Bridging the Safety Gap

The Key Role of a Sound Process Safety Culture in Minimizing Audit Findings

An ioMosaic White Paper

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Introduction

The United States (US) Occupational Safety and Health Administration (OSHA) process safety management (PSM) standard 29CFR 1910.119 is a performance-based management system regulation intended to prevent catastrophic releases of hazardous chemicals. This standard contains requirements for the safe management of hazards associated with processes using, storing, manufacturing, handling, or moving highly hazardous chemicals onsite. It emphasizes the management of hazards through an established comprehensive program that integrates technologies, procedures, and management practices. The OSHA PSM 1910.119 standard consists of 14 elements and compliance audits is one of them. It requires compliance audits of all covered facilities every three years; these audits are the ongoing quality assurance process for the process safety management systems.

This paper illustrates a case study that compiles and analyses management system audit findings and related data from a sample of sixteen (16) process facilities. The study identifies the most frequently cited elements and compares them with the results obtained by OSHA refinery and chemical National Emphasis Program (NEP) inspections. NEP are the most significant PSM enforcement actions since the OSHA standard was promulgated in 1992.

Audit Methodology Performed

A process safety management system must be consistently applied and thoroughly integrated to be effective. This is a challenge for most companies and third-party audits are key in helping with its implementation, continuous monitoring and improvement.

The scope of the audits included all 14 PSM elements (Fig. 1, 2), as all PSM elements work together to provide multiple layers of protection (Aziz, Shariff and Rusli, 2017). Moreover, the scope of the audit included an assessment of the applicability of the standard based on the chemicals handled on each specific site. The audit findings were classified according to three different categories: Regulatory (non-compliant), Recognized And Generally Accepted Good Engineering Practices (RAGAGEP), and Local Attention.
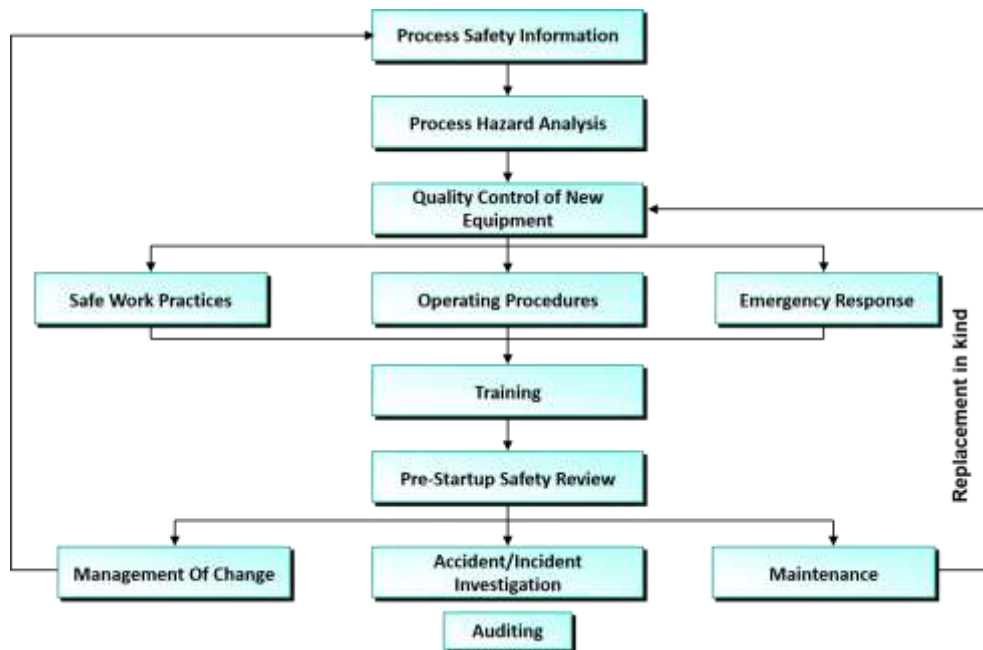
Figure 1: Fourteen Elements of the OSHA PSM Standard

All PSM elements work together. Their interrelations are presented in the image below:

Figure 2: Interrelations among the 14 Elements of the OSHA PSM Standard

The audits were conducted or lead by a person knowledgeable in audit techniques and who was impartial towards the facility or area being audited. Additionally, the compliance audit was conducted by at least one person knowledgeable in the process.

