Mind the Gap
The case for a formally agreed ISO standard for process safety

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Abstract

In May 2019 an explosion at AB Specialty Silicones (1) killed four workers, destroyed the company's production facilities and damaged nearby businesses. The explosion was caused by the incorrect mixing of poorly labelled chemicals; the mixture generated hydrogen which escaped into the workplace from unsealed vessels and exploded. The US Chemical Safety Board investigated the incident and released a video (2) which is introduced by CSB Chair and CEO Dr Katherine Lemos, who says "inadequate recognition and evaluation of reactive chemical hazards has been a causal factor in a significant number of reactive chemical incidents of known causes and yet companies are often not required by regulation to implement the most basic safety management system elements to control these hazards. For these reasons serious incidents like the one at AB Specialty continue to occur".

On the CSB video, Vonzella Vincent, the CSB Lead Investigator states "effective safety management systems that address process safety are critical for companies that handle reactive chemicals… AB Specialty did not have a process safety management programme in place at the time of the incident". The video goes on to say that had AB Specialty instituted a safety management system that addressed process safety, including a robust hazard analysis programme, the company could have identified the serious safety hazards associated with its manufacturing operations.

The video then draws out the point that despite the hazardous nature of the reactive chemistries at the site, neither the OSHA process safety management standard nor the EPA's risk management plan rules actually required AB Specialty to have a process safety management system for their operation. This is because the quantity of chemicals present on site are below the specified threshold quantities. Dr Lemos emphasises the CSB's previous recommendation that OSHA and the EPA should be given regulatory powers which close the gap and provide better coverage of the industry, to prevent further tragic incidents and save lives.

This gap between highly regulated, highly controlled, high hazard companies and companies with much lesser regulatory related obligations, but which can still carry significant hazard potential, exists right across the supply chain and across different national jurisdictions. In most cases, the gap is a consequence of Governments needing to prioritise regulatory resources. This prioritisation is often done simply through the use of inventory threshold levels for hazardous substances. Other approaches could be used: for example, specific high hazard reaction chemistries might be an alternative and equally appropriate method for prioritising regulatory attention. Indeed there will be sites carrying significant process safety hazards through their processes which fall below any qualifying inventory threshold. These sites, their employees and their local communities will not benefit from proactive regulatory oversight. This paper proposes that process safety risks across the industry, nationally and internationally, would be driven lower by developing a standalone certifiable ISO management system standard, specifically for process safety.

The standard should wrap any of the existing process safety frameworks (3) (4) (5) (6) (7) (8) inside a 'plan-do-check-act' management system cycle to provide a Process Safety Management System (PSMS) which as an ISO standard would be audited and certified by competent assessors. This certification would significantly increase the visibility and perceived importance of process safety management. Over time, and with industry support, site leadership teams would be subject to peer pressure through their supply chains, to develop the right competencies and provide the right resources to achieve certification to the new standard and thus demonstrate they are managing their process safety risks. The commercial functions within companies will take an interest as certification to the new ISO PSMS standard becomes an industry-standard expectation and the competitive advantage becomes apparent. Commitment from leadership teams will be more visible and the necessary management oversight will be more readily developed.

As an example, for lower tier or sub-COMAH sites, the regulator in the UK is not sufficiently resourced to provide a similar level of oversight and assurance of process safety management on a pro-active basis, as it is for upper-tier COMAH sites. A third party, commercially driven basis for such assurance, if implemented with adequate integrity and true intent, would build competency across the industry. It would assist the regulator, and bring safety benefits to companies, employees and local communities. Through reputational improvements it would build business benefits across the whole process industry, both nationally and internationally.

