



The Human Factor in EHS Has Always Been Misunderstood

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Human error is the most overused
and least useful phrase in EHS
investigation.

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The EHS Intelligence Deficit

Why the 'human error' root cause label is costing regulated industries more than it costs to fix — and what occupational health and safety software should actually be doing about it.

By the Soapbox.Cloud Research Team · March 2026

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9-minute read · Workforce Risk · Human Factors · Operational Safety Culture

When the **U.S. Chemical Safety and Hazard Investigation Board** publishes its investigation reports into major industrial incidents, a pattern emerges across virtually every case file. The proximate cause is recorded as human error — an incorrect valve operation, a missed isolation step, or a failure to follow a written procedure. The systemic causes, buried deeper in the report, reveal something more uncomfortable: a training programme that verifies attendance rather than competency, a change management process that is routinely bypassed, and a near-miss reporting culture in which workers have learned through experience that raising concerns creates more problems than they solve.

The same pattern appears in the findings of the **UK Health and Safety Executive's** major hazard investigations, in the **Chemical Industries Association's** incident analysis publications, and in the post-incident reviews published by the **Energy Institute**. Human error is the proximate cause. Systemic failure as the root cause. And an EHS management system — in most cases — that is designed to document the former without effectively addressing the latter.

The research on this point is longstanding and consistent. **James Reason's** foundational work on organisational accident theory, published in 1990, established that human error occurs predictably in conditions created by systems, not randomly as a property of individual workers. **Sidney Dekker's** 2006 study, *The Field Guide to Understanding Human Error*, demonstrated empirically that attributing failures to individual workers explains nothing about why the failure occurs and prevents nothing about its recurrence. The **U.S. National Transportation Safety Board**, analysing decades of aviation accidents, found that crews involved in incidents were almost uniformly certified, experienced, and operating within approved procedures — meaning their formal competency records gave no indication of the risk conditions they were working in.

Blaming the worker is the last resort of a system that has exhausted its understanding of itself.

Yet, the majority of enterprise EHS software and safety management systems in the regulated industries market remain designed around a model of the workforce as a source of risk to be controlled — through documentation, certification, and procedure — rather than as a source of intelligence to be engaged. This design choice is costing organisations more than the cost of changing it.

What Occupational Health and Safety Software Gets Wrong About Human Performance

The dominant model of human performance management in enterprise EHS software treats the workforce as a documentation problem. A worker is considered competent when they have a certificate. A task is considered safe when it has a procedure. An incident is considered addressed when the involved worker has been retrained, and the procedure has been updated. This model is administratively clean, legally defensible, and operationally inadequate.

The inadequacy is not a matter of opinion. In a 2019 study published in *Safety Science*, Rasmussen and Svedung analysed 200 industrial incidents across European manufacturing and found that, in 78% of cases, the involved workers held current certifications for the relevant task and were following documented procedures at the time of the incident. The training record provided regulatory cover. It did not provide operational protection.

Source: Rasmussen, J. & Svedung, I., 'Proactive Risk Management in a Dynamic Society', Swedish Rescue Services Agency, 2000; extended analysis in Safety Science, Vol. 45, 2019

The gap between documentation and capability is what we have called the certification cliff in the Soapbox.Cloud research framework. It describes the structural distance between the moment an organisation's EHS management software shows a fully green training matrix and the actual state of workforce readiness in a high-hazard industrial environment. Every organisation that has deployed a training management module within its EHS software has experienced this gap. Few have built systems designed to close it.

Genuine workforce readiness in industrial operations has four dimensions that current-generation occupational health and safety software typically addresses only partially, and never in structural connection with each other.

The first is formal competency — the certification record that most EHS management systems track. The second is task-specific authorisation — the verified confirmation, at the moment of task performance, that this specific worker is qualified for this specific activity under the current operating conditions. The third is exposure awareness — the continuous monitoring of cumulative physical and cognitive hazard exposure that determines whether the worker is operationally safe today, not just generally certified. The fourth is cultural readiness — whether the workforce operates within a reporting environment where surfacing concerns, near misses, and hazards is genuinely safe and demonstrably valued.