Prior to arriving on site, a pre-audit questionnaire was requested to be completed and forwarded to the audit team to help them prepare for the audit. This pre-audit questionnaire had information regarding how the PSM regulation is implemented at the specific facility. Once on site, a kick off meeting was conducted to introduce the audit team, to identify the element champions, to review the plan and approach for conducting the audit, and to establish an agenda according to the team's availability. All 14 OSHA PSM Elements were distributed among the several members of the Audit Team.

The audit was based on the following:

- Physical inspections of the facility;

- Examination of selected process safety administrative and operating records;

- Interviews and discussions with key facility management, staff, and contractors; and

- Verification activities to assess the facility's application of, and adherence to, the regulations and related facility policies and procedures

During the audit, the team identified any findings. An audit finding (exception, citation or violation) is a conclusion reached by the audit team based on data collected and analysed as to whether part of the PSM program does not meet regulatory requirements or industry standards. Findings from an audit can be categorized as follows:

- Regulatory – finding related to the OSHA PSM Standard

- RAGAGEP – finding related to Recognized and Generally Accepted Good Engineering Practice (or best industry practice)

- Local attention item – finding of a relatively minor nature or not within the scope of the audit

Daily debriefing meetings were held to communicate preliminary findings and observations made by the audit team to facility personnel. Likewise, a closeout meeting was also held to present all the regulatory, RAGAGEP, and local attention findings on the last day of the PSM audit.

The Key Role of a Sound Process Safety Culture when Implementing PSM

One of the definitions of process safety culture is "The combination of group values and behaviours that determine the way process safety is managed. A sound process safety culture refers to attitudes and behaviours that support the goal for safer process operations" (CCPS, 2007).

The values that underlie the process safety culture help the individual understand, accept, and do what is right when no written rules or procedures are in place to address a particular situation or when procedures may be out of date or inconsistent with the organization's values and objectives. A sound culture also would ensure that these disparities are brought to the forefront and resolved.

Although everyone in a team has a role to play in ensuring an organization's safety, security, and environmental protection, goals and accountability must be assigned. Upper Management must provide enough resources and training to ensure proper management of Process Safety. Everything starts with a strong safety culture and management leadership and commitment. The safety culture cannot change in an organization until the company's attitude about safety changes. It is a development process; it takes time and a lot of persistent hard work (Cheung Ch. And Burch G., 2014; Clarke Sh. And Flitcroft Ch.,2013).

Proactively managing an effective process safety program displays a high level of corporate responsibility and encourages the company to sustain it long-term. The bottom line is that outstanding process safety performance is a pathway to both financial success and the license to operate. Figure 3 below shows a list of statements which can affect the safety culture in an organization. A weak safety culture can be caused by lack of communication, lack of training and conflicting priorities, whereas a sound safety culture has three main pillars: commitment to health, safety, and environment (HSE) as a core value, workforce participation and ownership of safety problems and solutions, and trust between operations and management (IOSH, 2015).

**Figure 3: Pillars of a weak or sound process safety culture (Prats, 2015)**

Case Study

ioMosaic has carried out many audits over the years, and a sample of sixteen (16) audits, from 2010 to 2016, was selected for conducting the analysis described in this paper. The sample of 16 audits covered chemical facilities, refineries, and facilities handling explosives. The objective of the audits was to evaluate how well each facility complied with the requirements of OSHA PSM (OSHA 2013). All 14 elements were audited:

- Employee Participation (EP)

- Process Safety Information (PSI)

- Process Hazard Analysis (PHA)

- Operating Procedures (OP)

- Training

- Contractor Safety

- Pre-Startup Safety Review (PSSR)

- Mechanical Integrity (MI)

- Hot Work Program

- Management of Change (MOC)

- Incident Investigation

- Emergency Planning and Response (ER)

- Compliance Audits

- Trade Secrets

A total of 1,108 findings are identified when analysing the data of all 16 audits, from which 648 are Regulatory (58%), 199 RAGAGEP (18%) and 261 local attention (24%). Figure 4 shows the distribution of the findings per audit conducted.