This paper argues that it is incumbent upon industry to take the reins in this regard, not least to ensure that there is a "level playing field", ensuring fair competition across industry, countries and regulatory regimes. Industry should act together to build a cross-industry, cross-continental team to develop a standalone, certifiable ISO management system standard, to close the gaps in process safety management. We should not wait for the hefty wheels of the regulators to grind into motion because in the words that Trevor Kletz deliberately mis-quoted from the famous John Donne poem to recognize that we are all connected through our industry and one incident affects all of us:

'No plant is an Island, entire of itself; every plant is a piece of the Continent, a part of the main. Any plant's loss diminishes us, because we are involved in the Industry: and therefore never send to know for whom the inquiry sitteth; it sitteth for thee'.

Keywords: Management Systems, Safety Leadership, Industry Action, Regulatory Attention, Process Safety Improvement

Introduction

The obligation for organisations which handle hazardous materials to implement and maintain Process Safety Management Systems (PSMS) is well accepted within organisations handling hazardous materials above the COMAH or Seveso quantity thresholds in the jurisdictions where the regulations apply (all the EU and the UK).

Organisations which understand their process safety hazards will engage with relevant industry forums and adequately resource their site teams to deliver suitable PSMS. On the other hand, sites which fall just below the threshold at which proactive regulatory attention is expected may not have the immediate incentive to give adequate attention to their PSMS. These sites could be considered as 'unengaged' with process safety. Senior leadership teams may not have the awareness or specialist competencies necessary to develop, implement and then properly interrogate process safety key performance indicators. In turn, this could mean that financially driven, short term decisions may not properly account for the process safety risk implications.

Poor process safety related decision making can run for years before any consequences are realised and leadership teams, if not specifically asking for information related to process safety, can be blissfully unaware of the underlying hazards or growing process safety risk. Internationally, many (in fact most) jurisdictions are less advanced in process safety awareness and regulatory attention than those subject to the Seveso directive. This means they have a greater likelihood of harboring a significant proportion of unengaged sites. Unengaged sites will be less likely to self-select to attend industry forums and conferences for the advancement of process safety, to search out lessons learned from relevant incidents, to resource their sites adequately to deliver process safety improvements, and also less likely to recognise their own failings in this regard.

The questions this paper poses to the engaged process safety community are:

> How to engage these unengaged sites in good process safety and process safety improvement?
>
> What incentive(s), short of globally enforced regulation (which is not available), could be introduced which would be effective in persuading the unengaged that process safety management improvements on their sites are needed and would be worthwhile?

By ignoring such questions or writing them off as only of concern to the individual unengaged businesses themselves, the whole industry is at risk. The industry will continue to suffer reputational damage and consequent regulatory intervention as process safety incidents continue to occur. The whole of society is at heightened risk of suffering unnecessary environmental damage or loss of life if such questions are left unanswered.

The case for change

Given the call from the CSB for US regulators to close the gap on process safety expectations (2) and the current availability of only reactive regulatory attention for many sites in the UK, it is proposed that industry itself should make proactive efforts to begin to close the gap rather than wait for regulators to take action. The American Chemistry Council's Responsible Care initiative goes some way towards addressing this issue. It provides a Process Safety Code within the Responsible Care suite of management systems under RC14001. However, it is not a standalone certifiable Process Safety Management System Standard and requires sites to demonstrate conformance against several other codes including occupational health and safety, product stewardship, security, emergency response, pollution prevention and distribution. For sites which are already unengaged, this makes the size of the task - which is entirely voluntary - appear huge and unwieldy. Its size effectively becomes another roadblock to process safety improvements. The combined commitment probably acts as a barrier to companies to subscribe to the standard at all. Crucially this then inhibits them from undertaking the specific commitments required under the process safety elements.

If the regulatory framework is not able to deliver additional proactive process safety improvements in its current state and if some companies are not adequately engaged in process safety to voluntarily seek improvements, a third question becomes:

> How should the high hazard industry which is committed to good PS, seek to influence its own fellow participants to deliver better PS management right across the board, both nationally and internationally?

This paper argues that the answer could lie in the supply chain.