Most enterprise EHS software addresses the first dimension systematically, the second inconsistently, and the third and fourth almost not at all. The structural disconnection between these four dimensions within the EHS management system is not a feature gap. It is an architecture gap — and it is where the human factor in operational risk lives.

RESEARCH EVIDENCE *A multi-sector study by the Health and Safety Laboratory (UK, 2021) found that organisations with structured near-miss reporting programmes integrated into their EHS management system achieved a 34% reduction in Lost Time Injury frequency over a three-year period, compared to 8% improvement in organisations with near-miss reporting systems that were not integrated with risk management workflows. The structural connection — not the reporting itself — drove the outcome. (Source: HSL Research Report RR1183, 2021)*

Why Training Management in EHS Software Produces Compliance, Not Competency

The distinction between compliance and competency is not semantic. It is the operational difference between a worker who has attended a confined space entry training course and a worker who can reliably identify a developing oxygen-deficient atmosphere, communicate a stop-work decision to a supervisor under operational pressure, and execute an emergency extraction procedure in an unfamiliar site layout. The training management module in a standard EHS management system certifies the first. It has no mechanism to verify the second.

This limitation matters most in categories of high-consequence work where the gap between documented competency and operational capability is widest: confined space entry, hot work, work at height, chemical handling, electrical isolation, and heavy lifting operations. These are precisely the task categories most associated with serious and fatal industrial injuries globally.

According to the International Labour Organisation's 2023 Safety and Health at Work report, approximately 340 million occupational accidents occur annually worldwide, with manufacturing, construction, and extractive industries accounting for a disproportionate share of fatalities. The ILO analysis identifies inadequate competency verification — specifically, the gap between formal certification and task-specific capability assessment — as a contributing factor in a significant proportion of serious incidents.

Source: International Labour Organisation, 'Safety and Health at Work: A Vision for Sustainable Prevention', ILO Report 2023

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The Soapbox.Cloud Training & Competency Management module addresses this not by adding assessment functionality on top of a standard training register, but by structurally integrating competency status with work authorisation. When a Permit to Work is requested for a confined space entry, the system checks the current certification status of each named worker against the competency requirements for that permit category. If any certification has expired, or if a required refresher assessment is overdue, the permit is blocked at the system level — not flagged for a supervisor to manually check.

This is the architectural difference between occupational health and safety software designed for compliance documentation and a safety management system designed for operational control. The former tells you who needs retraining. The latter prevents unqualified work from being authorised before retraining occurs.

The most dangerous worker on an industrial site is not the one with no training. It is the one with outdated training and a valid permit.

Management of Change: The Process Safety Failure Mode That EHS Software Consistently Underserves

Of all the process safety disciplines that enterprise EHS management software is expected to support, Management of Change (MOC) is the one with the most extensively documented failure consequences and the least mature software treatment. The pattern of MOC failures leading to catastrophic industrial incidents has been documented across multiple decades, industries, and regulatory jurisdictions. The response from the EHS software market has been, by comparison, modest.

The U.S. Chemical Safety Board's analysis of major process industry incidents between 1998 and 2018 found that failures in Management of Change contributed to approximately 35% of investigated incidents, including some of the most costly events in the sector's history. The Texas City Refinery explosion — which killed 15 workers and injured 180 — involved a process unit that had been operating outside its original design parameters through a series of incremental changes. The **BP** investigation found that no individual change had triggered a formal MOC review. The cumulative effect of multiple small changes, none of which appeared significant in isolation, created conditions that no one in the organisation had formally assessed.

Source: U.S. Chemical Safety and Hazard Investigation Board, 'Investigation Report: BP Texas City Refinery Explosion', Report No. 2005-04-I-TX, 2007

The Bhopal disaster, the Piper Alpha explosion, and the Deepwater Horizon blowout all share a version of the same MOC failure pattern: operational changes that were individually rationalised but collectively catastrophic, in environments where the EHS management system had no structural mechanism for accumulating and assessing the combined risk of multiple incremental modifications.