Figure 4: Distribution of the findings per audit conducted
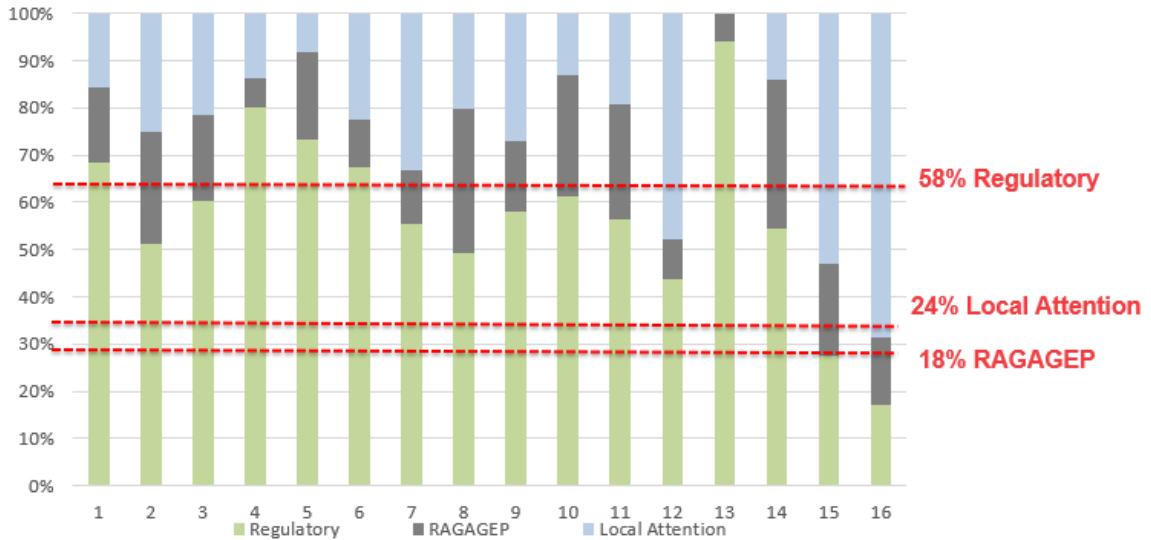
The next step of the analysis was to determine which were the elements most cited for each of the finding's categories. By conducting a detailed analysis of each of the audits, a determination of which elements are more critical in process safety management can be done. The first category to be analysed is "Regulatory", finding related to the OSHA PSM Standard. Out of the 626 Regulatory findings, 104 belong to mechanical integrity, 78 to process safety information, 76 to operating procedures, and 72 to hot work permit. These findings represent a 52.7% of all the Regulatory findings. Figure 5 depicts the total percentage of Regulatory findings per each of the 14 OSHA PSM elements.