Whilst by no means perfect, we believe the ISO14001 environmental management system standard (9) has been effective in delivering environmental performance improvements through influencing the customer–supplier chain. Customer companies towards the end of the supply chain, who are often well regulated, preferentially purchase from ISO14001 certified companies giving their suppliers a financial incentive to obtain the certification. If the standard is well implemented at sites, following the intent of the requirements, this means that environmental performance is continually

improved up and down the supply chain without the need for any additional regulatory attention. Whilst this is crucially dependent on the quality of inspection and audit by the companies who provide accreditation to the standard, there can be little doubt that pressure through the supply chain has led to a worldwide surge in accreditation, to ISO9001 & ISO14001 especially. The accreditation has then led to improved quality and environmental performance over time.

If the same process could be followed for process safety, the whole of industry and society would benefit from reduced process safety risk related to high hazard operations. The leadership teams of the currently unengaged sites would benefit from increased awareness of their process safety performance through regular third-party assessment and reporting. Sites that already engage well with process safety would benefit from the international supply chain led cascade of improved process safety awareness. They could take assurance from process safety standard certification gained by their suppliers and their customers, reducing to some extent their burden of supply chain auditing and increasing their continued assurance of good practice implementation with consequent societal benefits.

While the ISO45001 (10) standard covers occupational health and safety management systems, experience tells us that such auditors tend not to be process safety specialists and will not delve deeply into the specifics of process safety management systems within an ISO45001 audit process. In a similar vein, such auditors are not specialists in wellbeing or mental health either and for this reason, the ISO45003 "Occupational health and safety management — Psychological health and safety at work — Guidelines for managing psychosocial risks" standard (11) was published in 2021. This paper proposes that there would be benefit to industry, society and international governments with the development of a related standard specifically for process safety which takes a similar development cycle to the recent ISO45003 route to publication. This new standard should integrate well with existing aforementioned standards in terms of structure but be focused entirely on process safety management systems to avoid significant overlap with existing standards.

The proposal

Serious incidents caused by the loss of containment of hazardous materials and/or the loss of control of energy from hazardous reactions, resulting in fires, explosions, toxic clouds, injury and damage to process plant, property and the environment continue to occur in the process industries around the world. Significant improvements in regulation and management of major accident hazards, particularly in the chemical industries, across many jurisdictions have encouraged organisations to implement process safety management systems to reduce the risk of such incidents occurring. There remains however, scope to widen the uptake and visibility of management of major accident hazards and process safety across industry. Widening the uptake of good process safety management will reduce the frequency and severity of process safety incidents which occur.

There are already several widely accepted process safety frameworks published. Examples include:

- The American Chemistry Council's Responsible Care Process Safety Code (3)
- The Energy Institute's High-Level Framework for Process Safety (4)
- CEFIC Responsible Care Management Framework Process Safety Code (5)
- CCPS's Guidelines for Risk Based Process Safety (6)
- OECD's Guidance on Corporate Governance for Process Safety (7)
- IChemE Safety Centre's process safety framework (8)

Each of the above documents, provides a structure of elements to consider when developing and implementing a process safety management system. There is an opportunity to formally wrap these frameworks firmly inside a yet-to-be-developed, certifiable and internationally recognised standalone PSMS standard. Such a standard would align with existing ISO management system standard approaches which cover, for example, environmental (ISO14001) and health and safety (ISO45001 and ISO45003) subject areas. Impact of any overlap with existing standards would be low because this standard would be specific to process safety and due to the proposed structural alignment, it would lend itself to integration with existing standards for ease of implementation. The process of writing the standard, under ISO/BSi supervision should be able to take this into account and ensure the standard 'fills the gap' which undoubtedly exists at present. ISO/BSi endorsement will also mean the new standard is subject to periodic review and revision to keep it up to date.

