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Strategic Implementation of Risk Based Process Safety in Process Plant Organization

Masayuki Tanabe[a], Atsumi Miyake[b,*]

[a] JGC Corporation [2-3-1, Minato Mirai, Nishi-ku, Yokohama 220-6001, Japan
[b] Yokohama National University [Hodogaya-ku, Yokohama, 240-8501, Japan
tanabe.masayuki@jgc.com

The US OHSA PSM and the CCPS RBPS clarifies the requirements for the operation and asset management elements related to process safety. Since different departments are in charge of these elements across organizations and sometimes tend toward organizational silo of operation-maintenance-safety, the ability to organize process safety information across departments becomes important. The Strategic PSM (SPSM) Research Group was established through industry-government-academia collaboration to propose an effective implementation of the risk-based approach for process safety management for Japanese industry. This is since Japanese Safety Regulation systems had been moving from a prescriptive approach to emphasizing operator's accountability and risk-based approach.

1. Introduction

Various organizations like US OSHA PSM, AIChE RBPS (CCPS, 2007), and IChemE Safety Centre PSM Pillars have clarified the requirements for operation and asset management elements related to process safety. However, since different departments are in charge of these elements (i.e., allocated work for each discipline) in an organization, they sometimes tend to work in organizational silos on operational, maintenance, and safety management issues. This highlights the importance of having the ability to organize process safety information across departments. The Strategic PSM (SPSM) Research Group, an industry-government-academia collaboration, was established to propose an effective implementation of the risk-based approach for process safety management in Japanese organizations. The safety regulation systems of Japanese companies have been transitioning from a prescriptive approach to a risk-based approach, with emphasis on operators' accountability.

This paper describes the objectives of the research group, as follows:

- Discuss the organizational management model for risk-based approach
- Identify the organizational challenges through a questionnaire for Japanese operators
- Identify and improve the current asset management approach at the frontend

2. Strategic PSM

Strategic PSM implements the risk-based process safety management system into the organization with consideration to several factors. The key factors of SPSM are described below.

2.1 Management System Model

The SPSM research group first clarified the management concept for the risk-based approach, which is based on a process-based management system (e.g., described as Goal-Strategy-Process model) (IAEA, 2015). Since RBPS application should be strongly considered in an organizational alignment, the situation changes how the goal of minimizing risk can be achieved by considering external and internal factors by each organization member.

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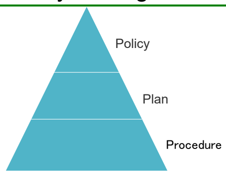
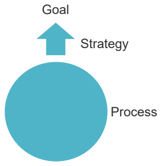
Table 1: Difference of Management Models

	Traditional Safety Management System	Process Based Management System
Image		
Application	Non-Risk Based Safety Management Systems	Risk Based Safety Management Systems (e.g., ISO45000)
Features	Good for management system for known hazards	Good for unknown hazards or continuous improvement by organization
Matches to RBPS	×	○

2.2 Organizational Challenges

The SPSM Research group attempted to identify typical organizational challenges in Japanese operators that may prevent smooth risk communication within the organization using a questionnaire.

(1) Organizational Information Flow for Process Safety

An organization faces fundamental challenges due to the nature of operation and maintenance management and process safety management.

An operation management system is designed to achieve an organizational business target of normal operation management as shown in Figure 1. Meanwhile, a risk-based process safety management system is designed to technically manage deviations in the organization and management system (Deviation Management in Figure 1). However, these two are different and it is fundamentally difficult for the same person to share functions in two different management systems. Many organizations face the challenge of reducing resources in the site organization. Middle management currently covers important roles, tasks, and activities for normal operation and deviation management (Figure 2). However, middle management faces challenges on normal operation management due to a shortage of site organizational resources, which in turn may decrease their focus on deviation management.

The group then proposed enhancing the application of the "risk management process" in the organization by appointing an "inline" process safety leader who will lead the multi-discipline process safety communication and adopting a digitalized facilities management tool that would be the basis of design accident scenarios with functional requirements for each tagged safety critical item.

