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## **Organizational Process Safety: Taking Process Safety to the Next Level**

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### **Abstract**

Process safety management relies on multiple models for the safe manufacture, storage, use and transportation of highly hazardous chemicals. For the most part these models are little more than a checklist of activities that, at best, create a fractured strategy for preventing catastrophic incidents. To manage process safety at a world-class level, organizations need to develop their culture and capabilities around process safety. These two elements help integrate the overall system and move process safety to the next level.

### **Introduction**

There are many models for process safety management, and these have evolved from the early CCPS process safety management model (1989), OSHA PSM rule (1990), and Responsible Care code (late 1980s) through company-specific approaches, the EU's Seveso I, II and III directives, to the CCPS 2007 risk-based PSM model. Each identifies a number of PSM elements that comprise essentially a checklist of activities suggested for organizations wishing to manage process hazards. Most companies involved in manufacture, storage, use and transportation of highly hazardous chemicals have adopted one or more versions of these models, and yet we continue to see many serious and catastrophic incidents each year.

The fragmented approach reflected in all of the PSM models is a root cause of our limited progress in reducing process incidents. The activities typically identified as PSM program elements are interdependent and must be tied together by two overarching elements that determine their effectiveness and sustainability.

We characterize the elements of managing process safety as shown below. These seven elements incorporate all of the individual activities identified by the CCPS 20-element risk-based PSM

model, all elements of OSHA's PSM rule, all elements of the Responsible Care Process Safety Code – in fact all elements of whatever traditional PSM model you prefer.



What this model does differently is recognize the critical interrelationship of two elements with each of the others – those being Organizational Culture and Organizational Capability. These are not just additional “check-the-box” aspects of process safety management. *Rather they are the glue that integrates an effective system – and that is often overlooked.*

### **Organizational Capability**

Organizational capability refers to having the knowledge, experience, data, and analytical tools to support all elements of process safety. There are two primary aspects of organizational capability: data/information/tools, and knowledge/experience.

#### Data/information/tools

We employ many types of information in managing process safety. For example, information on the flammable properties, toxicity, and reactivity of chemical substances, and on the compatibility of chemicals with each other and with the equipment is critical to our understanding of risk and determination of adequate risk control. Information is derived from data, and data must be validly obtained and appropriate to the situation. We should not accept the validity of information without understanding the validity of the underlying data on which it is based.

Data, and therefore information, can change with time and context. Operating conditions, material properties and contaminants, equipment characteristics, and processing sequences can all impact the validity of data for a specific use.

Models are employed to take data and information and use them to predict the consequences of incidents. Models are necessarily imprecise – they’re attempts to use mathematics to understand complex relationships that occur in physical and chemical phenomena. In using models, questions must be asked such as: What are limits of a particular model’s validity? What are the limits of model accuracy and precision? Which model is best for a given situation? Models are often treated as black boxes, but without understanding capabilities and limitations they can lead to poor conclusions.

Organizational capability depends on having the right data and information, and using the right models in the right ways to reach appropriate conclusions. Having the right data, information, and models is foundational to process safety, but information and tools must be used by people with the right skills, knowledge, and experience.

### Knowledge/skill/experience

The importance of knowledge is generally recognized, but the question should be asked, is one’s knowledge deep or superficial? A computer can be programmed to ask HAZOP guide questions, but that doesn’t mean the computer will produce a thorough and meaningful hazard analysis. Knowing the mechanics of a PHA technique is not the same as understanding the basis of the technique and the underlying objectives of the exercise. Without adequate depth of knowledge it becomes a “check the box” drill.

Experience is another important contributor to competence, and one that in many organizations is being rapidly lost as the “baby boom” generation retires. What systems are in place to capture institutional knowledge and facilitate its use by less experienced up and coming individuals?

Another consideration is practical knowledge, which is as important as book knowledge. An analysis done by engineers who have never operated a unit is likely to be less valid than an analysis in which the engineers are joined by operators who run the unit daily. The operators know how things are really done and why, and often know which steps are tricky or risky.

What this boils down to is that in implementing each element of process safety management we need:

- People with right knowledge and experience in the right roles/activities;
- Supported by information derived from accurate, relevant, up-to-date data;
- Analyzed with models and tools that are properly fit for purpose; and
- Drawing upon robust institutional knowledge.

A traditional PSM audit will not tell you whether you are addressing these issues. Assessing organizational capability requires a thorough review of how various activities are being conducted and by whom they are being conducted, in addition to the traditional evaluation of the process safety management systems.

## **Organizational Culture**

In the last few years we have seen many people write and speak about process safety culture. Unfortunately, much of this dialog has come from technical process safety experts whose views about establishing or strengthening culture are either misleading or incorrect.

