

**DIGITIZING
OPERATIONAL RISK
MANAGEMENT**
**FOR IMPROVED SAFETY
PERFORMANCE**



**Next-level safety
performance with Digital
Barrier Management**

INTRODUCTION

Every year, work-related safety incidents and illnesses take something like two million lives and cost the global economy an estimated \$1.25 trillion (4 percent of global GDP)¹. Most of this loss – perhaps all – can be avoided. Companies need to be more proactive and holistic in their management of operational risk.

Workplace safety incidents are on the rise. In Europe in particular, the numbers are striking. Fatal incidents per 100 million work-hours hit a five-year high of 5.11 in 2016 (up from just 0.52 in 2012) above any other region analyzed by IOGP.² This is an alarming trend, especially given the range of technological advances available to improve safety performance in asset-intensive industries.

Preventive measures to date have often focused on enhancing asset inspection and maintenance strategies. Asset condition is important for managing operational risk, of course, but it's just one part of the jigsaw. The key to truly getting on top of workplace safety is to take a broader view of the whole picture. The focus needs to shift towards holistic risk-based safety performance using digital techniques which enable real-time and predictive insights.

A key part of this shift is understanding that an organization's lines of defence – the "safety barriers" used to monitor asset condition and assess safety risk – go beyond retrospective audits and fixed inspections, which identify failures rather than root causes. In fact, acquiring true visibility into operational risks rests on understanding a complex web of interconnected parameters, which influence safety but are not necessarily evident through physical inspections.

Digital Barrier Management (DBM) is a new concept which harvests the vast amounts of unused data generated through daily operations to bring new real-time preventive insights into safety performance. It helps companies detect process issues early, giving them time to correct operational conditions before safety incidents occur. It thus provides a critical new capability for preventing lost production, and saving time, money, reputation, and – most importantly – lives.

IMPROVING SAFETY PERFORMANCE: NO EASY ASK

Companies understand the need for more proactive risk management. But do they have the insights they require to make it a reality? And are their teams working together in the right way to make it happen?

The Right Focus – But a Lack of Visibility

Operators of asset-intensive workplaces are still rightly focused on safety performance. Indeed, Accenture's 2017 Digital Refining Survey showed that over a third of refinery managers cite HSE compliance and operational risk reduction as their second highest priority after asset maintenance and reliability.³ Other surveys of the oil and gas, chemical, and petrochemical industries have found similar results, with **"36 per cent of respondents saying they prioritize reducing operational risk and major hazards over other activities."**⁴

Despite this focus, many companies say they lack a clear view of the elements that actually contribute to operational risk and thus have no defined means of managing them. In fact, as many as two-thirds of senior executives and technical leaders say operations do not always understand which parts of their jobs are most critical to managing process safety risk.⁵

This is vital because unplanned or unexpected events are often in practice the most common hindrance in realizing operational plans. So, understanding this inherent risk, and actively managing it, are essential. Clearly, there is huge scope to transform operational risk management with proactive intervention and predictive identification of leading indicators.

A Need for a Holistic Approach

Ensuring safety performance in asset-intensive industries is a complex endeavour, requiring a range of multidisciplinary teams performing numerous safety activities simultaneously. Often, however, these teams work independently without a full understanding of the inherent interconnectedness of the various elements that comprise safety risk. Additionally, their strategies are too often overly centred on asset maintenance alone – and even then, are sometimes executed half-heartedly thanks to an excessive focus on manual procedures.

