The Silo Factor – Why Tackling Silos Can Improve Process Safety Performance

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Introduction

Efforts to galvanise global industries against the threat of hazardous catastrophes are being hampered by an uncoordinated and disjointed approach to Process Safety Management (PSM) – referred to as 'the silo factor'. This is the principal finding of a research project carried out by ABB Consulting.

This paper defines what the silo factor is and details the findings of research carried out by ABB in terms of the common PSM weaknesses that have been identified, discusses their underlying causes and presents some ideas on how to eradicate the factors that can lead to silo behaviour.

Without the necessary focus and attention silo behaviour could be lowering defences against more disasters on the scale of Buncefield, Texas City and Macondo in future. Such events have intensified focus on process safety management, leadership, key performance indicators and competence in recent years.

The uptake of these activities by operating companies' and industry bodies is certainly encouraging. Amid tighter budgets, however, and a sharper focus on balance sheets, process safety performance is being threatened by the silo factor - an inability within process safety management circles to collaborate and be consistent across all departments in the organisation.

The UK's Health and Safety Executive (HSE) is still seeing evidence of process safety management approaches being disjointed, with a wide variation in the uptake and application of PSM. HSE investigations and inspection programmes show no shortage of serious failures to adequately manage process safety risks.

There are clear economic benefits from tackling the silo factor - for example not over specifying equipment, reducing the amount of in-service testing and inspection, more efficient sharing of process safety information and not duplicating safety studies.

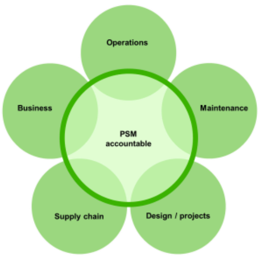
This paper aims to encourage industry wide debate that will help to take the high hazard sector closer to an agreed and consistent approach to process safety management.

What is the silo factor?

Modern PSM is complex and requires an organisational approach that involves an array of engineering disciplines, functions, and often different businesses in ensuring that performance is sustained or improved.

Each engineering discipline, function or business involved in PSM has its own responsibilities and roles to play in the overall PSM picture. However most of the parties involved are also responsible for many other day-to-day activities, such as production, quality, cost savings or process improvements.

PSM responsibilities



The silo factor described in this paper occurs when each of these parties thinks more about optimising their own area of responsibility and less about optimising the overall organisation's PSM performance. Effective performance of the PSM system, however, can only be achieved through integrated and collaborative thinking and processes that encourage a relentless focus on MAHs.

One way the silo factor can impact on PSM performance can be seen through an example of the maintenance organisation; they play a very important role in ensuring that safety critical equipment is appropriately tested and maintained. This focus can potentially be lost however, as they also maintain many other systems that are not safety critical. The maintenance team may see benefit from standardising test intervals and maintenance methods across all of the systems they are responsible for, but in doing so can lose sight of the safety critical nature and requirements of protective systems.

Another way the silo factor can negatively impact both PSM and financial performance is linked to the inconsistencies found in sharing and passing on information. Using a maintenance example again; the technicians need information to understand how, for example, a temperature sensor is protecting against a runaway reaction so that they can assure adequate reliability of the measurement device. This needs to be communicated to others if any changes they make (for example testing less frequently or introducing a more reliable device) may reduce or increase the level of protection provided. This information could allow operations to determine that the risk is now too high to continue operations or for the process safety team to determine that another independent protective system is no longer required.

A robust management of change system is at the heart of ensuring the communications described above, but achieving effective communication flow in every instance, given the often complex systems for storing information, is a real challenge. Often the silo factor impedes this flow of information.

Findings of common weaknesses in PSM systems

The HSE challenge to high hazard facilities following Buncefield was to be able to answer 'yes' to the following questions at all levels in the organisation:

Do we understand what can go wrong?

