

Understanding Process Safety Culture Disease Pathologies - How to Prevent, Mitigate and Recover from Safety Culture Accidents

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The Center for Chemical Process Safety (CCPS) made process safety culture a key element when it published its *Risk Based Process Safety Guidelines*. One chapter described how to nurture process safety culture and defined the 12 essential features of a good culture. Over the past seven years, many other organizations in different industries have proposed frameworks to understand and assess safety culture. This paper initially compares different aspects of the frameworks in terms of definitions, descriptions, monitoring, etc.

In recent years, ABS Group has performed over 35 culture evaluations of companies involving hundreds of facilities, tens of thousands of employees and contractors, across all global regions and ethnic cultures. We developed a method to cross-correlate the culture survey responses with the companies' key performance indicators. By reviewing a number of the evaluations together it is possible to see a clear causal relationship, between specific safety culture weaknesses and company safety performance. Many of these will not be a surprise to practitioners but the work enabled us to provide the "demonstration" that, for example, poor process safety leadership led to an API-Tier-2 event. These weaknesses represent the current "disease states" for these companies. Three case studies show different causal pathways for the different diseases:

- In one company, process safety was not a core value, leading to normalisation of deviance and lack of responsiveness to safety concerns
- In another safety performance had plateaued due to poor process safety leadership by front-line supervisors
- And a third where "shoot the messenger" had led to hiding off-normal situations and ultimately a major accident

Identification of the disease pathways, i.e. what was it in the corporate culture that led to the degradation over time, enabled them to adopt practical measures to recover from their safety culture disease.

1. Introduction

Companies have been taught many times that organizational factors have been important contributors to major accidents. Some of those organizational characteristics have to do with not having a proper safety culture, failing to exhibit strong leadership to support the culture, and not creating the consistent operational discipline at all organizational levels. One theme common to all three of these aspects has been the failure of companies to learn from experience – either from their own or from others. The following are some characteristics of a "process safety learning-disabled company:"

- Dysfunctional safety culture
- People hide things and kill messengers
- Fail to question; procedures not followed without accountability
- Mixed/improper safety/production messages
- Complacency, low trust, silo mentality
- Misplaced safety ownership, invisible/ineffective leadership
- Superficial causal analysis of problems
- Things don't get fixed – or things don't stay fixed
- No company memory

In order to address these learning disabilities, companies should strive to improve operational discipline, leadership, and eventually their culture. The following sections describe examples of each of these aspects and how to improve them.

2. Relationship among culture, leadership and operational discipline

Process safety culture has been a key organizational factor in several major process safety incidents. Leadership has been a focal point of several industry group promoting performance improvement CCPS's 20 elements for success and Vision 2020 and RBPS Culture and Conduct of Operations elements.^{1,2} The UK Process Safety Leadership Group's report following the Buncefield accident focused on improving leadership.³ Subsequently, tools were provided by the OECD and the UKPIA.^{4,5} In the U.S., the API/AFPM have been focusing on Process Safety Leadership as one of its assessment areas.⁶ Finally, lack of operating discipline, as a product of a Conduct of Operations program, has been a sore point for many companies whose incident causes increasingly involve "people did not follow the procedures."⁷

How Are These Aspects Connected?

Culture is the tendency in all of us – and our organization - to want to do the right thing in the right way at the right time, ALL the time – even when/if no one is looking. Leadership is an essential feature of a good culture. Operational discipline (or the lack thereof) is a behavioral result of your culture and leadership.

Safety Culture Definitions and Scales

There are many; below is a selection of definitions:

- **Weick & Sutcliffe** - Cultures are based upon shared values, beliefs, norms, and perceptions (2001)
- **Jones** - the combination of group values and behaviors that determine the manner in which process safety is managed (2001)
- **UK HSE** - the product of the individual and group values, attitudes, competencies and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety programs. (2002)
- **IAEA** - that assembly of characteristics and attitudes in organizations and individuals which establishes, as an overriding priority, that safety issues receive the attention warranted by their significance. (2002)
- **Arendt** - Individual culture is the tendency in each of us to want to do the right thing in the right way at the right time, ALL the time – even when/if no one is looking. Organizational culture is a complex amalgamation of individual cultures, work processes, barriers, and behavioral rules (2006)

And associated scales:

- **James Reason's high-level framework** - Just, Informed, Reporting, Learning, Flexible
- **Westrum (1988)** - Pathological; Bureaucratic; Generative
- **Kiel Centre/UK HSE Safety Culture Maturity Model (2001, 2009)** - Pathological; Reactive; Calculative; Proactive; Generative

3. Frameworks for understanding safety culture

The CCPS made “culture” an official safety management system (SMS) element for the first time when it published its **RBPS Guidelines**.¹ CCPS safety culture working group and ABS Consulting evaluated major organizational accidents and prepared a Safety Culture Awareness tool, which has been widely distributed via CCPS's web page. Subsequently, Process Safety Culture was defined as an element in the **RBPS Guidelines** that created a culture management practice and laid out the “Twelve Essential Features of a Good Culture.”

Table 1 - CCPS Process Safety Culture – Essential Features

1	Establish safety as a core value
2	Provide strong leadership
3	Establish and enforce high standards of performance
4	Formalize the safety culture emphasis/approach
5	Maintain a sense of vulnerability
6	Empower individuals to successfully fulfill their safety responsibilities
7	Defer to expertise
8	Ensure open and effective communications
9	Establish a questioning/learning environment
10	Foster mutual trust
11	Provide timely response to safety issues and concerns
12	Provide continuous monitoring of performance

Other organizations have followed suit with establishing their own industry structures for culture. Below is list of several:

- Reasons
- HRO (High Reliability Organization)
- UK HSE (Health and Safety Executive)
- PSLG (Process Safety Leadership Group)
- IAEA Safety Culture Characteristics (Nuclear Industry)
- IAEA Generalized Safety Culture Characteristics
- NRC Traits of a Strong Safety Culture
- INPO's Principles for a Strong Nuclear Safety Culture
- BSEE Safety Culture Aspects
- CNEB - split into four positives and four negatives (defenses needed)
- Pipeline Hazardous Materials Safety Administration (PHMSA)
- Energy Institute

As one could expect, the more of these frameworks created by various groups – almost without respect to which industry they come from – the more these frameworks tend to cover the same aspects. Figure 1 compares the CCPS safety cultures features with the other frameworks to see which framework appears to be most complete.