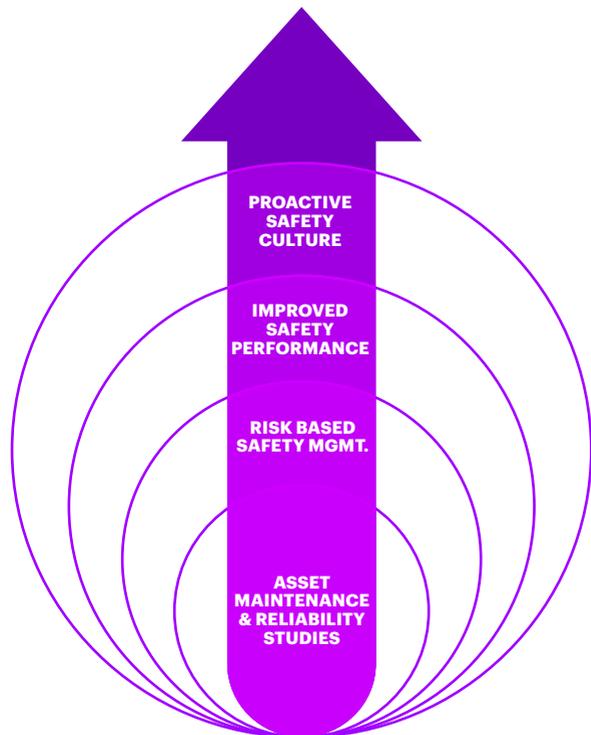
More comprehensive approaches to asset safety need to be cemented into organizations. That includes a deeper understanding of how to monitor and maintain the “lines of defence” – or the “safety barriers” – encompassing all the technological, organizational, and human factors which contribute to operational risk. In doing so, all the parts of the organization, from operations to maintenance to engineering, should be singing from the same hymn sheet, sharing the same safety performance targets, and monitoring the same safety conditions.

The most effective way to achieve this is by enabling a real-time holistic view of the effectiveness of an organization’s safety barriers.

Asset maintenance is a core part of this view, of course. But it needs to be seen in the context of a much broader safety culture within the organization (see Figure 1).

Figure 1:

Asset maintenance is a part of a broader safety culture



Reinforcing the Safety Barriers

Whichever model an organization uses to recognize hazards and prevent safety incidents occurring, their safety barriers are usually identified and implemented during commissioning or start-up. However, there can be issues with this upfront, asset-focused approach because certain aspects of the safety barriers are generally ignored.

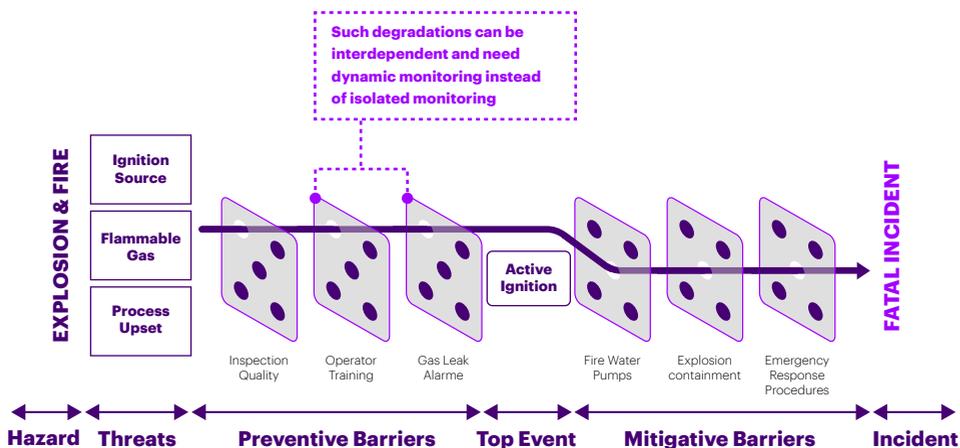
Firstly, barriers are not only technical or hardware-based. Organizational, operational, and human factors also contribute to safety issues. In fact, experience shows the primary cause of a major safety incident is seldom simple asset failure and is often more likely a result of human negligence, lack of training, or a failure to see and act on leading risk indicators. Thus, maintaining healthy hardware or assets can only ever be one part of the overall strategy.

Secondly, barriers are not static and degrade over time. Left alone, barriers put in place during the design phase will degrade in the course of normal operations and elevate overall safety risk over time.⁶ Continuous monitoring is thus the only way to comprehensively manage risk.

Finally, many barriers have hidden dependencies or interconnections. A degradation of one can have immediate impacts on numerous others (see Figure 2).

Figure 2:

Degradations can be interdependent and have much broader safety impacts



Today’s approaches for addressing these issues are often too narrow and too reliant on manual asset inspections – particularly those ensuring Safety Critical Elements (SCEs) to meet their Performance Standards (PS). In relying on this approach to achieve zero asset failures, too many facility managers expect safety incidents to be prevented as a direct consequence. But static audits, inspections, and preventive maintenance tasks can only ever give a temporary and delayed view of barrier health owing to their long cycle times (see Figure 3).

Continuous barrier monitoring, linking barrier performance with real-time risk impacts, is thus more effective.