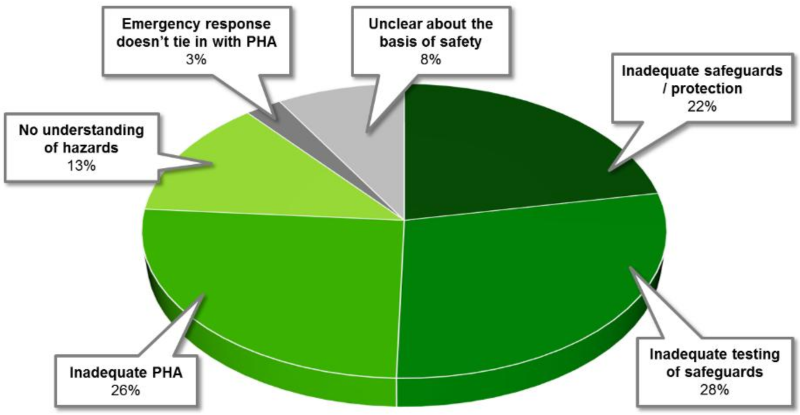
Do we know what systems we have to prevent this happening?

Do we have information to assure us these systems are working effectively?

By implementing robust process safety hazard identification and risk assessment processes during the Design stage, comprehensive risk controls during operations and maintenance, and implementation of reliable monitoring of these risk controls, we should be able to answer 'yes' to all the above.

Yet analysis of over 500 recommendations from 16 site process safety risk assessments carried out by ABB over recent years has revealed that many operators cannot answer 'yes' to the above due to inconsistencies and in some cases a complete lack of information sharing.

The pie chart overleaf shows the most common areas of weakness identified in the studies. Some examples to illustrate typical issues are then described.



Common areas of weakness

Inadequate testing of safeguards - Example findings included:

- Not differentiating between safety critical and other systems. In certain cases the term 'safety critical systems' was not in place and therefore no differentiation in the standard of testing for all systems
- Lack of access to design or previous inspection data
- Not completing end to end proof tests of safety instrumented systems. In many cases the Electrical, Control and Instrumentation (EC&I) team specified the testing requirements and end to end testing of 'barriers' was not in place and no reference to Process Hazard Analysis (PHA) documentation was being made in determining testing requirements
- Reduced maintenance on safety critical measurement devices leading to increased plant trips.

Inadequate PHA information - Example findings included:

- Not reviewing PHA assessments when designs are modified or new ones introduced
- Not updating LOPA studies based on real reliability data

- Not identifying critical alarms based on the PHA
- Not documenting PHAs well enough to pass on the nature of the hazardous event or the likely consequences. This often means that the SIL determination stage has to ignore the poor PHA output and start from scratch to identify hazardous events
- Not updating PHA records following an incident or near miss. ABB found that for one company a potential fatality near miss had not been captured as part of the PHA process

Inadequate safeguards in place - Example findings included:

- Not providing operators with information on how to respond to alarms
- Not considering some of the relief scenarios identified in the HAZOP during relief system design
- Frequent removal of some elements of trip systems during certain operations

Poor understanding of hazards – was another common theme with examples including :

- No regular training in key hazards being given to operators. When conducting reviews it was often found that operators are not aware of worst case credible events as a result of PHA documentation not being shared and process safety training not being carried out effectively
- Risk assessment reports not being accessible
- Not investigating incidents adequately to identify root causes and potential new weaknesses in the PSM system

Lack of clarity about the basis of safe operation and a lack of alignment between emergency responses and the PHA. Example findings include:

- Unnecessary protective and emergency response systems not being removed when no longer required
- Safety equipment not being positioned where hazards are located
- Procedures not being updated when new best practice is available

Analysis of the findings suggested there are a range of common weaknesses as well as areas of best practice. That said, in most cases the weaknesses were in some way a result of silo approaches to PSM with different functions / specialists / departments not integrating effectively.

The process safety implications of many of the examples above are clear with instances of: people performing safety critical tasks without understanding the significance of these tasks and the hazards they are protecting against; protective systems not designed with an adequate understanding of the scale of consequences they need to protect against; and management systems not identifying and rectifying shortcomings.

There are also economic implications from silo thinking such as: people recreating information that exists in another silo; protective systems that are over specified and expensive to maintain; and management systems that don’t identify the true risks and therefore fail to focus scarce resources on the areas of greatest concern.