Our belief is that while the CCPS culture feature framework is the most complete one, ultimately, it will not matter which framework you follow, but that you excel in the aspects of any one of them. When this doesn't happen and a poor culture persists, here are some lessons the authors have learned about why and what needs to be done.

- If you have poor culture, marked by mistrust or needs large improvement, the worst thing you can do is too just start “talking” about it at the top
- The “top” needs to first start “behaving” better to address culture weaknesses; then, the talk will build up from the bottom
- If you survey, do it anonymous and voluntary; you should commit to sharing the results – quickly
- Any education/training, etc. should extend to ALL of the workforce, including contractors
- BUILD OWNERSHIP

4. How to measure culture and leadership

Process safety culture is hard to measure and more difficult to change. There are few direct indicators of process safety culture, and because of its nature, it cannot be formally evaluated very frequently. Leadership and operational discipline are essential attributes of sustaining a healthy process safety culture. So, how do you know if better culture or operational discipline is needed? What evidence would lead you to believe that you need better operational discipline and that you need a ConOps element? Typical ways to get a handle on process safety culture are:

Establish safety as a core value	Everyone is personally responsible for nuclear safety [INPO]	Decision-making reflects safety first [INPO]	High priority to safety [AEA]	Strategic business importance of safety [AEA]	Absence of safety versus production conflict [AEA]	Motivation and job satisfaction [AEA]	Proactive and long term perspective [AEA]	Integration of good health and safety management with business	Sensitivity to operations [HRO]	Commitment to resilience [HRO]	Committed safety [CNEB]	Leadership is clearly committed to safety [PHMSA]	There is a safety conscious work environment [PHMSA]	
Provide a strong leadership	Leadership commitment to safety values and actions [BSEE]	Leaders demonstrate commitment to safety [INPO]	Leadership safety values and actions [NRC]	Proper resource allocation [AEA]	Clear roles, responsibilities and accountabilities [AEA]	Top management commitment to safety [AEA]	Visible leadership [AEA]	Clear and positive process safety leadership is at the core of managing a	Process safety leadership requires board level involvement and	Good process safety management does not happen by chance and	Board level visibility and promotion of process safety leadership is	Visible, active commitment from the board [UK HSE]	Leadership [CNEB]	Empowerment of Authority [CNEB]
Establish and enforce high standards of performance	Personal accountability [BSEE]	Personal accountability [NRC]	Nuclear technology is recognized as special and unique [INPO]	Good housekeeping [AEA]	Vigilance [CNEB]	Resistance to production pressure [CNEB]	Intolerance of inadequate systems and resources [CNEB]	Decisions demonstrate safety is prioritized over competing	Organization is fair and consistent in responding to safety concerns	Training and resources are available to support safety [PHMSA]				
Formalize the safety culture emphasis/approach	Work Processes [BSEE]	Work processes: Nuclear technology is recognized as special and	Awareness of work process [AEA]	Systematic approach to safety [AEA]	Quality of documentation and procedures [AEA]	Management of change [AEA]	Identifying and managing health and safety risks [UK HSE]	Reporting systems and accountability are clearly defined [PHMSA]						
Maintain a sense of vulnerability	Preoccupation with failure [HRO]	Reluctance to simplify interpretations [HRO]	Prevent normalization of deviance [CNEB]	Resistance to complacency [CNEB]										
Empower individuals to successfully fulfill their safety responsibilities	Respectful work environment [NRC]	Decision-making [NRC]	Sufficient and competent staff [AEA]	Involvement of all employees [AEA]	Good working conditions with regard to time pressure, workload and	Engagement of the workforce is needed in the promotion and achievement of	Engaging the workforce in the promotion and achievement of safe and healthy	Providing high quality training [UK HSE]	Employees feel personally responsible for safety [PHMSA]					
Defer to expertise	Compliance with regulations and procedures [AEA]	Man, technology, and organization knowledge [AEA]	Accessing (and following) competent advice [UK HSE]	Deference to expertise [HRO]										
Ensure open and effective communications	Effective safety and environmental communication [BSEE]	Effective safety communication [NRC]	Effective "upward" communication [UK HSE]	Handling of conflict [AEA]	Collaboration and teamwork [AEA]	Openness and communications [AEA]	Establishing effective "downward" communication systems and	Open and effective communication across the organization						
Establish a questioning/learning environment	Hazard identification and risk management [BSEE]	Environment for raising concerns [BSEE]	Respectful work environment [BSEE]	Inquiring attitude [BSEE]	A questioning attitude is cultivated [INPO]	Organizational learning is embraced [INPO]	Questioning attitude [NRC]	Continuous learning [NRC]	Problem identification and resolution-Organizational learning is	Organizational learning [AEA]	Employees have a questioning attitude [AEA]	Self-assessment [AEA]	Sharing best practice across industry sectors, continuous learning and learning implementing [PHMSA]	
Foster mutual trust	Trust permeates the organization [INPO]	Environment for raising concerns-Trust permeates the organization [NRC]	Relationship between managers and employees [AEA]	Relationship to regulators and other external groups [AEA]	Mutual trust is fostered between employees and the organization [PHMSA]									
Provide timely response to safety issues and concerns														
Provide continuous monitoring of performance	Continuous improvement [BSEE]	Nuclear safety undergoes constant examination [INPO]	Safety can always be improved [AEA]	Measurement of safety performance [AEA]	Publication of safety performance information provides	Monitoring safety performance based on both leading and	Monitoring reporting and reviewing performance [UK HSE]							

Figure 1 – Cross-reference of Safety Culture Frameworks to CCPS Features

Employee surveys – Surveys are the most frequently used method. Typically, a company will prepare an anonymous survey (20-70 questions, shorter is better) for both hourly employees and management. The content of the survey historically has been focused more on occupational safety issues, but recently they have been adapted to address process safety issues. Survey questions are developed to see how employees “feel” about important process safety-related matters. Respondents are asked to express the strength of their feelings about the issues – strongly agree, agree, neutral, disagree, strongly disagree. Questions and results are normally placed in categories relating to the process safety issues of concern (Process Safety Reporting, Commitment to Process Safety, Supervision, Procedures and Equipment, Employee Involvement, Process Safety Training, and Safety Processes). Table 2 lists some best practices for developing/conducting process safety culture surveys.