Organizational culture refers to the underlying, unstated, shared beliefs and values that exist within an organization. These give rise to behavioral norms, which are often described as “the way we do things around here” or the unwritten rules of the organization. People joining the organization quickly learn the behavioral norms, which reflect things ranging from how closely procedures are followed to where people sit in meetings.

Because these norms are based on what is perceived as having led to success, they cannot be changed simply by rewriting roles, responsibilities, policies, or procedures. Strengthening the organizational culture to better support process safety requires addressing Behavioral Reliability and Engagement.

### Behavioral Reliability

Behavioral reliability means doing the right things, in the right way, at the right time, every time. This means that the “unwritten rules” in the organization must be consistent with the objectives of process safety.

Leaders can influence the unwritten rules when the organization reflects nine general characteristics: management credibility, perceived organizational support, procedural justice, leader/member exchange, teamwork, workgroup relations, organizational value for safety, upward communication, and approaching others. When these characteristics are strong, leaders have the credibility and influence necessary for change, and workers at all levels are open to change.

There are also four process safety-specific characteristics that must be strong in an organization striving for outstanding performance in process safety. The four process safety-specific characteristics are anticipation, inquiry, execution, and resilience. When unwritten rules drive behavior that supports these characteristics process safety excellence results. Organizations stronger in these characteristics have better process safety performance, and examination of past incidents shows that the four process safety-specific characteristics consistently contribute to major events. When these characteristics are strong there is less chance of negative influence from normalization of deviance, cognitive bias, and failure to react properly in emergencies.

Barriers to desired behavior also impact behavioral reliability. Often we unintentionally make it difficult or even impossible for people to perform in the way we want them to. For example, if process safety information is incomplete or incorrect, verifying the location or condition of an underground pipeline can be difficult or impossible. We need systematic ways of identifying barriers to desired behavior.

## Engagement

Engagement is the second major component of culture. To achieve consistently excellent performance, there must be engagement in process safety at all levels. This is because the only way to change unwritten rules is through leadership, exhibited systematically and intentionally at all levels over a sustained period of time.

What engagement looks like for senior executives is different from what it means for front-line workers, but all levels must be engaged in the appropriate ways.

For senior executives, engagement involves exhibiting both symbolic and substantive leadership behaviors that support process safety. Symbolic behaviors – such as publically thanking people who make difficult decisions (such as shutting down a unit for safety reasons) or being present when safety milestones are celebrated – are important to reinforce corporate values, but are not effective unless there are also substantive safety leadership behaviors. For a senior executive, examples of substantive safety leadership behavior are regularly reviewing critical safety metrics, asking follow-up questions after receiving an incident report, assuring that action items from serious incidents are being closed out in a timely fashion and more importantly asking whether the action items have actually eliminated the exposure, or asking direct reports about their progress on safety-related goals.

Mid-level managers and first-level supervisors play a critical role through their safety-related leadership behavior. These individuals are the management representatives closest to the actual work, and what they do and do not do, and say and do not say, actively or tacitly endorses or rejects the unwritten rules that arise from culture. For these employees, engagement means adopting safety leadership behaviors that support the 13 organizational functioning characteristics described above.

Front-line employees' engagement is manifested through the sense of ownership they exhibit in actions that support safety. Reporting small deviations, providing reinforcement to one another when safety procedures are followed, assisting someone who is struggling with following the safety practices, and ensuring that safety-critical activities occur are all examples of things engaged employees do regularly. Engagement of front-line employees occurs when the employees understand the importance of these (and other) actions, feel that their immediate managers want these actions to occur, and feel supported in their work by their immediate managers and supervisors.

Engagement is also encouraged by appropriate use of metrics and monitoring. Many organizations do not have or use either leading or lagging metrics for process safety. In the absence of performance metrics, people do not know whether performance is good or bad. Because major process safety incidents are relatively infrequent, it is important to use metrics that indicate the occurrence of precursors to process events. Such metrics should be shared widely to encourage engagement, and should be regularly reviewed by management to provide feedback to the organization and to identify when new or added focus is required.

## Conclusion

In summary, organizational culture for process safety requires:

- Creating an environment in which the key organizational characteristics are strong;
- Senior executives regularly exhibiting both symbolic and substantive process safety leadership behaviors;
- Mid-level managers and supervisors regularly exhibiting safety leadership behaviors that reinforce the desired safety behaviors;
- Frontline workers demonstrating a sense of ownership for safety-supporting actions; and
- Effective use of both leading and lagging metrics to create accountability and to communicate progress.

As with organizational capability, a traditional PSM audit will not tell you whether you are addressing these issues. Assessing organizational culture requires a careful examination of key organizational characteristics and the leadership behavior that drives those characteristics.

Each of the last 15 independent investigations of major process safety incidents performed by the US Chemical Safety Board has shown capability and culture to be important causes of the incidents. Understanding your organizations strengths and weaknesses in these areas is critical to avoiding process safety incidents.