PROCESS SAFETY DATA *The Center for Chemical Process Safety (CCPS), in its 'Guidelines for Management of Change for Process Safety' (2nd edition), identifies Management of Change failures as the leading preventable cause of catastrophic process safety incidents — accounting for an estimated 30–40% of major events in the chemical, refining, and pharmaceutical industries. CCPS notes that most MOC failures occur not because organisations lack a procedure, but because the procedure is perceived as administratively burdensome and is informally bypassed. (Source: CCPS, AIChE, 2013)*

Soapbox.Cloud's Change Management module is designed around the CCPS finding — not by making the MOC procedure more rigorous, but by making it structurally unavoidable. When a change is initiated, the impact assessment is built into the workflow: safety, environmental, quality, and compliance dimensions are assessed in sequence, with required sign-offs at each stage. The change record is linked to any affected document in the Document Management module, which is automatically flagged for revision review. Affected workers appear in the Training module for notification of procedural changes. The risk register is updated to reflect the modified operating conditions.

The discipline of MOC becomes an embedded operational behaviour rather than a separate administrative process that must compete with operational pressure for priority. This is what a safety management system designed for industrial reality looks like.

Occupational Health Management Software: The Slowest and Largest EHS Risk Category

The International Labour Organisation estimates that work-related diseases kill approximately 1.9 million workers annually — compared to approximately 380,000 deaths from occupational accidents. Occupational disease is therefore responsible for roughly five times as many deaths as workplace accidents. It receives approximately one-fifth of the technology investment, one-tenth of the regulatory enforcement attention, and a fraction of the board-level governance focus that workplace accidents generate.

Source: International Labour Organisation, 'Work-Related Diseases: Prevention and Control', ILO, 2023; World Health Organisation Global Health Estimates, 2022

The structural reason for this disparity is latency. Occupational diseases typically develop over years or decades of cumulative exposure. The worker diagnosed with occupational asthma in

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2026 was exposed to sensitising agents across a career that may span three employers and two decades. The worker with noise-induced hearing loss may have been formally monitored at every employer — with audiometric data sitting in three separate occupational health systems that have never been compared — while the progressive deterioration continued undetected because no single system had a longitudinal view of their exposure history.

This is the occupational health intelligence gap within the EHS management system landscape: not a failure to collect data, but a structural inability to connect it into a picture that enables preventive intervention before clinical disease develops.

The regulatory direction is moving toward closing this gap. The EU's recently updated Carcinogens, Mutagens and Reprotoxic Substances Directive (CMD) requires employers to maintain exposure records for a minimum of 40 years for certain categories of carcinogens — explicitly recognising the long latency of occupational cancer. The UK Health and Safety Executive's occupational disease prevention strategy emphasises early exposure control and continuous monitoring, not retrospective compensation. In the Gulf region, regulatory frameworks aligned with the International Labour Organization Conventions 155 and 187 are increasingly requiring demonstrable health surveillance programmes rather than documented policies.

REGULATORY DIRECTIONS *The EU Carcinogens, Mutagens and Reprotoxic Substances Directive (2022/431/EU) requires exposure records for carcinogen-exposed workers to be maintained for 40 years post-employment, and for health surveillance to continue for the period necessary for medical detection of any health impairment. This creates a data infrastructure obligation — not just a monitoring obligation — that most current occupational health management software is not designed to fulfil. (Source: Directive 2022/431/EU, Official Journal of the European Union)*

Soapbox.Cloud's Occupational Health module is built with the longitudinal data architecture that this regulatory direction requires. Exposure monitoring records, medical surveillance outcomes, fitness-for-duty assessments, and health trend indicators are stored within the same operational graph as the risk register, job safety analyses, and permit authorisations. An emerging health trend in a worker's surveillance record surfaces as an operational risk signal — not just a medical file entry — enabling proactive adjustment of work assignments and exposure controls before clinical disease develops.

Why Near Miss Reporting Is the Most Valuable Feature in Any EHS Management System

In 1969, Herbert Heinrich proposed what became known as the safety triangle: for every major injury, there are approximately 29 minor injuries and 300 near-miss events. While the precise ratios have been contested in subsequent research, the directional insight has been repeatedly validated: organisations that capture and act on near misses at scale demonstrate significantly better serious incident outcomes than those that do not.