Table 2 - Important Considerations for Doing a Safety Culture Survey

1. Surveys should be engaging, but not too short (can't achieve sufficient inquiry into measurement objectives) or too long (respondents get bored and just "tick the box"), Survey questions should be simple 30-50 questions, 15-20 min.
2. Questions should be based on designed measurement objectives; don't just categorize the questions by "topic" (e.g., training, reporting).
3. Make sure the survey is linked to the company "values".
4. Develop questions that will stand the test of time. Be willing to augment previous survey with some "new/hot" topics.
5. Endeavor to make questions/answers either all "positive" or all "negative".
6. Answer spectrum should allow "not applicable"; we recommend using a Likert psychometric scale:
 - Strongly disagree, Disagree, Neutral, Agree, Strongly agree
7. Include everyone - even contractors.
8. Voluntary - agree on them seeing results/actions within a reasonable period of time.
9. Be careful with demographic questions - can make groups so small it can piece anonymity.
10. Do them electronically and augment with hard copy as needed.
11. Have at least one essay answer question at end.
12. Frame questions about what a respondent sees others doing - subordinates, peers, direct supervisors, or management/company" – rather themselves
13. Must be preceded by good rollout communication.
14. Put into field for a couple of weeks. Monitor, give reminders, but not too pushy.

Table 3 lists a few examples of typical process safety survey questions. Some difficulties with surveys are (1) that they should be voluntary, which may lead to insufficient participation to achieve statistical validity and (2) surveys cannot be repeated very often or else workers will become accustomed to it and can tend to feed back "what you want to hear" rather than what they are really feeling.

- Plant management is sincerely interested in feedback on process safety from the employees.
- My co-workers routinely report all process safety issues - including near misses - to our supervisor.
- Process safety is #1 at this company – we do not cut corners in order to maintain or improve production
- When an incident occurs, management focuses on correcting the issue rather than on "blaming someone."
- Our supervisor never asks us to perform an unsafe operation or task.
- My coworkers never "work around" a safety problem, rather than report it
- Overall, I am satisfied with the process safety training we receive
- Safety systems are not left disabled, but are restored as rapidly as possible

Table 3 - Typical Process Safety Culture Survey Questions

Interviews – another way to elicit process safety culture insights is through limited, representative, but targeted, interviews of company personnel. These interviews may last from 15 minutes to an hour. A disadvantage of interviews is that they are very time-consuming and resource intensive and the results are more difficult to pull together in a consistent framework for analysis.

Work observations – Process safety culture issues that deal with the tendency for employees to not following procedures, safe work practices, etc. can be identified via workplace observations. These can very effective, but are difficult to conduct in a consistent fashion using a large number of observers. The biggest limitation is that they are difficult to do without the person being observed knowing that they are being watched/evaluated. If they know, you are unlikely to get the "real" information about how the worker behaves "without anyone looking."

Process safety leading indicator metrics – More companies are using leading indicators of process safety as a window into process safety culture. For example, the rate of reporting of near-misses, the rate of close-out of action items, or the completeness of training compliance can be used to gage a company's leadership in process safety. Metrics are good because they can be refreshed frequently, but they are usually very "indirect" measurement of process safety issues.

Depending upon the situation, we typically use a combination of these means, anchored by some variation on a culture survey.

4.1 Process Safety Performance Assurance Review

ABS Consulting has devised an approach for connecting process safety culture survey results to process safety outcomes. This process safety **Performance Assurance Review** approach (Figure 2) categorizes the culture survey results and maps them to the 12 essential features of a good process safety culture, (b) categorizes the results from a review of recent and historical process safety performance at a plant (e.g., current PSM or EHS audit results) and maps these results to the same 12 essential features. The “weighted outcome” of the mapping of contributions of both the survey results and the PSM audit results to the 12 essential features are totaled and the most significant process safety culture issues are identified for the plant/company.

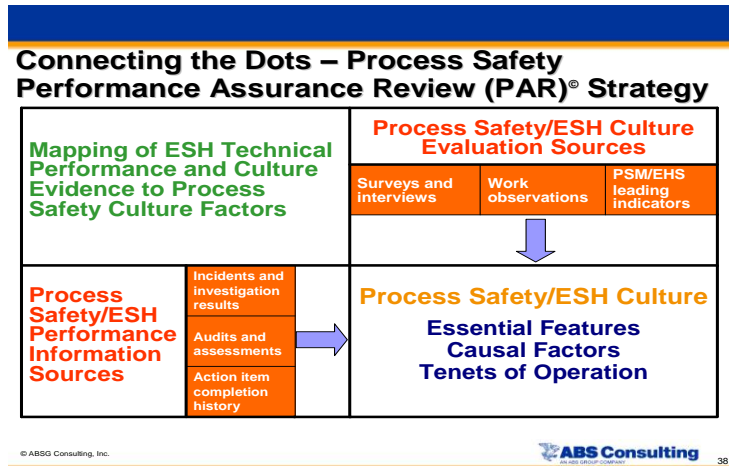


Figure 2: Process Safety Performance Review Culture Evaluation Approach

The results of the process safety culture survey are categorized into the 12 essential features of a good process safety culture. Example survey results for the positive responses (Strongly Agree plus Agree) are ranked as shown in the Figure 3 below. Also shown is a typical difference one sees in survey responses between demographic groups.

4.2 Categorizing the Process Safety Performance Review Results

Technical findings are given varying degrees of “risk significance” (Figure 4) based upon (a) the type of finding (e.g., imminent integrity issue vs. improper training records) and (b) the number of items contributing to the finding (e.g., 93 problem situations found for one category of finding vs. 8 situations found for another). Each of these categories is mapped to the 12 essential features of a good process safety culture. This mapping shows the relationship between the existence of the apparent underlying culture problem and how it may have results in the evident process safety outcome. For example, a plant that has (1) known, imminent apparent safety hazard situations that have not been fixed in a long time, (2) a large number of action items not completed, (3) large deficient equipment and inspection backlogs, and (4) poor operating discipline indicated by a lack of following safety work practices indicates that the plant has the culture disease symptom of “Normalization of Deviance – Lack of Setting and Follow Process Safety Standards and Rules”.