Figure 3:

Long maintenance cycles can only reduce risk temporarily⁷

BARRIER EXAMPLE	MEANS TO ESTABLISH STATUS	TYPICAL FREQUENCY
Inspection programme	Audit	3-year audit
Preventive maintenance	Audit	3-year audit
Inspection or PM item	Inspection results	External inspection frequency 6-12 months (for some barriers internal inspection may be 5 years)
Relief valve	Bench test	5 years
ESD valve	Actuation test	At unit shutdown (scheduled 2-5 years)
Gas detection device	Calibration test	6-12 months
Training course	Test certification	Original data plus retraining interval (3 years)
Fatigue management	Audit	Annual
Work permit system	Audit and record view	Audit 3 years, RR 3 months

A STEP-CHANGE IN OPERATIONAL SAFETY

Recognizing that their safety barriers are highly complex systems comprising numerous interdependent elements, companies should now be monitoring all aspects – organizational, operational, and human – in real time.

Digital is the essential enabler.

The New Way to Manage Safety Barriers

An untrained operator elevates safety risks as much as, if not more than, an underperforming asset. Smart companies thus aim to reduce safety incident rates by recognizing the risks posed by all the parts and systems in their organization, not just the health of their assets. Digital technologies offer a key means of doing so.

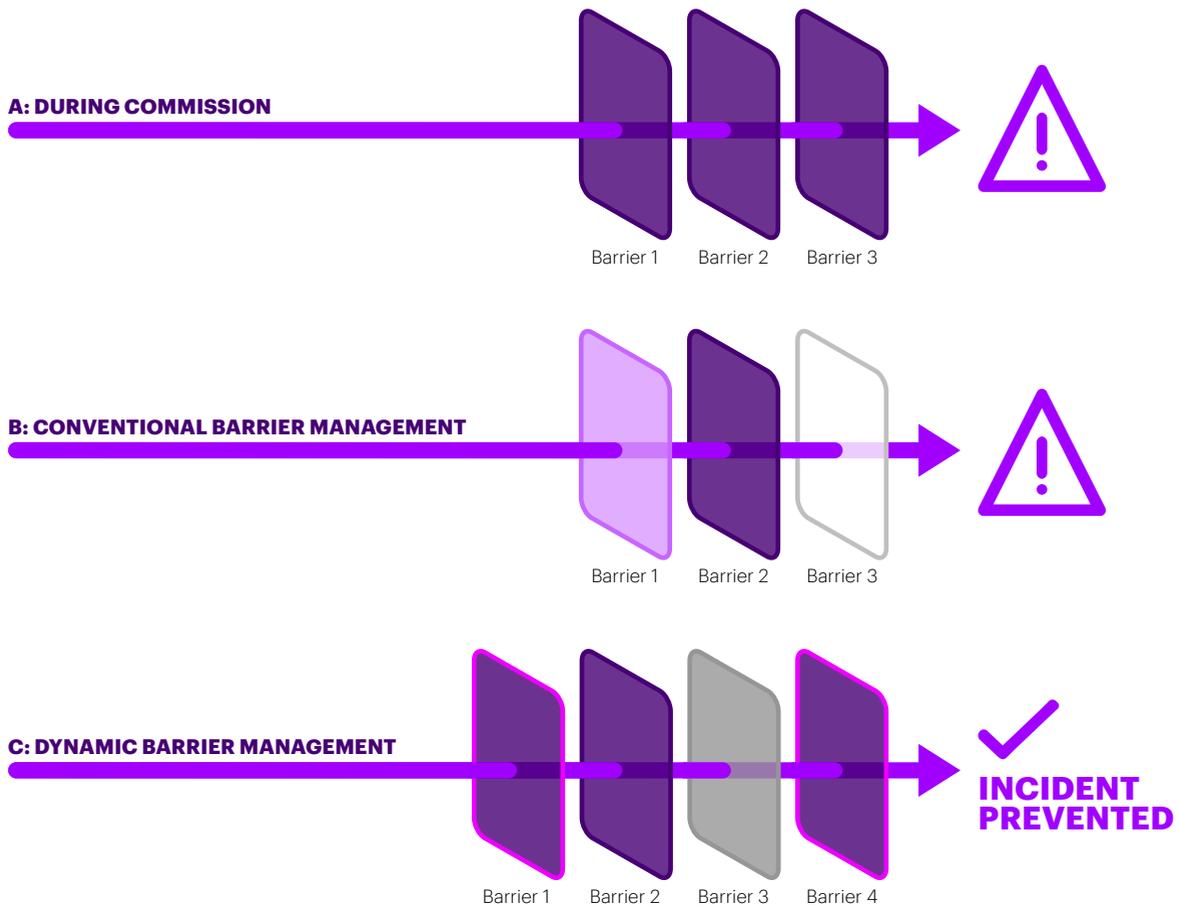
Digital Barrier Management (DBM) is a new concept focused on comprehensively managing a set of dynamic organizational safety barriers in real time. It uses the vast amounts of data already available in existing systems, leveraging an intelligent digital infrastructure to make the degradation of safety barriers visible in real time to HSE personnel. With that instant visibility, they can move to reinstate degrading barriers proactively – and bring about a step change in safety performance.