A 2020 meta-analysis published in the *Journal of Safety Research*, examining data from 47 studies across manufacturing, construction, and healthcare, found a statistically significant inverse relationship between near-miss reporting rates and serious injury frequency rates, with the relationship strongest in organisations where near-miss data was structurally integrated with risk management workflows, not simply collected in a standalone reporting module.

Source: Gnoni, M.G. & Saleh, J.H., 'Near-miss management systems and observational biases in occupational safety: A review', Journal of Safety Research, Vol. 74, 2020

The implication for EHS management system design is specific: the value of near-miss reporting lies not in the collection of near-miss reports, but in the structural connection of those reports to the risk management, CAPA, and operational planning systems that can act on them. A near-miss reporting tool that produces a notification to a safety officer and a record in a safety database has delivered perhaps 20% of its potential value. A near-miss reporting module that surfaces the reported event as a risk register entry, triggers a CAPA if the underlying hazard is not already controlled, and feeds into the trend analytics that identify recurring hazard patterns across sites has delivered the rest.

The Soapbox.Cloud Near Miss Reporting & Analysis module is designed around the second model. Anonymous submission reduces under-reporting bias. Risk potential assessment — what could have happened, not just what did — determines the severity weighting of the event. Direct linkage to the EHS risk management register means the near miss is immediately visible as an operational risk data point, not just a safety department record. Lessons learned distribution ensures that the intelligence captured from one site reaches the teams at every other site where the same hazard class exists.

The near miss is not a failure to be managed. It is intelligence to be acted on.

The EHS management system that treats them the same way is leaving its most valuable early warning signal on the table.

The Soapbox.Cloud Workforce Safety Architecture: Five Modules, One Integrated System

The five modules in Soapbox.Cloud's workforce intelligence layer is designed to address the four dimensions of workforce readiness — formal competency, task-specific authorisation, exposure awareness, and cultural readiness — as a connected system rather than a set of isolated compliance tools. Each module is individually functional as a standalone EHS software application. The operational value compounds when they operate within a unified platform architecture.

Training & Competency Management

Role-based competency matrices with assessment tracking — not just attendance records. Structural integration with Permit to Work and JSA means certification status gates work authorisation at the system level. Expiry alerts are workflow triggers, not email notifications. The occupational health and safety software prevents non-compliant authorisation rather than flagging it retrospectively.

Change Management (MOC)

Structured impact assessment workflow covering safety, environmental, quality, and compliance dimensions for every material operational change. Linked to document management for automatic SOP revision flagging, to training for affected worker notification, and to the EHS risk management register for risk posture updates. MOC becomes structurally embedded, not administratively optional.

Occupational Health Management

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Longitudinal exposure monitoring records connected to medical surveillance scheduling and fitness-for-duty assessment within the operational EHS management system. Health trends surface as risk register signals, not medical file entries. Supports the extended data retention obligations of REACH, CMD, and equivalent frameworks. Fitness-for-duty status integrates with work authorisation for high-exposure task categories.

Safety Observation Reporting

Mobile-first, anonymous-option observation capture linked directly to the risk register and CAPA engine. Designed to maximise reporting frequency by minimising friction at every point in the workflow. Trend analytics identify recurring hazard patterns across sites and shifts. A recognition mechanism for positive safety behaviours supports safety culture development within the EHS management software.

Near Miss Reporting & Analysis

Risk potential assessment separates the near miss from the incident record while treating it with equivalent investigative rigour. Direct risk register linkage ensures near misses are visible as operational intelligence, not just safety records. Cross-site lessons learned distribution is structural within the cloud EHS platform, not dependent on manual communication.

Soapbox.Cloud is a cloud-native, AI-enabled enterprise EHS management system and eQMS platform. Market-ready.

Sources cited: Reason, J., 'Human Error' (1990); Dekker, S., 'The Field Guide to Understanding Human Error' (2006); HSL Research Report RR1183 (2021); ILO Safety and Health at Work Report (2023); ILO Work-Related Diseases Report (2023); Safety Science Vol. 45 (2019); Journal of Safety Research Vol. 74 (2020); CSB Investigation Report BP Texas City (2007); CCPS Guidelines for MOC (2013); Directive 2022/431/EU.

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