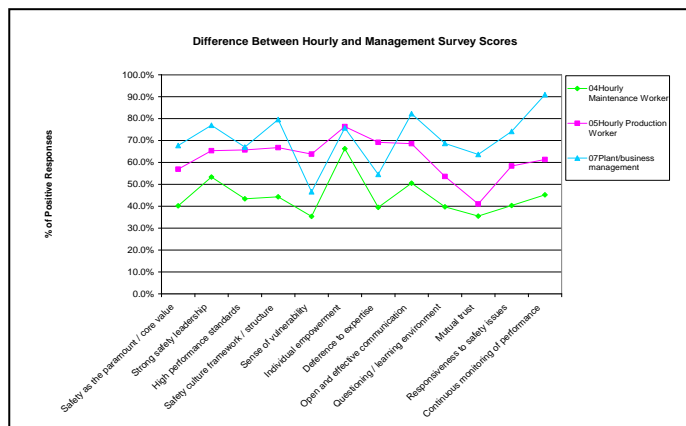


Figure 3 – Example of Survey Results by Culture Feature and Demographic Group

- Containment integrity issue allowed to exist
- Unsafe work practice
- Action item not completed or late
- Safety hazard situation is allowed to exist
- Inadequate inspection, testing, maintenance
- Inadequate management practice/ system / procedure
- Inadequate hazard, risk, root cause analysis
- Inadequate monitoring or auditing
- Inadequate training
- Inadequate recordkeeping and documentation
- Inadequate communication or signage/placards

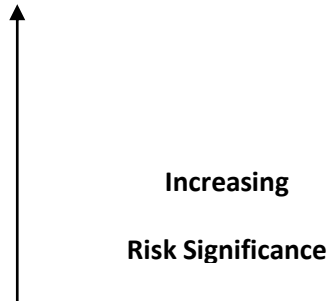


Figure 4 – Process Safety Performance Deficiency Categories

4.3 Connecting Process Safety Performance to Culture Results

The survey results and the technical results are both weighted and mapped to the same 12 essential features. The weighted contributions from survey results that also have contributions from the technical results are summed to give the overall score for the essential feature. Features that have high survey results but do NOT have high scores for process safety evidence are reduced in significance. Features that have significant survey scores that also have significant process safety evidence scores are enhanced in importance. Figure 5 is an example.

Safety Culture Essential Features:						Safety as the paramount value	Strong safety leadership	High performance standards	Safety culture framework / structure	Sense of vulnerability	Individual empowerment	Defence to expertise	Open and effective communication	Questioning/ learning environment	Mutual trust	Responsiveness to safety issues	Continuous improvement
Scores from Survey Results of Dataset : 01						71%	73%	73%	71%	68%	76%	62%	68%	55%	70%	76%	66%
Safety Cultural Performance Ranking						4	4	4	4	4	4	6	4	6	4	4	4
Plant 1 Dataset						EHS Technical Performance / Culture Evidence to Process Safety Culture Factors											
Audit Findings	Consequence Level	Severity Adjustment Factor (1-4)	Risk Rating	Risk Category													
Containment integrity issue allowed to exist	0	50	0.0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unsafe work practice	0	25	0.0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Action item not completed, late, or chronic	0	25	0.0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Safety hazard situation is allowed to exist	0	20	0.0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inadequate maintenance, inspection, testing	4	20	2.0	40	6	0.3	2.4			0.3		0.7		0.7			2.4
Inadequate management practice / procedures / system	2	15	3.5	53	25	2.0	10.0		10.0	2.0		2.0					2.0
Inadequate hazard, risk, or RCA review / analysis	9	15	3.5	53	25	2.0	10.0		2.0	10.0	2.0	15.0		15.0			2.0
Inadequate monitoring or auditing	1	10	1.5	15	4	0.3	1.5	0.3	1.5	0.3	0.3			2.4	0.3		1.5
Inadequate training	3	10	3.0	30	6	0.3	2.4		0.3	0.3	2.4	0.7		0.7	2.4		
Inadequate recordkeeping and documentation	1	5	1.0	5	1	0.1	0.4										0.1
Inadequate communication or signage	1	5	2.5	13	1	0.1	0.4				0.4	0.4	0.1	0.1			
UPDATE COLORS					Priority Guide:	3	2		2	2	3	1	3	1	3		3
						5.4	27.2	0.3	14.1	13.3	5.1	16.4	2.4	19.0	2.8	0.1	8.1
						7	3	11	4	5	8	2	10	1	9	12	6

Figure 5 – PAR mapping of Culture Soft Results to Performance Data

The process safety performance assurance review (PAR) seeks to find technical evidence consisting of process safety outcomes (e.g., findings and improvement areas) that seem to support the opinions and feelings of the respondents from the process safety culture survey. The results of this comparison showed which process safety culture problems indicated by “opinions” in the survey were “proven out” by the company’s recent historical performance in the field. This way, a company can have greater confidence that the potential culture issues uncovered from the survey are, in fact, real – and supported by visible evidence in the field.

Table 4 illustrates the results from a typical PAR, indicating the top six process safety culture issues that need to be addressed by the company. In this table the process safety features are characterized by their negative representation – thus, called cultural causal factors, similar to causal factors identified in a root cause analysis. The cultural causal factors are listed in five strata – the more significant culture issues are nearer the top of the table. From this table it is apparent that this company is challenged with several process safety/culture factors – the primary ones being the lack of a questioning/learning environment and a lack of monitoring of process safety performance/pursuit of continuous improvement.

Table 4 – Example of Safety Culture Evaluation Results

Process Safety Cultural Causal Factor	Ranking
9. Lack of a questioning/learning environment	1
12. No performance monitoring/pursuit of improvement	1
5. Lack of sense of vulnerability	2
7. No deference to expertise/burden of proof on safety	2
11. Non-responsiveness to safety concerns	3
3. Normalization of deviance	3
2. Lack of strong process safety leadership	3
1. Process safety is not a core value	4
4. No formalization of a “culture process”	4
8. Ineffective communications	4
10. Lack of trust – unsafe reporting environment	4
6. Lack of personal responsibility for process safety	5

Now this company can move forward in improving process safety with better insights into not only the physical and management system problems that need to be fixed, BUT ALSO the underlying cultural issues that have contributed to these problems existing for so long. Addressing ALL of these issues will give the company the best chance at sustaining its process safety improvement for a longer time.