The management system wrapper, would apply the standard plan-do-check-act management system standard and continual improvement cycle, around any of the above process safety frameworks. It would be adequately flexible to enable individual sites to tailor their approaches appropriately (being sensitive to site complexity, context and risk profile). Whilst achieving this, it would also provide the fundamental assurance, intrinsic in the plan-do-check-act management system cycle, of appropriate management oversight, competency and resourcing to deliver continual process safety improvements and thereby risk reduction.

A systematic approach to PSM is proposed for organisations to implement PSMS with the aim of reducing and managing process safety risks. Organisations can use their commercial influence to encourage the implementation of such a management system through the supply chain, thereby encouraging leaders of organisations not already engaged in PSM or not subject to surveillance level regulatory oversight to realise the benefits for themselves and all society. For those organisations already engaging with PSM, the additional third-party observations will be beneficial to the overall process of continual improvement.

A key benefit for site leadership teams (and for company leadership teams, for multi-site organisations) is that implementation of such a standard would help demonstrate major accident risks are as low as reasonably practicable (or equivalent) and thus help demonstrate legal compliance, where required.

Scope

It is proposed that the scope of this new process safety standard specifies requirements for a PSMS that an organization which handles, stores, transports, manufactures, or processes hazardous materials, can use to enhance its process safety performance. It would be suitable for use by an organisation seeking to manage its process safety risks in a systematic manner, ultimately continually reducing risk and thereby continually aiming to improve its process safety performance.

The standard should help an organisation achieve the intended outcomes of its PSMS, which provide value for the local community, employees, contractors, visitors, the organisation itself and interested parties. Consistent with the organisation's safety policy, it is proposed that the intended outcomes of a PSMS would include:

- Continual improvement in the control of process safety hazards
- Reduction in process safety risk
- Improved assurance of process safety performance
- Fulfilment of compliance obligations
- Achievement of process safety objectives

Such a standard should be applicable to any organisation which handles, stores, transports, manufactures or processes materials with hazardous properties. It would apply to the management systems surrounding the containment and control of such materials and would not state specific process safety design or performance criteria. Requirements would align with process safety management expectations under the Control of Major Hazards Regulations (2015) or the Seveso III Directive (2012) but are not restricted to only those installations meeting the lower or upper tier threshold inventory levels.

Leadership

A key element of management system standards is the need for demonstrated leadership. The certification to a process safety standard, would in itself become an assurance of senior level commitment to continual improvement in this field. It is proposed that leadership requirements would be incorporated into the process safety standard. Senior management should ensure the organizational structure and reporting lines support inter-departmental collaboration and appropriate and timely escalation of process safety concerns. They should support processes which give transparency to the impact on process safety risk of decisions made right across the organization. They should ensure the right process safety competencies are in place and maintained for each role across the whole organization, not just in the Safety Department. They should demonstrate leadership and commitment with respect to the PSMS by the following activities:

- Taking accountability for the effectiveness of the process safety management system
- Ensuring that the process safety policy and process safety objectives are established and are compatible with the strategic direction and the context of the organisation
- Ensuring the integration of the process safety management system requirements into the organisation's business processes
- Ensuring that the resources needed for the process safety management system are available and all relevant personnel are competent
- Communicating the importance of effective process safety management and of conforming to the process safety management system requirements
- Ensuring that the process safety management system achieves its intended outcomes
- Directing and supporting persons to contribute to the effectiveness of the process safety management system
- Promoting continual improvement
- Supporting all management roles to demonstrate their leadership in process safety, as it applies to their areas of responsibility.

Senior management should also establish, implement and maintain a process safety policy that, within the defined scope of its PSMS:

- Is appropriate to the purpose and context of the organisation, including the nature, scale and process safety risk of its activities, products and services
- Provides a workflow for setting process safety objectives
- References an industry recognised framework for managing process safety

- Includes a commitment to the management of and continual reduction of process safety risk relevant to the organisation
- Includes a commitment to fulfil its compliance obligations
- Includes a commitment to continual improvement of the process safety management system to improve process safety performance and reduce process safety risk.

