact that a focus on single barriers rather than an entire barrier system may fall short in preventing a major accident in cases of multiple barrier failure.

Barrier management has been deployed in both greenfield and brownfield projects. In brownfield projects, the original barrier management solution has been upgraded to a more dynamic digital solution that encapsulates the entire operation. Safety managers, as well as operations and design engineers, are involved (in some capacity) in establishing a barrier management solution in what are sometimes proactive, or reactive, brownfield installations. Most buyers would appreciate a tried and proven turnkey solution (oftentimes the unique aspects of each project require a bespoke design).

Many buyers have come to the realization that their facility requires dynamic modeling that meets ISO 31000 standards rather than isolated assessments for barrier management.

Road Map Needed

Many buyers have come to the realization that their facility requires dynamic modeling that meets ISO 31000 (Risk Management) standards rather than isolated assessments for barrier management.

The critical steps in risk management processes are as follows:

- Establish context — standard best practices
- Identify hazards and establish barriers
- Analyze risk
- Evaluate risk — establish risk picture
- Treat risk — establish performance standards

These steps recognize that physical barriers need to consider more contingent scenarios and that there needs to be tighter management of human negligence. One challenge (and ultimately a benefit) to putting together an all-encompassing solution is the need to bring together operations, maintenance, engineering, and corporate functions such as onboarding, training, and so forth. The idea is to understand that along with the core technical performance requirements (e.g., functionality, integrity), organizational considerations (e.g., training, competency) and operational performance requirements (e.g., standard operating procedures) also contribute to operational risks. Total cost of ownership will also be a consideration, although safety is of the utmost importance.

The Digital Barrier Management Solution

Digital barrier management (DBM) is a relatively new and dynamic approach to barrier management for improving operational risk management.

The following barriers are used in the Swiss cheese model for management and visualization of operational risk:

1. Structural integrity (e.g., heavy lift cranes, mechanical handling equipment, mooring system)
2. Process containment (e.g., fired heaters, heat exchanger, rotating equipment, tank, piping)
3. Ignition control (e.g., hazardous area ventilation, certified electrical equipment, earth bonding, fuel gas purge system, flare tip ignition system)
4. Detection systems (e.g., fire and gas detection system, water in condensate)
5. Protection systems (e.g., fire and explosion detection system, fire water pumps, passive fire protection, fire water spray, power management system)
6. Shutdown systems (e.g., emergency shutdown, depressurization system, high-integrity pressure protection system)
7. Emergency response (e.g., escape and evacuation routes, emergency/escape lighting, communication systems, uninterruptible power supplies)
8. Lifesaving systems (e.g., personal survival equipment, rescue facilities)

A DBM solution connects safety systems with broader information systems related to the previously mentioned barriers, such as data historians, reliability and inspection management systems, maintenance management systems, shift management systems, hazard and operational (HAZOP) studies, environment systems, competence matrices, HR/resource planning systems, documentation, training, drills, risk assessments, and condition monitoring. Data from all these systems has to be holistically leveraged for creating proactive management of operational risk. In many brownfield cases, this data is already collected but generally unused. DBM frequently employs new technologies such as analytics, robotics, mobility, Internet of Things (IoT), artificial intelligence (AI), machine learning, augmented reality/virtual reality (AR/VR), cloud, blockchain, 3D printing, and drones to achieve proper identification and redefinition of failure. This network of technologies can also provide cross-functional insights through information technology/operational technology (IT/OT) integration.

The DBM system comes together and allows the operator to monitor asset data with integrity operating windows (IOWs) through an operational system, providing real-time visibility of operational risk. The SCE variations provide real-time analysis that allows for risk mitigation given the ability to make timely operational changes in real time. This allows an operator to avoid a massive event caused by interrelated isolated events that could be triggered by traditional isolated hazard monitoring. The dynamic management of collective barriers lowers the total cost of ownership and is ultimately more cost effective than traditional solutions.

Digital Barrier Management: Key Digital Elements

Digital barrier management focuses on real-time risk monitoring and proactive actions to reduce operational risk in the following ways:

- Centralized and real-time monitoring of the health of all safety-critical elements for different performance requirements related to technical integrity, including aspects such as capacity, functionality, effectiveness, integrity, reliability, and availability
- Organizational considerations such as training and competency and operational performance requirements such as standard operating procedures
- Visualization of risk for the facility overall based on identification of risk for each barrier across time, location, and hazard type; prioritization of the risk for proactive and corrective actions
- Proactive actions for improving the health of the barriers, such as improving the performance of safety-critical elements

Considering Tech Mahindra's DBM Solution

Tech Mahindra Limited is an Indian multinational subsidiary of the Mahindra Group, providing IT services and business process outsourcing (BPO) to companies in various vertical and horizontal markets. The company's solution applies ISO 31000 standards by using both communication and consultation with Tech Mahindra's streamlined workflows and unified communications platforms. Tech Mahindra also addresses ISO 31000's monitoring and review standards by providing intuitive dashboards and integration with multiple systems.

Solution Description

- Integrated solution to manage operational risk through digital safety barrier management
- Real-time monitoring of barriers with inputs from multiple systems related to technical integrity, organizational considerations, and operational performance requirements and dynamic visualization of overall risk
- Proactive risk mitigation through what-if analysis and conflict management

Through DBM, risks are viewed in a dynamic digital safety barrier model over time and locations with drill-down capabilities to quickly understand what's contributing to them. Organizations can understand how all the risk and impairments in the barriers align in terms of a specific major hazard event (e.g., fire and explosion).

DBM helps keep people and assets safe by ensuring everyone knows what's happening, where it's happening, when it's happening, and what's driving the risk.

Business Value of DBM Solution

- Minimize risk
  - Controlling and reducing the risk of major accidents by identifying health of barriers/SCEs and controlling events that can trigger incidents
  - Monitoring leading indicators and proactive actions to minimize chances of Level 1 and Level 2 incidents
- Maximize safety
  - Real-time visualization of barrier impairment status through visualization of lead indicators
  - Visualization of overall risk at plant level and implementation/optimization of activities to reduce overall plant risk
- Increase operational excellence
  - Improved and optimized planning

Reduced maintenance and increased reliability make the business case relatively straightforward. When these benefits are combined with reduced safety liability, the solution has the potential to save tens to hundreds of millions of dollars, if not more.

Challenges

Adoption of DBM solutions has increased but still falls prey to the usual inhibitors of technology adoption in the industry. In the upcycle of oil prices, potential users would commonly find themselves to be "too busy" to alter any standards that might interrupt workflows or processes. Even with time on their side, oil and gas technical professionals — including design engineers and plant managers — tend to use the most basic of tools. Further, companies need to articulate very clear economic benefits for change and can sometimes be challenged internally when championing new approaches to formally established standards.

Conclusion and Recommendations

While traditional barrier management approaches are still prevalent, the complexity of modern oil and gas facilities requires a more dynamic approach to barrier management. Digital barrier management accounts for the broad complexity of modern oil and gas facilities. Safety and operations managers who focus on safety should consider the complexity of risks in their operations and the potential payback of adopting DBM solutions.

About the Analyst

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