Figure 5: Total percentage of Regulatory findings per each of the 14 OSHA PSM elements
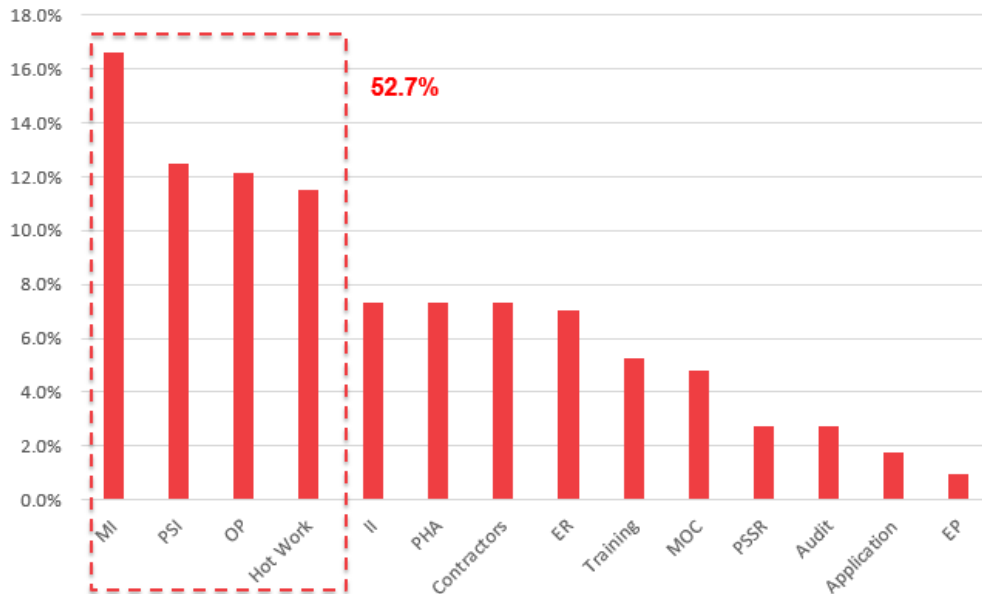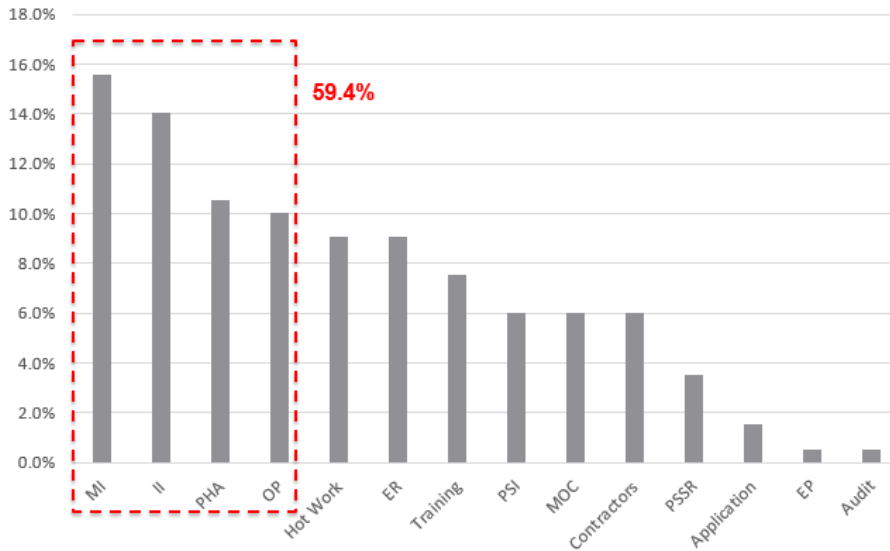

The next category to be analysed is the findings related to Recognized and Generally Accepted Good Engineering Practice (RAGAGEP) (or best industry practice). The OSHA PSM standard is a performance-based standard, and it does not specify how the OSHA PSM standard has to be implemented at each facility. Therefore, companies are sometimes not aware of industry best practices or standards that can be followed to ensure a proper PSM implementation, and it is the auditor's responsibility to properly explain the reason for the RAGAGEP finding.

Out of the 199 RAGAGEP findings, 31 belong to mechanical integrity, 28 to incident investigation, 21 to process hazard analysis, and 20 to operating procedures. The sum of these findings represents a 59.4% of all the RAGAGEP findings. Figure 6 depicts the total percentage of RAGAGEP findings per each of the 14 OSHA PSM elements.

Figure 6: Total % average of RAGAGEP findings per each of the 14 OSHA PSM elements

The last category to be analysed is the findings related to Local Attention, finding of a relatively minor nature that does not represent a chronic PSM issue or a finding related to requirements not specifically listed in the PSM regulation. Out of the 261 Local Attention findings, 42 belong to emergency response, 32 to operating procedures, 32 to incident investigation and 24 to mechanical integrity. The sum of these findings represents a 49.9% of all the Local Attention findings. Figure 7 depicts the total percentage of Local Attention findings per each of the 14 OSHA PSM elements.