How is DBM different? Figure 4 illustrates a typical scenario.⁸ A set of safety barriers are established during the design stage of a plant (Case A). Using a snapshot of the plant after a period of normal operations (Case B) the accident risks inherent with conventional barrier management are clearly evident. One barrier has degraded over time, while the status of another is unknown as it awaits its annual inspection.

But with the real-time monitoring of barriers enabled by DBM (Case C), plant safety personnel have immediate data-driven insights into barrier health and can take proactive action, such as reinstating a barrier or creating a new one, to prevent an accident.

Figure 4:

DBM helps mitigate or replace degraded barriers



The Key Change: Better Failure Definition

DBM's approach to defining barrier failures sets it apart. It's based on an understanding that every asset failure has a root cause. Defining these failures and causes accurately is thus essential in improving safety performance.

That means understanding their origin in a web of underlying processes and parameters not always evident during physical inspections or audits. It also means recognising that maintenance failure is just one type of safety barrier that can be impaired.

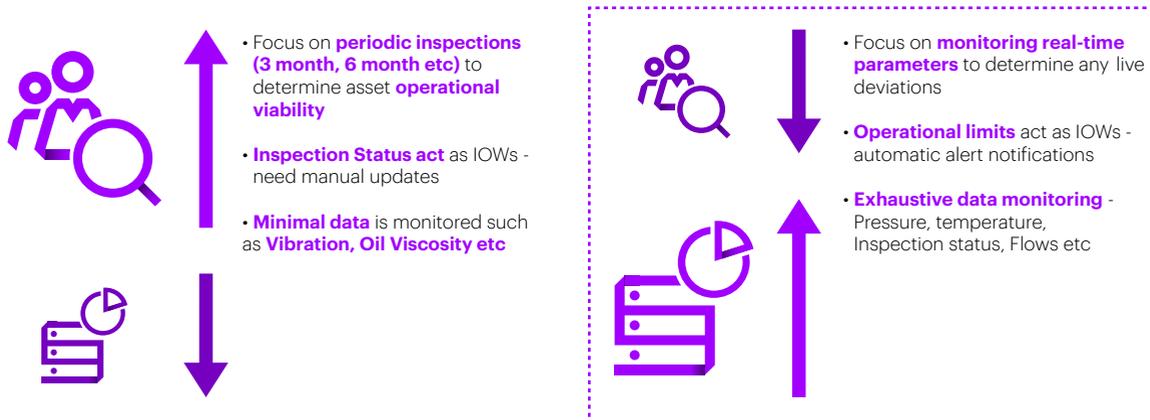
Others – whether operational, organizational, or human – can only be monitored by diving deep into the organization's processes and monitoring their critical parameters in real time.

This is where DBM is so valuable. By identifying the underlying causal factors influencing barrier health – from simple process parameters like pressure or temperature to more complex factors like an employee's ability to conduct maintenance procedures – DBM can more accurately define how an asset's safety barriers are performing in real time.

That includes both the operating limits of the asset (the Integrity Operating Windows, or IOWs) and the safety-critical elements such as equipment, reports, training and competency levels, etc. (see Figure 5).