PSM requires an integrated approach across the organisation. Poor PSM performance through silo behaviour means that there is potential for the holes in the ‘Swiss Cheese’ model to align - each silo should be focussed on making sure that their slice of cheese has fewer smaller holes, but who is accountable for making sure that small holes don’t line up?

What leads to silo behaviour?

Below the six main areas of shortcoming identified in the research are considered and used to explore the underlying causes of the silo factor.

The silo factor related causes of PSM weaknesses to inadequate PHAs include:

- Poor initial PHAs due to a lack of availability of relevant information
- PHA findings not being clearly recorded in a way that takes into account the needs of the subsequent users (silos)
- PHA results not being shared with the right people or in the right format
- PHA actions not being well specified or closed out robustly
- Consequences not adequately described or modelling results not made available in a consistent manner

Weaknesses linked to inadequate safeguards arise from failure to:

- Validate that the specified safeguards adequately deliver the risk reduction required by the PHA
- Robustly ensure all risk reduction requirements are identified, designed and installed
- Appropriately prioritise efforts towards major accident hazards

The other silo related causes of shortcomings, covering the other four themes, include:

- Safeguard test intervals and procedures not consistent with PHA findings
- Test results not being reviewed and fed back to PHA teams to update assessments
- People carrying out safety critical tasks not being informed and trained in plant risks and PHA findings
- Hazard identification and risk control documentation not being simplified in a suitable format for all staff to understand
- Management of change not considering every step of the risk process from PHA to auditing and training

It can readily be concluded that the majority of the above causes relate to effective and clear two way communication of all relevant process safety information between the various departments in the organisation.

How can the silos be broken down?

It is important to point out that removing silo behaviour, whilst vitally important, is not enough on its own to assure good process safety performance - that line of thinking is a good example of silo thinking. Effective PSM requires each area / silo to operate effectively in its own right, but in addition there must be no impediments to the flow of information between each of the many groups involved in delivering PSM. Indeed, there needs to be careful thought around the implementation of processes and protocols to ensure formal two way communication is consistent and becomes embedded as 'business as usual' within operators.

Three key areas are suggested as focus areas to overcome organisational factors that can lead to silo thinking :

Firstly, accountability and oversight

Who in the organisation is accountable for the overall management of process safety risk? These are the people who must look across the slices of cheese according to the Swiss Cheese Model and make sure that the holes don't align. They must ensure that information in a consistent format flows freely between the different parties and that the whole system is healthy by having an adequate range of audit programmes and other measures of performance in place.

Secondly, communication

What needs to be communicated to and by each party? A shared understanding of this information flow is a good starting point for making sure that it is achieved. Identifying the barriers to the smooth flow of information and taking them down may mean looking at procedures, systems and information storage. A key requirement is to ensure that there is an effective relationship between MAHs and safeguards and that this relationship is managed continuously during the safety lifecycle.

Thirdly, simplification.

How to simplify PSM and pass on the information everyone needs in ways that they can understand and act on? PSM can be very complex and some elements of it very technically challenging, but many groups need only the clear simple messages. The output from a HAZOP is not for the HAZOP team, but for the people that need that information to determine criticality, understand the top site hazards etc. so can the output be simplified to give them something that meets their needs? Can aids to communication, like bow-ties, be used more effectively to share the overall picture more widely?

Conclusions

This paper has defined the meaning of the term silo behaviour in a PSM context and highlighted that it can weaken defences in layers of protection/barriers that are essential for prevention of major accident hazards.

ABB's extensive research has revealed common PSM weaknesses and this paper has discussed their underlying causes and presents some ideas on how to eradicate the factors that can lead to silo behaviour.

These suggestions relate to overcoming organisational factors that can lead to silo thinking. Firstly, having clear accountability and oversight of PSM; Secondly, having clear communication systems in place to ensure that PSM-related information flows freely and thirdly, how to simplify PSM from being a technically challenging topic to one where everyone in the organisation is very clear on his/her role in PSM.

This paper aims to encourage industry wide debate that will help to take the high hazard sector closer to an agreed and consistent approach to process safety management.