4.4 Process Safety Culture Evaluation Case Studies

Over the past 8 years, process safety culture reviews have been conducted for 35+ companies in the oil, chemical, pharmaceutical, consumer products industries, involving tens of 1,000's of employees, 100+ facilities, domestic U.S. and international and old companies and new companies. All of these studies included an evaluation of safety culture – most also involved mapping to process safety performance outcomes. Figure 6 is an example that summarizes the frequency at which the 12 essential features of a good process safety culture were found lacking for 9 company evaluations – company names not included. Some observations can be made from these combined results:

- The top few cultural problems were way above all the others
- Surprising that “culture foundation issues” were so low – core value and strong leadership
- Two companies had process safety culture problems that were not high in the other 7 cases
- Six out of 9 the companies had undergone significant organizational change in this decade
- Even without having robust cultural root cause information, it is possible to heal culture disease

Process Safety Culture Problem	Company Problem Location									
	A	B	C	D	E	F	G	H	J	
Normalization of deviance	1	1	4	2	1	2	7	1	2	
Non-responsiveness to safety concerns	3	8	3	3	7	1	3	3	3	
Lack of a questioning/learning environment	4	5	7	5	3	3	2	4	5	
Lack of trust – unsafe reporting environment		6	1		10	5	5	7	6	
Lack of personal responsibility for safety			8			9	9	8	9	
Not listening to technical experts		10	6		9	8	1	6	4	
No performance monitoring or pursuit of improvement	2	9	9	1	2	4	4	2	11	
Lack of sense of vulnerability	5	2	5	4	8	7	8	5	7	
Ineffective communications		11	2		11	6	6	11	10	
Process safety is NOT a core value	6	3	12	6	5	10	10	9	8	
Lack of strong PS leadership	7	7	11	7	6	11	11	10	1	
No formalization of culture process		12	10		12	12	12	12	12	

Figure 6 – Comparison of Safety Culture Rankings

5. Understanding safety culture degradation pathways

Safety culture evaluations, whether using the approach outlined above or other methods, determine the existing status of the entity’s culture – at a point of time. As such, this is a picture of the current “state” or condition of the culture. Typically, these culture states evolve over a fairly long period of time. To use a health care metaphor, the degradation of safety culture is similar to a person getting sick – acquiring safety culture disease. Rarely is there information available from a company about how they acquired the particular safety culture disease and the specific pathway on how they got “culture-sick”. Normally, this information is only available from major investigations where organizational factors were identified as causal factors and the investigation team invested significant time to go back in history to chart the various events that happened and conditions that accumulated over a long time to create the organization culture dysfunction or disease that contributed to the accident. The following are three examples of culture disease pathways that we uncovered as a part of process safety culture evaluations we performed over the past five years. Even though the small sample size restricts the breadth of our conclusions, there are some notable lessons.

5.1 Case Study 1

Figure 7 involves a company that had experienced an increasing trend of process safety incidents with common root cause trends. During our evaluation we found that there were several safety culture weaknesses, including **process safety not being a core value**, a lack of a sense of vulnerability, normalization of deviance, and lack of responsiveness to safety concerns. Upon more detailed review, we discovered some of the sources of each of these weaknesses, and when they had occurred along a timeline. In this case, a senior operating manager put extreme pressure on his staff and workforce to generate production and numerous decisions were evident that put safety behind economics. This resulted in a low sense of vulnerability in operating staff due to the apparent priority of safety behind production. The low sense of vulnerability led to a “superman complex” on the part of some operations staff that encouraged workarounds via circumventing safe work practices in order to keep producing units online, in spite of an increasing number of safety systems that were disabled in order to keep the units online. Eventually, this caught up with the operating units, resulting in a series of process safety incidents that resulted from multiple safety systems being out of service, some unbeknownst to operating supervision.

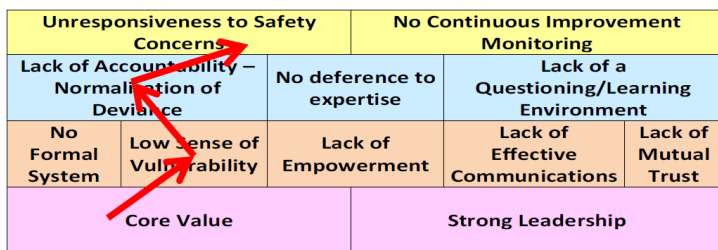


Figure 7 – Safety Culture Disease Pathway Example 1

5.2 Case Study 2

Example 2 in Figure 8 was another company where safety performance had “plateaued” over a two-year period. This was traced to poor process safety leadership by a few first-line supervisors, resulting in employees not feeling empowered to stop work when operating conditions became untenable. These situations led supervisors to not depend upon the technical opinion of operations leaders, which ultimately led to outside operators not properly conducting outside inspections and under-reporting of degraded equipment.

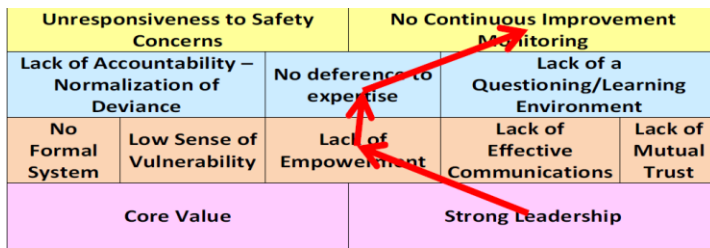


Figure 8 – Safety Culture Disease Pathway Example 2

5.3 Case Study 3

Example 3 (Figure 9) involved a company that had experienced a major accident, where there had been a multitude of prior near-miss incidents under similar circumstances, with multiple chronic PSM system audit findings/corrective actions that were not properly completed/closed out. An executive VP who held weekly plant manager operations phone calls displayed a “shoot the bad news messenger” leadership style. Over time, this led to people not taking the HSE management practices seriously, particularly incident/near-miss reporting. Subsequently, plant management and senior operations staff at the subject facility began to “hide” off-normal situations, hoping that they would be cured, rather than bringing u problems early on weekly phone calls to ask for assistance/advice. This eventually minimized the learning opportunities that the facility had access to in order to monitor the effectiveness of several of its important PSM practices – notably safe work practices and management of change. Safe work practice sloppiness and lack of use of the MOC system led to a major accident, and in retrospect, also had caused a number of precursor events that have not been previously reported.