Figure 5:

Regular maintenance approach vs. Digital Barrier Management



POWERING A SAFETY TRANSFORMATION WITH DBM

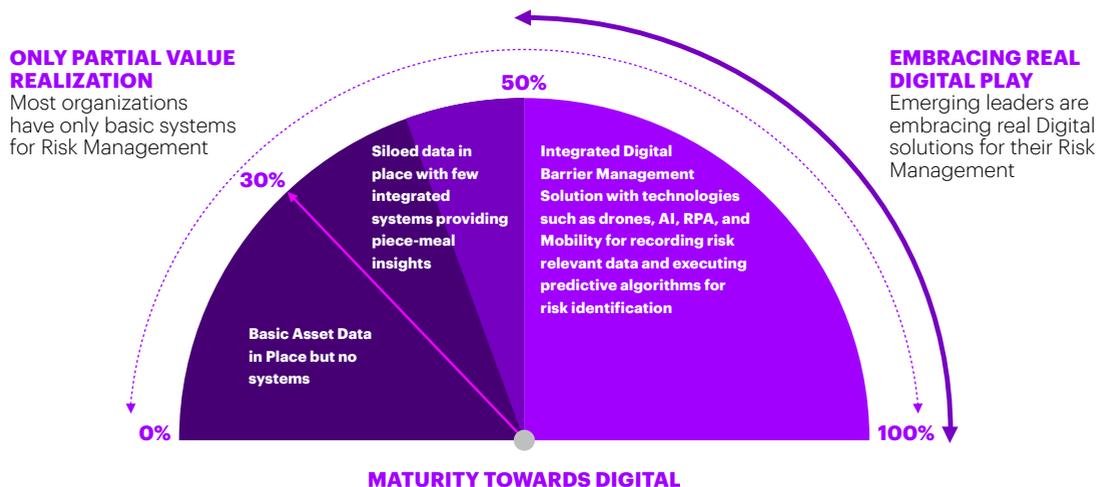
The real-time monitoring that DBM enables represents a radical change for operational risk management in asset-intensive workplaces.

The Right Focus – But a Lack of Visibility

Today's conventional forms of safety performance focus on maintenance and inspection-based IOWs, together with minimal data monitoring (vibrations, oil viscosity, etc.) to ensure asset reliability. However, this approach is almost always reactive due to the lack of real-time data. What's more, it fails to account for the reality of operating an asset-intensive workplace, where ad-hoc incidents, unexpected events, asset repairs, environmental conditions, maintenance hazards, and human error all combine to create safety risks. Companies are missing out on the real value hidden in digitizing their safety operations to capture all this information proactively. (Fig 6).

Figure 6:

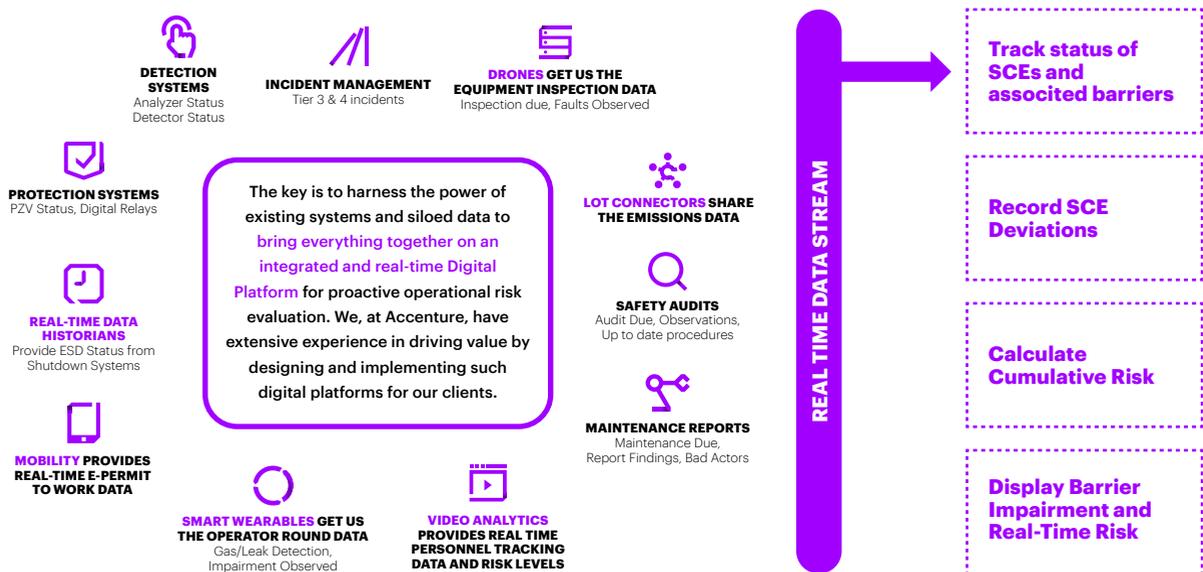
The Hidden Value lies in Digitizing Safety Operations