Figure 7: Total % average of Local Attention findings per each of the 14 OSHA PSM element
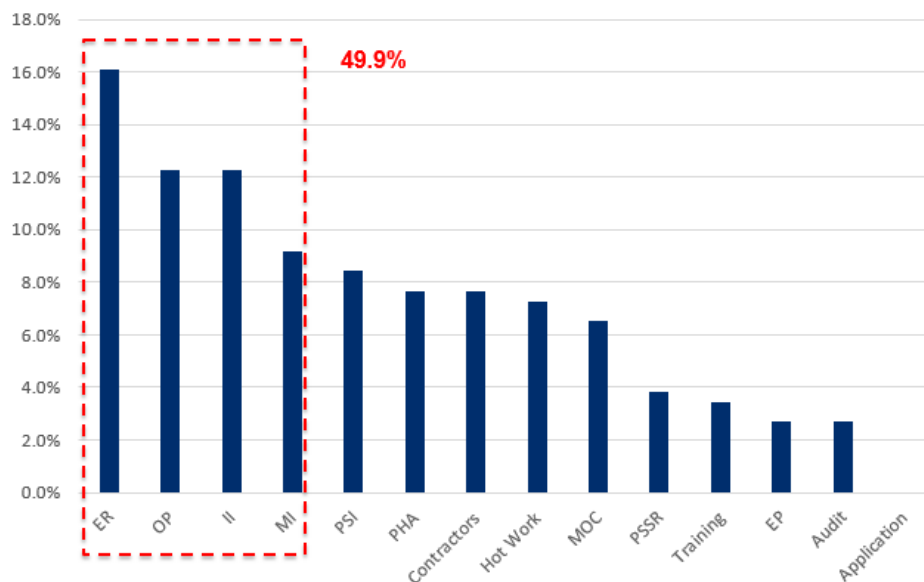
The last statistical analysis conducted is the overall review of all the findings per element, to identify which elements are the most cited and to be able to compare them with the OSHA inspections. Figure 8 below depicts a pie chart with all the OSHA PSM elements and the percentage of findings (Regulatory + RAGAGEP + Local Attention) per element.

Figure 8: Distribution of all the findings (Regulatory + RAGAGEP + Local Attention) per element
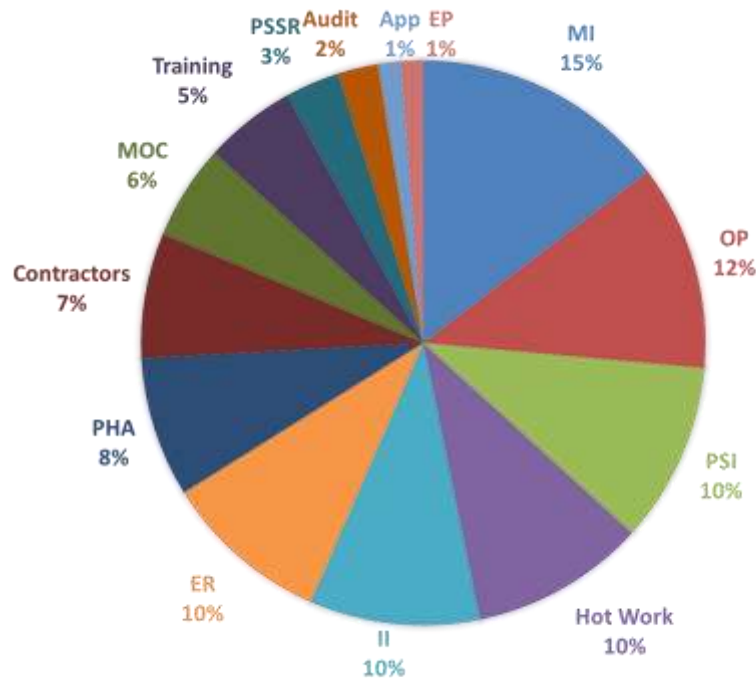
Based on the ioMosaic audit results, the following elements can be considered the most cited and correspond to the 57% of all findings including all categories and all facilities:

- Mechanical integrity (15%)

- Operating procedures (12%)

- Process Safety information (10%)

- Hot Work (10%)

- Incident Investigation (10%)

Why are these elements the ones that companies fail the most? Companies fail in implementing mechanical integrity because the inspections are overdue or because when deficiencies are identified, they are not addressed. The OSHA PSM Standard requires

companies to develop procedures for each operating phase. This is a requirement that a lot of companies fail to comply with, as well as including the consequences of a deviation and the steps to correct and avoid it. Companies struggle to complete and keep evergreen all the process safety information required by the OSHA PSM regulation. This process safety information has to be updated when management of change takes place or prior to a process hazard analysis revalidation. The hot work procedures and permits sometimes lack continuous Lower Explosive Limit (LEL) monitoring, don't consider a fire watch present during the entire hot work task, or the requirements for venting are not documented on the hot work permit. Finally, the incident investigation reports do not contain all the required information, and the investigations are not conducted within 48 hours.

Despite best efforts, almost all safety management systems (SMS) have gaps in practicality and effectiveness. A sure way to improve SMS programs is to conduct proper training, improve process safety culture in the organization, conduct third party audits, and implement an enterprise software solution.

Are the results of this statistical analysis consistent when comparing them to the findings obtained from the OSHA Refinery and Chemical NEP inspections? In 2012, OSHA presented the results of their OSHA Refinery and Chemical NEP top PSM elements citations (Barab 2012). Table 1 below summarizes the results of the percentage of regulatory findings for the most cited elements. Mechanical integrity, process safety information, and operating procedures are the elements with more findings. The column on the right corresponds to ioMosaic's audit findings which are similar to the OSHA Refinery and Chemical NEP top PSM elements citations.

Table 1: ioMosaic's audit finding versus OSHA NEP top PSM element citations

Element	% Refinery NEP	% Chemical NEP	% ioMosaic (Regulatory)
MI	19.5	23.2	16.6
PSI	17.4	20.9	12.5
OP	17.1	14	12.1
Total %	**54**	**58.1**	**41.2**

Table 2 below shows the total number of facilities inspected or audited, the corresponding number of citations or findings, and its percentage based on citations per inspection

Table 2: Number of audits conducted, and findings identified

Description	Refinery NEP	Chemical NEP	ioMosaic (Regulatory)
Inspections (facilities)	88	173	16
Citations (findings)	962	1487	648
Citations/Inspections (%)	10.9	8.6	40.5

Mechanical Integrity, process safety information, incident investigation, and operating procedures are highly dependent on the personnel's attitudes and behaviours. A strong safety culture competency is key in every organization since a safety management program will only be as effective as the underlying safety culture permits.

All audits reveal a history of repeat findings indicating chronic problems. Therefore, audit findings should always be seen as calls for action and should be addressed in a timely manner.

Conclusions

Audits reveal a history of repeat findings indicating chronic problems which can only be effectively achieved by addressing the technical and cultural root causes. Thus, key audit findings are a valued source of information for understanding current weaknesses and lessons learned.

The results from the statistical analysis highlights trends and provides detailed conclusions on how to potentially link actual industry weaknesses (audit findings), via maximizing the importance of implementing a sound Process Safety Culture (supported and followed from top Management, through operations and maintenance, to all facility workers). In this context, the statistical analysis confirms that the most cited elements in the study are: Mechanical Integrity, Process Safety Information, and Operating Procedures.

In order to minimize the number of findings and to ensure proper implementation of the OSHA PSM standard, it is necessary to focus the efforts in conducting proper training, improving process safety culture in the organizations, conducting third party audits, and considering the implementation of enterprise software solutions.

References

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