Further, the most senior management should ensure that the responsibilities and authorities for relevant roles are assigned and communicated within the organisation. They should therefore assign the responsibility and authority for:

- ensuring that the process safety management system conforms to the requirements of the process safety standard
- reporting on the performance of the process safety management system, including process safety performance and process safety risk, to all levels in the company including the most senior management.

Plan

It is anticipated that a process safety standard would require the organisation to establish, implement and maintain a process for hazard identification that is ongoing and proactive. The process should, where relevant, take into account, but not be limited to:

1. The basis of safety for each process safety hazard;
2. Process or technology changes and organisational changes;
3. Unintended changes such as ageing plant, corrosion, sudden or unplanned business led alterations and creeping changes occurring over a long period of time;
4. Process design;
5. Compliance obligations;
6. Abnormal conditions and credible accident scenarios;
7. Leadership and culture;
8. Human factors;
9. Normal operations, start-up and shutdown;
10. Asset integrity and containment;
11. Process control and instrumentation;
12. Cyber security;
13. Past relevant incidents, internal or external to the organisation, including emergencies and their causes;
14. Physical security;
15. Occupied buildings within accident hazard scenario impact range;
16. Hazardous materials and reactive chemistries;
17. Competency, employee selection, placement and health assurance;
18. Communications and operating procedures and operational interfaces;
19. Operational control (risk control systems, reliability, process monitoring);
20. Emergency preparedness and response;
21. Shift handover, role handover and succession planning;
22. Inspection, testing and maintenance (safe isolation, overrides, safety critical devices);
23. Safety critical tasks and the potential for human error;
24. Permit to work;
25. Selection and control of contractors and other outsourced services;
26. Procurement of products or services;
27. New information, or changes in knowledge of hazards;
28. Worst-case credible accident hazard scenario consequences;
29. Regulatory requirements, industry good practice / relevant guidance and standards;

A justifiably appropriate methodology for assessment of acceptability of the risks related to the above hazards should be applied. From this, process safety objectives can be determined and action plans for improvement drawn up.

Do-Check-Act

The existing management system standards in the Safety Health and Environment area, ISO14001 and ISO45001etc already require the complete 'plan-do-check-act' cycle. The 'do-check-act' elements of this proposed process safety standard will also drive the delivery ('do') of the objectives (determined in the 'plan' stage), 'check' that such delivery is effective, and 'act' to change arrangements where deemed necessary following any performance review. This is the strength that the certifiable management system wrapper can bring to the existing process safety frameworks. It can drive the process through its full cycle at regular intervals, providing opportunities for companies to take the time to consider the process safety related implications of its decisions. These are often the decisions on which safety depends and whose true and ultimately potentially disastrous consequences may otherwise lay hidden for many years.

Given that the overall intention of the proposed standard is to deliver risk reduction, it is proposed that the suggested ISO process safety standard would include a requirement for organisations to establish, implement, control and maintain a complete 'plan-do-check-act' management process. The objective would be the effective control of process safety hazards, the continual reduction of process safety risk and creating an environment where the workforce are encouraged to learn and apply lessons from process safety incidents, both internal and external.

In order to help achieve these aims it is suggested that the PS management system (plan-do-check-act cycle) approach should be applied directly to the sub-processes of:

- Process hazard analysis
- Compliance obligation management
- Emergency preparedness and response
- Competency management
- Site security
- Process safety culture
- Asset integrity
- Management of Change
- Permit to Work
- Incident Investigation
- Functional safety and cyber security
- Contractor management
- Dual assurance (leading and lagging) PSM KPIs