DBM, in contrast, leverages the power of existing data and digital technology to widen the focus of safety teams to encompass the whole organization – and enable real-time monitoring at the same time. It connects the organization’s HSE systems with its data historians, maintenance and reliability systems, environment CEMS, permits to work (PTWs), DCS/PLCs, equipment sensors, and HR systems through new age breakthrough technologies such as IoT, Mobility, Smart Reports etc to enable real-time data capture. This information is converted to real-time barrier health status which in turn reflects the live safety risk levels – allowing enough time for operators to reduce risk and prevent safety incidents (see Figure 7).

Figure 7:

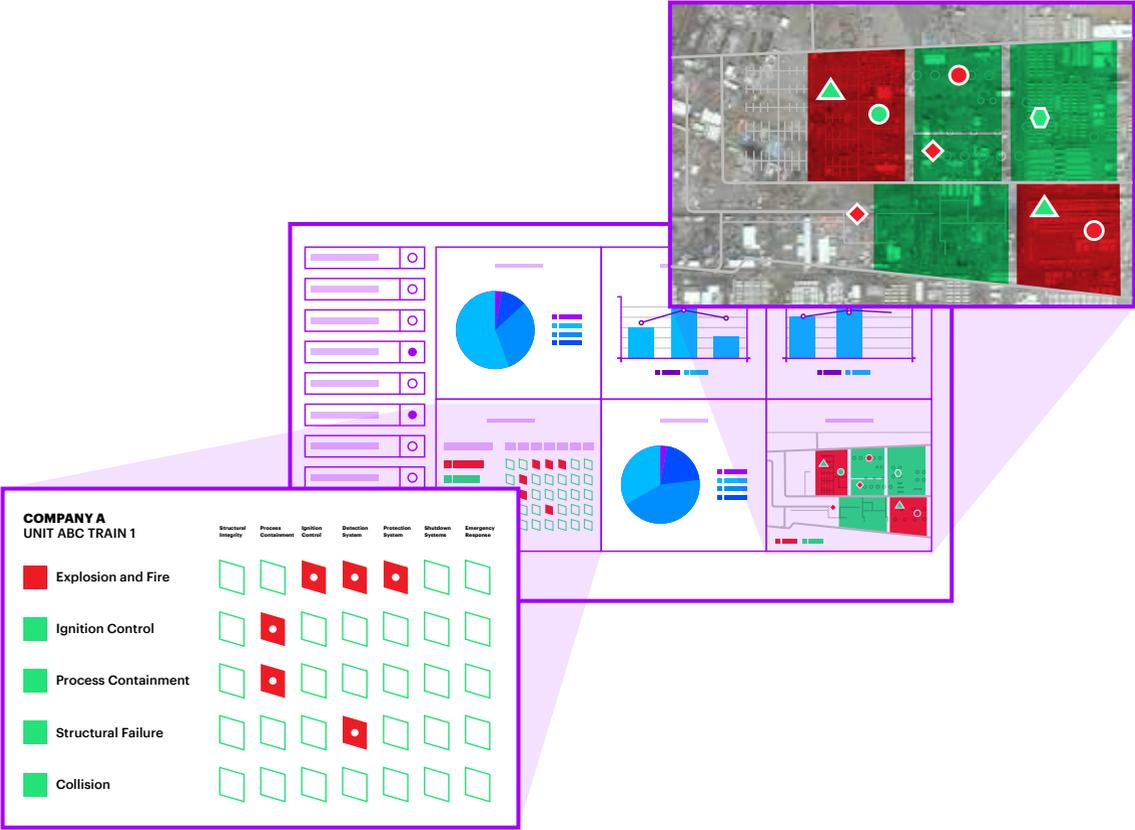
Real-time system integration at the heart of DBM



This step change in safety performance management means all relevant data can be analyzed, the insights generated presented in an intuitive and user-friendly way, and proactive or predictive actions taken to reduce risk. **The effect on workplace safety is genuinely transformative.**

Figure 8:

A conceptual demonstration of how DBM data could be visualized



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