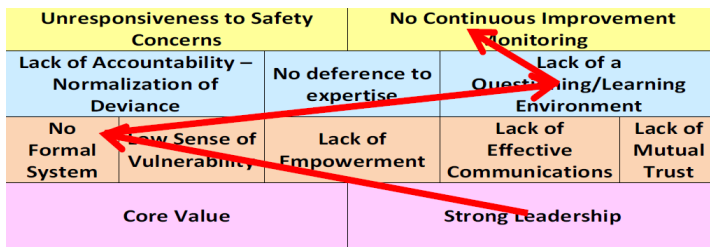


Figure 9 – Safety Culture Disease Pathway Example 3

These three examples are at best anecdotal. But what we have found, although there is no certain, absolute culture degradation model, we continue to find that safety culture degradation tends to flow up from “foundational failures” of core value and leadership failures to sequential failures within the other three “notional layers” shown in this group of figures. If this is true, then safety culture protection features can be designed to address the foundation levels of the culture model.

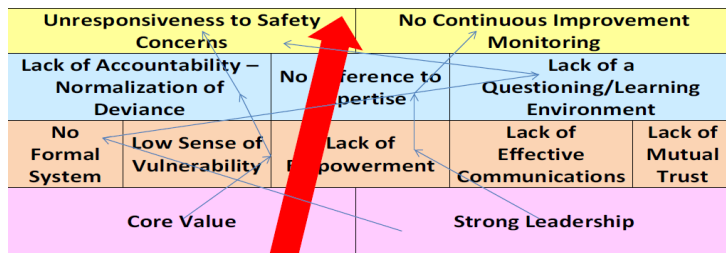


Figure 10 – General Safety Culture Degradation Flow

Having information on how a company slowly declined to the point where its safety culture was sick is important information to have. Lacking that information, we can prescribe for a sick safety culture some things to do to rid themselves of the disease. But in order to prevent future similar disease, it is better to know what the specific safety culture disease pathway(s) were so that specific safety culture preventative medicines, vaccinations, or vitamins can be applied to strengthen a company against getting safety culture disease in the future. Lacking that specific disease pathology information, sometimes the best we can do to avoid future safety culture disease and remain healthy is to take “broad-spectrum safety culture antibiotics” or pursue safety culture “exercises” to try to maintain a healthy safety culture. The next section describes some remedies that we have seen work to improve safety culture weaknesses and strengthen overall process safety performance.

6. How to improve process safety/HSE culture

Usually, culture improvement activities will take many months or years to have a deeply rooted impact. Table 5 lists the general steps we have found to be effective for improving safety culture at a facility.

Table 5 - Employee Engagement Culture Improvement Work Process

- Personalize to each person's job
- Connect to their "ownership basis"; create belief in results
- Brainstorm how they got to where they are
- List current and future conditions that could affect culture
- Select one or two weaknesses/strengths
- Discuss how they are relevant to daily jobs
- Provide culture improvement idea menu
- Ask them to create/commit personal daily/weekly plan
- Solicit ideas for department/facility/company plan
- Monitor culture improvement – plan, personal growth, and metrics
- Implement this approach with top leaders first, then First-Line Supervisors, then workers/contractors, and then the rest of the organization

6.1 Culture Workshop Ideas

Such training, whether for executives or hourly workers, is more effective if the delegates are fully engaged and thinking about culture change. Their opinions matter and it is important that we discover their ideas for culture change. Interactive, facilitated workshops provide an effective means for dialogue, soliciting ideas, engagement, and learning. These workshops are most effective if done using small groups that consider some of the following issues:

1. What can you do to assess the culture in your company and/or your facility?
2. What can you do to identify which process safety culture features will have the greatest impact in your company, i.e., the weakest?
3. Pick one of the culture areas and develop an action plan to address the following issue at your company/site.
 - Develop a culture improvement plan for your company/site. Be as specific as possible.
 - Decide which culture elements you are going to address
 - Decide who in management is needed to support your efforts
 - Develop a plan for the next month, the next six month, the next year, and the next three years
 - Determine what metrics will be used to monitor progress

6.2 Identify Culture Improvement Options

The following steps should be addressed in culture workshops at all levels of the plant/company.

1. Identify possible culture weakness root causes.
 - Brainstorm what has happened in the past that could be in the memory of the work force
 - Look at culture survey/interview results by feature; what is going on in the past year/recently that could affect this feature?
2. Identify existing activities that could be used or amended to help correct the cultural issues.
 - What things are going on now in the plant/company that could improve or adversely affect this issue?
 - Capital expansion/operations contraction
 - Employee welfare
 - Workforce changes
 - Implementation of new safety programs (e.g., Behavior Based Safety)
3. Look at the PSM/HSE audit finding resolution actions.
 - See how they could be done in a "culture-smart way"
 - Avoid initiative overload and unfunded mandates that could adversely affect culture efforts

4. Identify additional actions to fix the culture issues.
 - See the list of potential remedial actions in the next section as a starting point.
 - Have small groups during culture awareness training develop company and personal culture action plans using this list
5. Develop an overall, integrated list of activities to help deal with the culture challenges.
 - Work the plan as you would any process safety/HSE action plan
 - Monitor implementation
 - Develop culture improvement metrics

6.3 Remedies for Culture Weaknesses

Following the above approach will require that you eventually address what actions you should take to improve culture. You will follow an interactive process that engages all levels of the plant and company. At each occasion early on, you will seek people's opinions about the root cause of culture weaknesses, factors that contributed to the problems, conditions that the company faces in the near-term as it pursues culture improvements. Normally, a plant or company faces one or more culture issues at the same time. These issues should be addressed together to avoid adverse interactions of improvement actions and to increase efficiency. Table 6 gives an example of the possible remedies that have been used to address weaknesses where **Process Safety Is Not a Core Value**.