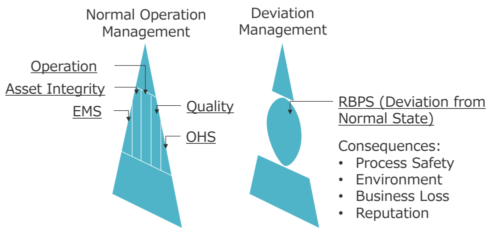


Figure 1: Differences of Target of Management Systems

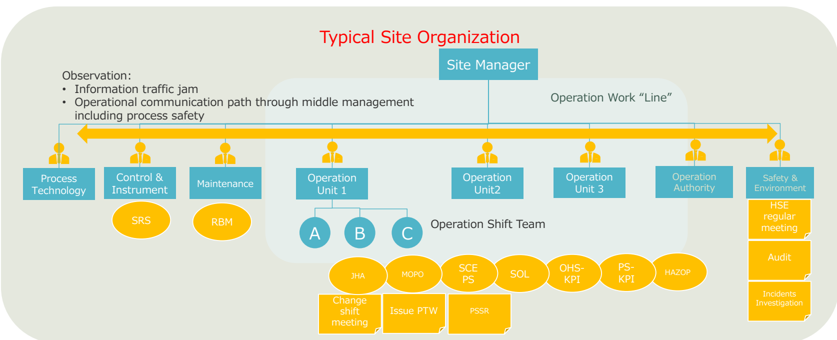


Figure 2: Observed Information Flow Bottleneck

(2) Details of Risk Information

Another challenge observed by the SPSM research group while investigating Japanese operators is the quality (detail and depth of identified accident scenarios) of hazard identification and risk assessment (HIRA), and internal risk communication. The ideal internal risk information flow is shown in Figure 3. Detailed hazard scenarios that cover low frequency/high consequence scenarios should be identified and the required risk reduction should be allocated to each safeguard and measure (ideally tag number basis). There are cases where hazard identification stops in realistic scenarios (high frequency/low consequence). Although detailed HIRA is conducted covering low frequency/high consequence scenarios, there are cases where no hazard is registered and performance standards are not documented making the ideal risk information communication difficult. Currently, the equipment management program's priority is largely driven by the RBM and regulatory requirements (Figure 4).

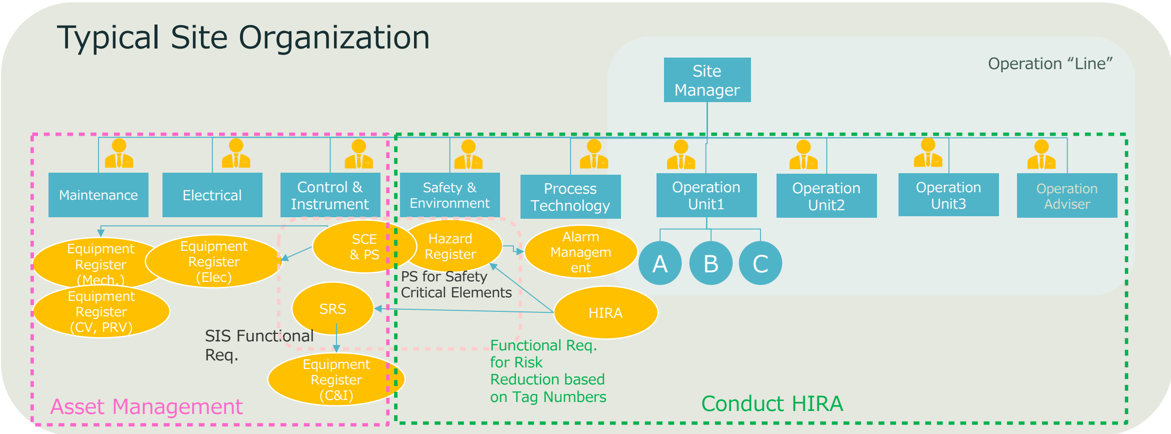


Figure 3: Ideal Internal Risk Information Flow

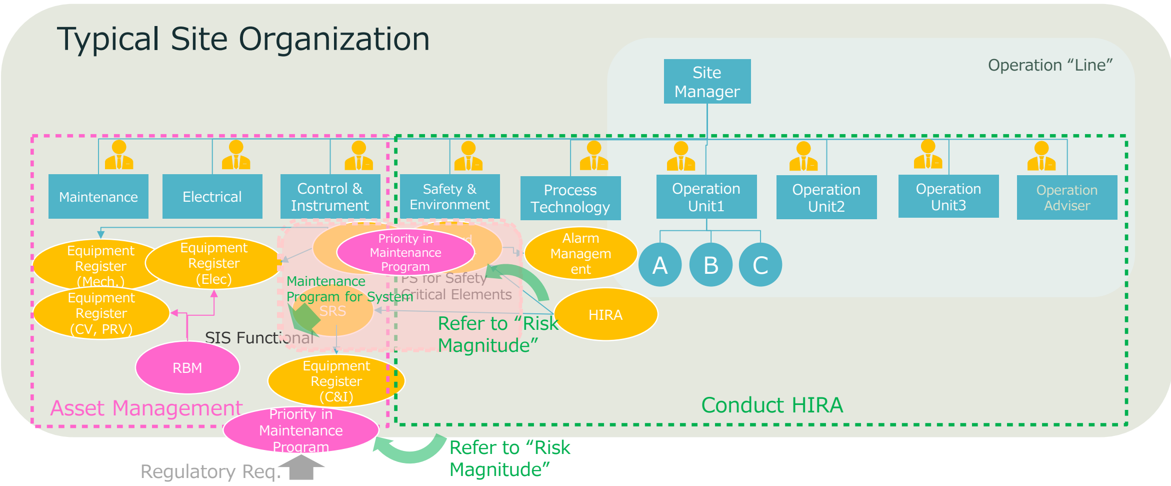


Figure 4: Observed Risk Information Flow

2.3 Requirement Management Tool

The facilities' risk management digital tool of "CoreSafety®" has been developed to overcome the organizational challenges mentioned above. The Fault Schedule method, which is used in the UK nuclear industry, is applied in CoreSafety® as a register of hazardous scenarios (ONR, 2014). Although the number of scenarios is enormous (accident sequences from initiating events to various accident events (i.e., all HAZOP scenarios plus QRA scenarios)), CoreSafety® simply provides critical operation and maintenance functional requirements from the Fault Schedule database based on the dynamic risk information by the Bayesian update of the failure frequency of all causes and safety devices with site-specific maintenance information (Figure 5).