Conclusion and call for action

If a specific standalone, certifiable ISO standard for Process Safety Management Systems were available, those that are certified will be audited regularly by a third party. This should assist the regulators, across all jurisdictions, in gaining the necessary assurance that a company's process safety performance is adequate. Part of the standard would require site operators to use their influence, principally through the supply chain but in other ways where appropriate, to encourage the company's suppliers and customers to improve their own process safety performance. This helps drive improvements without reliance on regulation or regulator intervention and can bring business benefits for companies. In the EU and UK companies regulated under Seveso/COMAH are required to maintain a process safety management system. If the regulators of these companies were - as an element of best practice - to encourage companies to use their influence inside their own supply chain by requiring supply chain companies to improve their process safety performance, this could be a powerful force for the proliferation of process safety good practice within the industry, turning good practice into common practice. The suppliers and customers would have an obvious method of demonstrating their intent for good process safety practice by becoming certified to the proposed process safety standard. Companies asking for such demonstrations would be relieved from potentially burdensome auditing processes through the implementation of simple screening checks around ISO certification.

Process Safety has the Energy Institute's high level framework for process safety(4), the OECD Guidance on Corporate Governance for Process Safety(7), the CCPS Guidance for Risk Based Process Safety(6) and other similar frameworks (3)(5)(7)(8) as well as the COMAH assessment manuals and delivery guides (12), and in the US, the OSHA process safety management standard (13). However, there isn't currently a standalone international standard which encourages continual

improvement specifically in process safety as related to major accident hazards for which third party certification is available. There is a risk - indeed more than a risk, a certainty - that leadership teams in some companies are not as aware of the process safety management practices in their own companies as they should be.

There is an opportunity to develop an internationally recognised, standalone, certifiable process safety standard to encourage continual improvement in process safety through the supply chain. This would support the work that local regulators are able to carry out but also enhance the transparency, assessment and visibility of performance in this area. It is envisaged that sites regulated under major accident legislation would be encouraged to seek process safety management system certification and use their supply chain influence to encourage further uptake of the standard wherever appropriate for their customers and suppliers.

The benefits would be:

- Increased assurance for the regulators that companies subject to major accident legislation are meeting their PSMS related obligations reducing the time the regulator needs to spend assessing this.
- Increased awareness and uptake of good process safety management practices for sites which normally would receive only limited process safety regulatory intervention.
- Improved process safety performance across the industry, brought about through continual risk reduction activities.
- Reduced risk to local communities from high hazard sites.

This paper calls for agreement and commitment from companies currently engaged in process safety to work together to develop a certifiable process safety international standard.

It calls for:-

1. Support from **regulators** to realise the universal benefits that such a standard could bring to the international stage and start to consider how this could be built into existing regulatory frameworks to best effect.
2. The engaged **process safety technical community** to look beyond their own mature process safety management systems, recognise the need for such a standard, recognise the potential societal benefits of such a standard and lobby their own companies to provide support for the development of a standard through an appropriate industry recognised body.
3. **Companies or individuals providing process safety consulting services** to bring their experiences of the need for such a process safety standard into the open and to build auditing expertise around the process safety standard.
4. **Institutions and trade associations** representing the high hazard sector to provide leadership in this endeavour to build a consortium, lead and provide the funds for the production of an ISO standard for process safety management, to persuade their membership of the value of supporting this initiative, and to work with the relevant certification bodies to push the development of this proposed standard through to publication.

Next steps

This paper simply suggests that if companies could collaborate to raise the funds needed to develop a standalone, certifiable process safety management system standard with the potential to go on to be an international standard, all companies and indeed society would eventually benefit.

A consortium funding approach which begins with the development of a ‘publicly available specification’ (PAS) is likely necessary to bring the standard to market. The costs for such an industry led development are of the order of £100k through BSi.

Just ten companies, each contributing £10k would achieve this, (or of course 20 companies each contributing £5k).

Please look at the four requested calls for action above. Please identify which of the four communities you fit into and please then, if you have been persuaded by the arguments in this paper, take action as suggested to help bring this process safety standard to publication for everyone’s benefit. Thank you.

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