

Process Safety Key Performance Indicators- A Structured Methodology

Ramesh Ramalingam K, Associate Vice President; Senthilraja M, General Manager; Venkata Sainath G, Manager

Cholamandalam MS Risk Services, 3rd Floor Parry House, Chennai, India

Process Safety is evolving every decade with newer objectives and approaches. Organisations around the world have already started taking the requirements and principles of process safety management elements into their systems. Off late the focus and monitoring for the upkeep of the process safety management systems and verification with the required design intents are not fully being met. Success depends on the organisation to identify the proactive indicators and monitor at specific intervals to ensure continual improvement.

Complacency in ensuring the efficacy of process safety management principles is hampering the continuous improvement and safety climate of the organisations. It is essential to keep a vigil and monitor the appropriateness of the system at regular intervals. Safety performance is generally monitored through lag indicators which are not addressing the strength of proactive measures & processes to attain the established mission and vision of the organisation.

Process safety metrics for the Process Safety Management are predominantly explained by the CCPS, IOGP. Chola MS Risk Services with vast experience in auditing PSM and facilitating the implementation of the process safety management systems has developed a new structured methodology for the identifying the key process safety areas requiring monitoring, development of the metrics, and application of key performance indicators for the elements of process safety. This structured methodology requires the expertise and facilitation of the external persons, focused on processes, employees concerns and the existing management systems which broadly involves the following

- **Identify the areas requiring monitoring:** Identifying and narrowing the requirements of respective process safety element to bridge the gap which clearly needs monitoring because this will be the key strategic tipping point to attain the mission and vision of organisation.
- **Prioritise and focus on the key performance indicator:** The selection of KPI should be capable to understand the intention and requirements of each process safety element. The accountability based on API 754, threshold values and timelines are defined.
- **Act on the decided key performance indicators:** Periodically monitor the KPIs and engaging the concerned people.
- **Development of persuasive dashboards:** This indicates the status, integration with operations and progress.
- **Creating a sense of accountability:** The responsibilities are cascaded and everyone is made accountable.

This paper discusses the above stated methodology in detail. With a simple facilitated exercise stated in this paper, the task of implementing and sustaining the process safety management to overcome the challenges in measurement and monitoring in process safety.

Key Words: Process Safety Management, Principles, Metrics, Continuous Improvement

Introduction

The concept of Process Safety Management was triggered by the Bhopal gas tragedy. In the wake of this disaster newer organisations like Centre for Chemical Process Safety (CCPS) were set up in 1985, in United States of America (USA) the Environment Protection Agency and Occupational Safety and Health Administration (OSHA) framed out the Process Safety Management (PSM). The industries storing the threshold quantities of chemicals mentioned, were supposed to adopt the PSM. The framework of the PSM though given by many organisations, it is a regarded as prescription standard and not a specification standard.

In the advent of slow success of the PSM in the organisations, the principles have been widely accepted throughout the world. Though, the PSM is not guided by any statutory requirement in India, many organisations from wide range of industrial sectors adopted the principles. The driving force for adopting PSM can be attributed mainly as proactive step by managements to address the Process Safety issues, address the global stakeholder requirements etc. In India also, it is looked upon as a workable model, structured approach to prevent catastrophic incidents of high severity and low frequency.

In this process of implementing the PSM, industries seek out to consultants like Chola MS Risk Services for implementing the program. Few common challenge faced in implementing the PSM in developing countries like India is that are

- In many cases, there already exists certain systems, management procedures already adopted by industry, which are addressing the principles of PSM, but require an improvement
- The wrong understanding of Process Safety Management and not able to differentiate the same from general safety
- Regarding PSM as a mere specification requirement and not as a path to operational excellence

For this purpose, many workable models were developed which are applied based on the nature, complexity of industry. One key element for monitoring the progress of implementation or workability of PSM is the process safety metrics or Process Safety Key Performance Indicators. Chola MS Risk Services having served this sector of business either by conducting PSM

audits or implementing PSM truly believes that this element of PSM is the key driving force and addresses the challenges mentioned above. Emphasising on this key element to work with any PSM implementation or sustenance model a structured methodology has been developed and the same is presented in this paper.

Structured Methodology

Process safety key performance indicators are predominantly explained by the CCPS and International Association of Oil and Gas Producers (IOGP). This structured methodology requires the expertise and facilitation of the external persons, focused on processes, employees concerns and the existing management systems which broadly involves the following

Identification of areas requiring monitoring

The key step to start would be a gap assessment which will give variety of inputs on where the organisation stands with respect to the terms of Process Safety Management. Based on the findings from gap assessment, incident statistics, charter is prepared for launching the implantation program. Quantifying the findings will give an opportunity to monitor the progress. This would help in understanding the nudges required to push the implementation program. The key focus requirements of each PSM element are listed down. Certain aspects to look out for few PSM elements are

- **Process Safety Information (PSI):** Upkeep of the data, transfer of data from the third parties to the company etc
- **Process Hazard Analysis (PHA):** Scheduling the PHA, determining the qualification requirements for PHA team, tracking the progress of recommendations.
- **Management of Change (MOC):** Identification of changes requiring MOC, Changes being carried out without MOC, tracking the closure and upkeep, communication of all relevant data to key stake holders
- **Pre Start-up Safety Review (PSSR):** Changes which were carried out without PSSR
- **Incident Investigation:** Determining the competency of the investigation team etc
- **Operating Procedures:** Identification, development of Operating procedures for all activities, identification of training need analysis based on the same, evaluating the operator performance etc.
- **Contractor Safety Management (CSM):** Determination of prequalification, establishment of selection criteria, training requirements, evaluation of contractors etc.
- **Work Permit System (WPS):** Training of the issuer and receiver, audits of the work permits
- **Emergency Response :** Identification of emergency scenarios, response procedures
- **Asset Integrity:** Understanding of inspection, maintenance practices being followed, tracking of deferrals etc
- **Training:** Identification of training needs, curriculum of the training

Each element requires a deep dive by a process safety element expert into the existing systems to understand how the aspects are addressed and each element interface is addressed. The whole idea in this step is to understand the aspects of elements which require focus.