Table 6 - Process Safety/HSE Is NOT a Core Value

- Establish a process safety policy
- Communicate the Business Case for Process Safety to senior executives; communicate the process safety policy regularly
- Hold training courses/workshops on the policy
- Reinforce policy via company newsletters and meetings
- Ask the workforce for feedback on whether they consider process safety to be a core value and whether management is acting that way
- Demonstrate that process safety is a core value by making decisions and taking visible action in support of the policy
- Celebrate workforce actions that demonstrate adherence to process safety being a core value
- Encourage senior executives to participate in process safety functions/committees/symposia with other respected executives
- Widely share the CCPS Process Safety Beacon
- Share significant incidents from similar facilities and relate the broader consequences of a process safety incident
- Help people at all levels in the organization to understand the importance of process safety
- Appeal to the business case for process safety, the humanitarian case for process safety, and the legal case for process safety
- Find a process safety champion high in the organization that is willing to try to influence other senior leadership
- Provide ideas/input for annual reports and other visionary documents that are periodically published

Possible remedies for the other 11 culture weaknesses addressed by the CCPS framework are included in the Appendix.

7. Conclusions

Many companies have overall safety policies or visions that embody some sort of "pursuit of zero accidents". Why can't we have a similar for vision for pursuing "Perfect Process Safety."

- A culture based on proper ownership of HSE empowered by visionary leadership
- Risk-informed sensitivity that guides everything
- Effective, fit-for-purpose management systems
- PS practices embraced and followed with good operational discipline at ALL levels
- Learning from ALL sources – internal, external and outside industry group

- Well-formed/visible performance pyramid; metrics at every level that drive intended behaviors
- Goals and actual performance that improves

“Perfect Process Safety” is a worthy and valuable stretch goal for all. It can only be effectively pursued by highly reliable organizations that embody effective learning patterns and have a growing culture. Sustainable process safety cannot not allow learning to just evaporate or “retire”. Companies that focus on improving process safety culture, leadership and operational discipline have the best chance.

References

- [1] *Guidelines for Risk Based Process Safety*, Written by ABS Consulting, AIChE Center for Chemical Process Safety, John Wiley & Sons, New York, NY, April 2007.
- [2] *A Management Approach for Creating a Strong Process Safety Culture – 20 Elements for Success*, AIChE Center for Chemical Process Safety, New York, 2007.
- [3] *Principles of Process Safety Leadership*, Process Safety Leadership Group, UKHSE, July 2009
- [4] *Successful Leadership Self-Assessment Module*, UK Petroleum Industry Association Ltd., November 2010
- [5] *Corporate Governance for Process Safety - Guidance for Senior Leaders in High Hazard Industries*, OECD Environment, Health and Safety, Chemical Accidents Programme, June 2012
- [6] *Process Safety Assessment Program*, API/AFPM, January 2012
- [7] *Final Safety Culture Policy Statement*, Bureau of Safety and Environmental Enforcement, May 9, 2013
- [8] *Guidelines for Conduct of Operations and Operational Discipline*, Written by ABS Consulting, American Institute of Chemical Engineers, Center for Chemical Process Safety, John Wiley & Sons, New York, NY, March 2011.

Appendix – Remedies for the other CCPS framework safety culture weaknesses**Table A-1 – Lack of Strong Process Safety/HSE Leadership**

- Establish a clearly defined process safety leader at a level that can influence operational vice-presidents and facility managers
- Clearly define process safety responsibilities
- Establish process safety element owners at the company level and at the site level
- Include process items in annual objectives for line management leadership positions
- Provide short talking points for company executives to mention during town hall meetings
- Periodically publish a short company process safety newsletter that includes notes from executives
- Provide process safety topics to be included in the company annual report
- Fund specific process safety activities
- Participate in process safety activities (e.g., management reviews)
- Process safety significance is reinforced throughout the chain of command
- Take decisions and action on the side of process safety
- Attend process safety training courses/workshops
- Address process safety issues in every company/work group meeting
- Discuss process safety during day-to-day conversations
- Visit workers and discuss process safety issues
- Investigate lapses in process safety performance
- Participate in external venues to promote process safety as a core value
- Participate in industry groups that support process safety
- Establish a process safety management review system

Table A-2 – Normalization of Deviance – Not Maintaining High Standards of Performance

- Create reasonable, high standards of performance and communicate expectations
- Create a dialogue within the company on the importance of operational discipline
- Promote accountability throughout the organization
- Institute a constructive discipline policy
- Promote a safe reporting environment; if necessary, create an anonymous reporting system
- Create metrics and communicate results
- Use a zero-tolerance policy for severe/willful, or chronic failures; take strong action when necessary to protect company performance standards
- Appropriately communicate both positive and negative consequence situations to significant breaches
- Highlight examples throughout the chain of command – not just at the hourly worker level
- Institute some fashion of pay-at-risk for performance failures and reward for performance successes

Table A-3 – Culture Process Not Formalized

- Develop a vision statement for process safety culture
- Ensure that process safety is included in annual objectives for facility leadership
- Provide “elevator speeches” for senior leadership so that they can speak frequently and consistently about the importance of process safety
- Establish clear documented accountabilities for process safety
- Establish and enforce high standards of performance for activities that affect process safety results
- Implement a policy of zero tolerance for willful violations of process safety policies and procedures
- Document how the organization approaches evaluating and nurturing process safety culture
- Consider establishing a Process Safety Culture element in the PSM system using the CCPS RBPS framework
- Create a process safety culture element with the company process safety management system
- Institute process safety culture evaluations
- Provide process safety culture training
- Highlight process safety culture as an evaluation area in audits, incident investigations, etc.
- Write articles and newsletter items on improving company process safety culture
- Make process safety performance and culture a part of every worker, supervision, and management annual evaluations

Table A-4 – Lack of Sense of Vulnerability

- Create institutional memory about past company accidents; communicate reminders
- Investigate and communicate lessons learned from recent accidents throughout the company
- Communicate lessons from external accidents
- Provide hazard/risk awareness training to all new employees; provide regular refreshers
- Provide root cause analysis training to all employees
- Institute a burden-of-proof in favor of pessimistic action to preserve safety rather than a presumption of safety
- Adopt incident investigation policy to look at what could have happened instead of just what did happen
- Relate on-the-job safety events to off-the-job situations
- Publish the CCPS Process Safety Beacon internally

