ISC RBPS Webinar – Questions and Answers

Q1 In your experience, can you attest to the reliability of sensors as factories and process plants to become more autonomous/hands off?

Sensor technology has evolved from pneumatic systems to digital and intelligent sensors, significantly improving reliability in automated and safety-critical environments. While modern automated safety systems generally outperform manual ones, their effectiveness depends on a clear understanding of how each device operates. Incidents like Buncefield show that misinterpreting a single level sensor can lead to major failures.

Automation is seen as highly beneficial in stable, mature industrial processes, where machines can handle routine tasks and humans can focus on complex problem-solving. However, in new or experimental batch processes, human adaptability remains essential.

A parallel was drawn with aviation: cockpit automation has greatly improved safety, but excessive automation can disengage operators and introduce new risks. The overall conclusion is that automation is valuable, but it must be balanced with meaningful human involvement and oversight.

Please read the special *LPB* edition dedicated to Buncefield here: www.icheme.org/media/29515/lpb306online.pdf

Q2 Despite sharing lessons learned from past accidents, providing effective training, encouraging safe behaviours, and having strict regulatory oversight, accidents continue to occur in industries. In your view, where are we still falling short?

The main reason accidents continue to occur, despite training, regulations, and shared lessons, is a persistent gap in leadership. Safety work always involves balancing competing demands, limited resources, and operational pressures. When incidents are analysed, attention often focuses on a single action or decision, even though workers are typically managing multiple, conflicting responsibilities at once. Strong teamwork is essential to maintaining safety under these conditions, and effective teamwork depends on effective leadership.

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Research included in the European Commission's Major Accident Hazards Bureau paper presented at the EFCE Loss Prevention Symposium in Prague, 2022 (Wood M.H., Koutelos K., Hailwood M., Cowley C., 2022, Learning lessons from chemical incidents – *What's stopping us and how we can make it happen*, Chemical Engineering Transactions, 90, 685-690 DOI:10.3303/CET2290115) supports this view, highlighting that organisations often fail to learn from past events not because lessons are unavailable, but because leadership does not consistently foster the practices needed for organisational learning.

Improving safety requires leaders at all levels to adopt adaptive, learning-focused approaches and to create environments where lessons are genuinely absorbed and applied.

Q3 Which single barrier or control, if it failed, would most critically increase the likelihood or severity of a major process incident in your facility?

No single barrier can be viewed in isolation. When a major incident occurs, it is usually because the final, immediate barrier failed – but only after several deeper organisational and engineering barriers had already been weakened. Using the Swiss cheese model, the speakers highlighted that the most critical vulnerabilities often lie further back in the system, where underlying failures can enable many different types of accidents. Strengthening these early-stage barriers is therefore one of the most effective ways to reduce risk.

Maintenance is frequently constrained by operational pressures and budget limitations, yet it is essential for asset integrity, especially as many facilities operate equipment well beyond the original design life. Historical examples show that older equipment (often built with wider tolerance) can remain robust decades later if properly looked after, while other components require timely replacement.

Good design is crucial when building new facilities, but in existing plants, the consistent resourcing and management of maintenance activities is one of the most influential factors in preventing major incidents. Neglecting maintenance rarely causes an accident directly, but it is often found somewhere in the chain of failures that allow one to occur.

Q4 Do consider human as solutions is very encouraging. This may lead to a consideration of 'repeatability' when considering human as solutions. The Hudson River landing example is remarkable, but it might not be repeatable by other pilots or even the same pilot. With respect to this, while we are trying to encourage human as solutions, what will be the practical principles that will be able to ensure they will be effective (ie with good level of being repeated)?

Humans excel not because they perform tasks identically every time, but because they adapt, interpret, and respond creatively to changing conditions. The Hudson River landing illustrates this because while the exact manoeuvre may not be repeatable, the successful outcome came from skilled human judgement in an unexpected situation.

To make 'humans as solutions' effective in high-hazard industries, several principles were highlighted:

- human-system integration from the design stage: Modern facilities should be designed so that automation, hardware, and human roles complement each other;
- avoid treating humans like machines: Humans are not naturally consistent in repetitive tasks, but they are excellent at detecting anomalies, adapting to change, and solving novel problems. Systems should be built to leverage these strengths rather than force machine-like behaviour;
- provide the right tools and information: Effective human performance depends on clear information, supportive technology, and equipment that enhances decision-making rather than overwhelms or restricts it;
- recognise that outcomes can be consistent even if actions vary: Humans may not repeat a task the same way every time, but they can still achieve reliable results when supported by well-designed systems.

Overall, the practical approach is to design environments where automation manages what it does best, and humans are empowered with the tools, information, and system design needed to apply judgement, adaptability, and problem-solving when it matters most.

Q5 What would be your advice for freshers in the process safety? How can they boost the knowledge about process safety and hazards management?

One of the most effective ways for newcomers to build process-safety knowledge is through direct exposure to real operations. Working shifts in an operating facility or participating in safety audits, especially during night operations, provides invaluable insight into how processes run, how people behave under pressure, and how work differs from written procedures.

Audits and assessments are most meaningful when they begin by asking operators how tasks are really performed, rather than focusing solely on documents or procedures.

Process safety is not the responsibility of specialists alone. While technical experts play an essential role in design, asset integrity, and research, effective process safety depends on contributions from everyone involved in the organisation, operations, maintenance, procurement, commercial teams, and human resources. Each person is part of the system that keeps facilities safe.

Leadership at all levels matters. Even individuals without formal authority can demonstrate leadership by fostering good relationships, supporting safe practices, and contributing to a culture where learning and collaboration are valued.