It should also be understood that KPIs can be defined not only element wise, but can be defined for key personnel who advise, monitor and implement PSM program. This type of grouping personnel element wise helps in ensuring that the persons with demonstration capabilities drive are earmarked with the responsibilities

Prioritise and focus on the key performance indicator

For each element, the list of key focus aspects must be identified and key performance indicator needs to be developed for monitoring. The KPI should typically address the following

- How the success of the focus aspect of element looks like
- The objective of how the focus aspect of element is being addressed
- Direct and relevant addressing the focus aspect of interest
- Timelines for tracking the KPI (Example- weekly, monthly, quarterly, yearly etc)
- Threshold quantities, if required
- The process flow of how the information transfers determining responsibility, accountability, consultation and information pertaining to each KPI

Caution should be made, as wrong selection or sidelined KPI would affect the whole implementation or sustenance program by showing the misleading figures or the focus aspect areas of elements not being addressed. The essential features of the key performance indicators are

- It should be measurable and comparable
- Auditable: This helps in assurance of the data

- Contributing for developing the data: It should eventually classify itself as leading or lagging indicator
- KPIs are to be established so that they clearly bring out the understanding on the linkages and interaction of various PSM elements. The data collected in itself should contribute in developing the trends for the interfacing PSM elements as well
- The KPI needs to be dynamic variable in nature: It is expected that it should address all the focus aspects as the element matures and gap identified bridges even though the KPI is modified

For the implementation or sustenance program, two types of KPIs need to be developed

Constant KPIs: These typically are leading indicators, lagging indicator etc. They remain unaltered throughout, developing the data for interpretation

E.g.: Process safety incident rate, Number of near misses reported, Defects notification of Fire and Emergency system)

Variable KPIs: These KPIs are dynamic in nature. The expectation is that, they can be altered to fit the purpose as required.

E.g.: Threshold for deferrals in maintenance schedule can be higher initially, but eventually reduce; Prequalification requirement for contractors can be lenient initially, but strengthened eventually

Example of how variable KPIs evolve dynamically as the implementation program matures, is provided in Table-1.

Table 1: Evolution of KPIs as the PSM program matures

Element	KPI during implementation	KPI during sustenance
Process Safety Information	Number of applicable PSI data not available	Number of PSI not transferred from the third parties to the company
	This is an indicator to collect data and monitor the progress	This is an indicator where the company has identified that the gaps were due to third parties not handing over the data
PHA	Compliance of plan vs actual for the PHA schedules	Number of gaps identified in engineering
	This gives input on whether PHA is being carried out	This address the quality of the recommendations
MOC	Number of changes where MOC was not carried out	Number of MOCs audited and the trend line of the scores
	The objective is to build the practice of adopting MOC when changes are made	MOC is thoroughly established and looking for continual improvement
Operating Procedures	Number of processes for which operating procedures need to be developed	Number of deviations observed during SOP audit and evaluation of operator performance
	Ensuring that all the operating procedures are available	Ensure the quality of SOPs and the training of operators is carried out.
Asset Integrity	Plan vs actual for number of maintenance activities carried out	Number of tasks for which deferrals were more than 6 months
	Ensure compliance to schedule	Understand the deferral management

One more benchmarked practice is to link the KPIs to four tiers mentioned in the American Petroleum Institute (API) 754

From the experience, it is suggested to have composition of 40 % and 60 % of constant and variable KPIs to monitor the PSM programs.

Act on the decided key performance indicators

After the list of KPIs with objective, periodicity of monitoring, information flow, responsibility is assigned training needs to be given for the concerned stakeholders for emphasising on objective of KPI. Though process safety metrics are broadly interfacing with all the elements, they have high interfacing with the element employee participation. In the process of monitoring the KPIs, the employee engagement increases and builds a sense of ownership when collecting, compiling or

analysing the data. The accountability of the KPI should always be with the owner department. For example, the upkeep of fire fighting equipment shall be with the fire team.

KPIs shall ensure monitoring of continual improvement and help in providing feedback to fix the ongoing implementation issues.

A KPI needs to be modified when

- The intended data was collected for understanding the real gap
- The trend lines when observed are constant
- The owner of the KPIs goes into complacency mode

Development of persuasive dashboards and creating a sense of accountability

During the implementation or sustenance program the use of web based dash boards indicating the KPI status, integration with operations and progress will increase the employee involvement and psychologically drive the implementation or sustenance program

An example of a simple dashboard for each KPI is mentioned below in Table 2

Table 2: Example of simple dashboard for each KPI

PSM Element	
Target group	
Objective	
Achievable Type	
Objective	
Periodicity	
Source of Information	
Information flow chart	

Conclusion

With the simple facilitates exercise mentioned in the paper, the whole process of measurement and monitoring can be assured and helps in gaining confidence in the process safety management implementation or sustenance program