Table A-5 – Lack of Empowerment and Personal Responsibility for Safety

- Clearly define accountability for process safety systems; who is responsible for what
- Effectively communicate expectations by training employees in process safety policies and procedures
- Implement a policy of zero tolerance for willful violation of process safety policies and procedures
- Be certain that management response to (un)acceptable performance of process safety responsibilities is timely, consistent, and fair
- Establish annual process safety objectives/goals throughout the organization
- Institute an off-the-job safety program
- Employ an “anyone can and everyone should shut it down” policy
- Provide awareness training on workplace hazards/risks and accident statistics
- Consider adopting an employee-driven behavior-based safety program including peer observations
- Promote highlighting of employee safety concerns through formal and non-traditional means
- Celebrate employee safety decision/action successes
- Establish a Conduct of Operations element that encourages rigorous implementation of process safety policies and procedures

Table A-6 – Not Listening to Technical Experts

- Identify the technical experts for various functions and types of operating equipment
- Define necessary technical disciplines that need to be involved in specific process safety activities (e.g., types of MOCs) and use them
- Train the individuals identified as technical experts to fill their technology expertise weaknesses
- Establish a network of technical experts within the company so that experts can share ideas and learn from experts at other sites
- Encourage technical experts to attend technical symposia in their area of expertise
- Involve management in defining expertise that is valuable/respected/needed
- Enhance the employee participation element so that management is more likely to naturally involve experts
- During discussions about critical issues, periodically ask management if they are using all of the available expertise to resolve the issue
- Expand MOC to non-traditional change types (e.g., organizational, policy, budget changes)
- Formalize the process for making risk decisions; itemize types; consider procedures and requirements
- Ensure SMEs are included in the decision making loop; seek out SME input
- Develop a process safety training competency matrix for all levels of the organization
- Consider designating a facility or company process safety “authority”

Table A-7 – Ineffective Communications

- Encourage senior management to be in the plant frequently to be available to listen and respond to employee concerns and seek input from all
- Provide a mechanism for anonymous input to management so that those that have fear of reprisal have an avenue to provide input
- Do not shoot the messenger
- Praise “bad-news” messengers in visible, public ways
- Provide frequent status of lengthy projects that are important to employees so they are aware that the project is progressing
- Help management include process safety messages in their periodic newsletters or other communications
- Establish process safety committees that include a vertical slice of the organization
- Hold regular process safety management reviews
- Provide communications training to everyone
- Solicit workforce opinions on effective communication means and frequency
- Create newsletters, increase safety meeting frequency and effectiveness
- Emphasize communication throughout chain of command
- Develop/improve communications response discipline for phone mail, email, and web responses

Table A-8 – Lack of a Questioning/Learning Environment

- Widely circulate the CCPS Process Safety Beacon
- Develop and distribute summaries of incident reports that include what happened, lessons learned, and how the lessons might apply locally
- Employ a “high potential incident” practice of communicating notable incidents across the company and industry
- Modify the incident investigation system to more fully address “what could have happened” instead of only the actual consequences
- Conduct table top drills with operating teams to discuss response to operating problems and incident scenarios
- Review key hazard scenarios with highest potential consequences from PHAs with operating and technical teams
- For serious outside incidents with lessons learned, require documented follow-up to ensure similar conditions do not exist or are well managed locally
- Conduct hazard awareness training for operating teams and for technical teams; institute a formal hazard evaluation system
- State a policy from the top that it is okay/required for people to appropriately question issues
- Hold training and workshops
- Hold meetings specifically to question issues; consider using peer feedback of work practices
- Demonstrate the questioning attitude in designed situations and then walk the talk
- In company meetings, invite people to question senior management on issues – model positive approaches to the workforce

Table A-9 – Lack of Mutual Trust

- Design a system that ensures response to incidents is consistent
- Establish an employee committee to help address consistency
- Institute blameless, root cause analysis system. Incidents result in minimal consequences unless willful policy violations occurred.
- Create an anonymous safety issue reporting system
- Communicate the need for reporting of all incidents
- Conduct refresher training about the progressive discipline system
- Include an elapsed time at which previous violations no longer impact future discipline, e.g., incidents >2 years old do not get progressive discipline
- Make examples of supervisors and management who do things right – and wrong
- Establish/re-invigorate an employee/management safety committee
- Include workforce representatives on an accident investigation committee
- Provide human factors/behavioral safety training

Table A-10 – Non-Responsiveness to Safety Concerns

- Relate the safety concerns of the company to actual incidents within the company or to incidents outside the company
- Present the business case for process safety to company executives and site management
- Ensure senior management understands the results of realistic scenario consequence modeling
- Communicate to senior management the OSHA fines from serious incidents
- and the possibility of personal criminal litigation
- Periodically share the learnings from incidents within your own company or from similar processes
- Publish the CCPS Process Safety Beacon internally
- Develop a strong near miss identification system for potential process safety incidents
- Do a survey of all process safety-related action items; determine status and due dates
- Determine roles and responsibilities and schedules for completion
- Develop a unified action item tracking system to stay on top of process safety items
- Develop an improvement strategy and supply resources to reduce backlog; communicate progress to workforce
- Determine performance standard on completion of action items
- Develop a management system to deal with process safety issues and action item life-cycle
- Create process safety issue metrics and monitor metrics during regular management reviews
- Incorporate safety concern responsiveness into regular management reviews
- Provide a means for employee input of safety concerns
- Provide awareness and detailed training as needed
- Include metric in employee accountability and performance reviews

Table A-11 – No Performance Monitoring or Pursuit of Improvement

- Include process safety topics in annual objectives for line management
- Start monitoring a few site-wide easily obtained but meaningful metrics; start small
- Ask each operating unit to monitor a few easily obtained but meaningful metrics; develop appropriate safety metrics scorecards and communicate broadly
- Establish a process safety management review system
- Form a site-wide process safety committee from several disciplines to promote PS improvement
- Ask senior leadership to promote process safety improvement in town hall meetings
- Establish a business case for process safety for your company
- Discuss with senior executives the consequences of a “Texas City type” event to your company
- Consider putting “pay at risk” based on performance to process safety objectives and metrics
- (Re)establish continuous improvement as a core value and communicate broadly
- Develop strategy to incorporate learnings from audits, hazard reviews, incidents into the work life
- Hold management reviews to spotlight good performance and focus on weaknesses
- Make improvement a part of the accountability and performance review system
- Create ways to solicit and accept employee suggestions