Q6 Some of the hazardous examples presented seem to be due to the inability of identifying the hazards in the first place. Leadership is important and has been appreciated as one of critical right things to do. But in practice, how will the two types of leadership help to improve the identification of hazards?

Successful identification of hazards involves a combination of technical rigour (science, systematic analysis)… with creativity (imagining how things can go wrong, asking 'what if..?' and so on). It also relies on good teamwork: encouraging people to share their diverse skills and knowledge. Adaptive leadership practices such as provoking discussion, active listening, joint reflection and sensemaking encourage such creativity and teamwork. (Sensemaking has been defined as 'the process of creating situational awareness and understanding in situations of high complexity or uncertainty in order to make decisions' (Gary Klein). For more explanation, see Dave Snowden's *What is Sense-making?*).

Directive leadership, on its own, tends not to create these conditions, but is needed to support the meticulous recording of discussions and the management discipline for implementing actions. It is the mutually supporting **combination** of Adaptive leadership practices and Directive leadership practices that is most effective for many aspects of Process Safety, including the fundamental aspect of hazard identification.

Q7 Why are we using new jargon of words ie Minimise, substitute, moderate or simplify rather than Hierarchy of controls?

Inherent safety by design happens long before hierarchy of controls. The idea is to design the process to minimise the hazard so that fewer controls are needed.

The hazard is what can harm us and risk is how likely it is to harm us.

Hazard control is all about reducing the hazard (inherent safety by process design – simplify, substitute, minimise, modify) – ideally at the design stage. Examples would be making a toxic intermediate on demand with minimal storage, substituting a volatile organic solvent with water, developing a new catalyst that allow us to run the desired reaction at lower temperature and pressure.

Risk control – on the other hand – is about reducing the likelihood of loss of control of the residual hazard – with robust independent barriers.

Trevor Kletz gave the example of a tiger in a cage. The tiger is the hazard, the barrier is a cage, and the risk is the likelihood of the animal escaping and eating someone. Risk control is about improving the barriers (the cage, the visitor separation, the feeding …). Hazard control focuses on choosing a less dangerous animal with similar crowd-pulling appeal (a baby panda?).

Q8 Do we still take credit of alarms in HAZOP studies to reduce the risk to the ALARP area?

No. An alarm is no use by itself. Any alarm must prompt a defined action to be taken within a given time. Too many alarms can lead to alarm flooding. If the operator is overwhelmed by multiple alarms, they may be unable to act in time.

Q9 Noting that the ALARP approach is now simplified to 'what more we can do', we still need to sometimes carry out cost benefit analysis to demonstrate ALARP. Is it still a practice to put a price to human life for CBA?

Britain's Health and Safety Executive ('the HSE') current guidance on ALARP for Hazardous Installations is ***Guidance on ALARP Decisions in COMAH*** published as guidance for its inspectors by the HSE Hazardous Installations Division and this includes guidance on cost benefit analysis.

Q10 The Hearts and Minds tool for culture survey is more focused on occupational safety and limited process safety management system elements. Are there any other recommendations for tools to measure PSM Culture covering all 20 elements of RBPS?

The Energy Institute (EI) Hearts and Minds culture survey tool 'Understanding Your HSE Culture' was originally designed for all kinds of safety, including process safety. Quoting from the EI website: 'Hearts and Minds originated in Shell, and is based on a £20 million research programme carried out in the 1980s, 1990s and 2000s – research that is still going on today'.

In fact a primary motivator for this research was the 1988 Piper Alpha disaster (another was the high fatal accident rate that Shell experienced in the 1980s). In 2018, the 'Understanding Your HSE Culture' was revised to the current version 6. In version 6, quoting again from the EI website "we added 5 new questions (and modified several others) to provide a greater focus on process safety culture, including questions on operational safety, maintenance, and barriers. Also, elements of systems thinking and operational excellence were incorporated throughout the new dimensions, as well as increased focus on organisational learning at the higher levels of culture".

As such, it remains, in our opinion, one of the most used, validated and useful tool for helping organisations understand their safety culture (including process safety culture) and how to move towards a higher maturity level.

The CCPS also has a number of excellent relevant publications including the book: ***Essential Practices for Creating, Strengthening, and Sustaining Process Safety Culture***, pub. Wiley, 2018.

Q11 What are the most difficult tasks for a process safety engineer?

Communication. Influencing when you have no authority.

Q12 How can we do barrier assurance? Is it any technique or method to verify?

Each barrier will require its own assurance plan. A Safety Instrumented Function (a protection layer whose objective is to achieve or maintain a safe state of the process when a specific dangerous event occurs) must follow a standard protocol as part of the Safety Instrumented System with testing frequency defined at the design stage to achieve the right level of protection (see IEC61511).

A passive barrier like a tank bund or dyke will need to be regularly inspected and maintained. A barrier which relies on manual intervention will require attention to training and competency and performance influencing factors like fatigue.

Q13 How can executives detect and correct a `silent normalisation of risk' before it manifests as a major process safety incident?

A crab being cooked slowly in warming water might be forgiven for failing to notice a drift to danger, but human beings with their senses intact should retain their curiosity and sense of chronic unease.

Don't surround yourself with people who only want to please, build diverse teams that include cautious pessimists as well as optimists. When someone brings bad news, listen and help – never shoot the messenger.

Normalisation of deviance can be harder to detect from the inside, which is why it's always a good idea to take time to compare practices in other locations organisations and bring in independent auditors who can see things with fresh eyes.

The warning signs to look for include – industrial unrest, high rates of staff turnover, superficial investigations, actions closed before completion. a change in the number of safety incidents (rising due to more accidents or a dropping due to lack of reporting).

Get up from behind the computer, get out and walk around the facility, ask questions, listen to the answers. Act on what you find.