The use of CoreSafety®, combined with dedicated inline process safety engineers in organizations, can improve internal risk information communication.

Figure 5: Main Screen of CoreSafety®

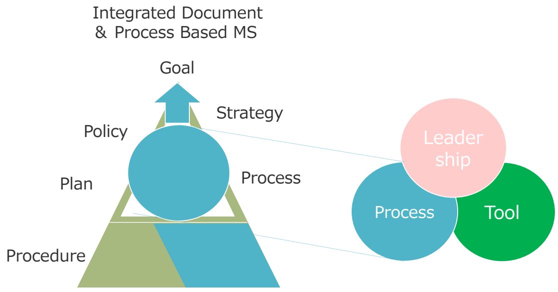


Figure 6: Concept of Strategic PSM

3. Consideration of Strategic PSM Effect

The SPSM application aims to streamline internal risk information flow in organizations through proper process safety leadership with inline process safety function, a process-based management system, and a digital tool. This concept is shown in Figure 6.

The risk information flow enhances the use of functional requirements to achieve the required risk reduction by related disciplines in the organization. This is considered to define the link among RBPS elements as shown in Figure 7. The definition provides clear required inputs to operation and maintenance work, while the leadership and tool strengthen the communication path.

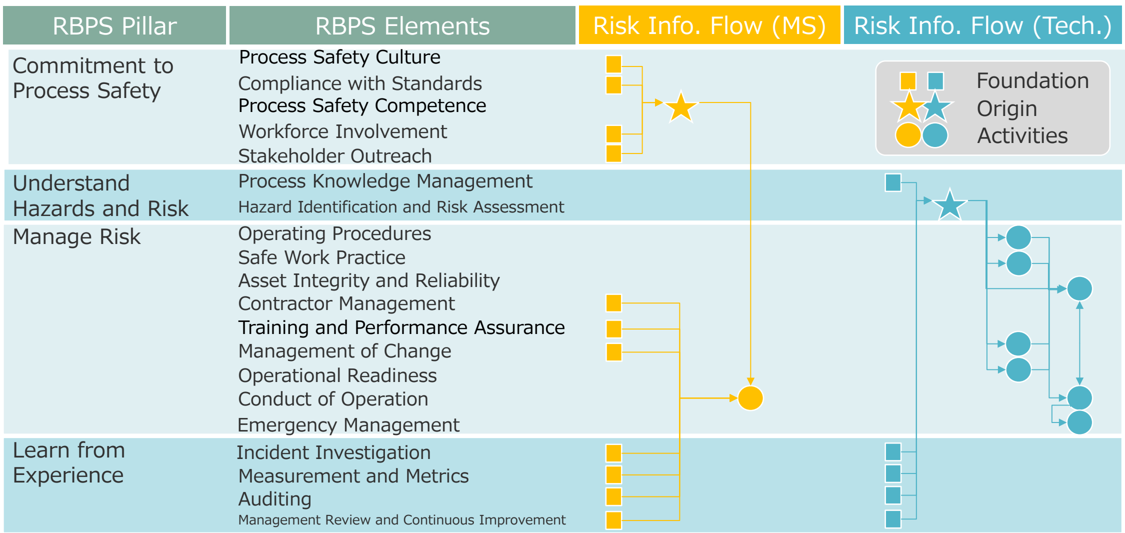


Figure 7: Definition of Risk Information Flow in RBPS Elements

4. Improvement of RBPS Application

The PSM framework assessment is based on the organizational challenge identified in Section 2.2. To evaluate the effectiveness of the proposed measures in Section 2, 10 indicators were identified to monitor the internal risk information flow path and its usefulness in operation and maintenance management. The categories of these indicators are shown in Figure 8. Further, the average levels of a good RBPS management system for each indicator are defined in Table 2.

The potential to improve the discussion points in this paper is demonstrated using the PSM framework assessment indicators in Figure 9. The evaluation is not for a specific organization but for a typical non-RBPS application. Radar chart (a) initially showed lower ratings due to the absence of LOPA, a dedicated process safety engineer, and RBPS application (Figure 9). However, radar chart (b) shows that ratings, especially indicators 2 and 5, improved when the inline process safety engineer and LOPA were applied. Finally, radar chart (c) shows that the performance of the indicators, specifically indicators 4, 6, 7, and 8, significantly improved once RBPS is applied with a process safety requirement management tool (such as CoreSafety®).

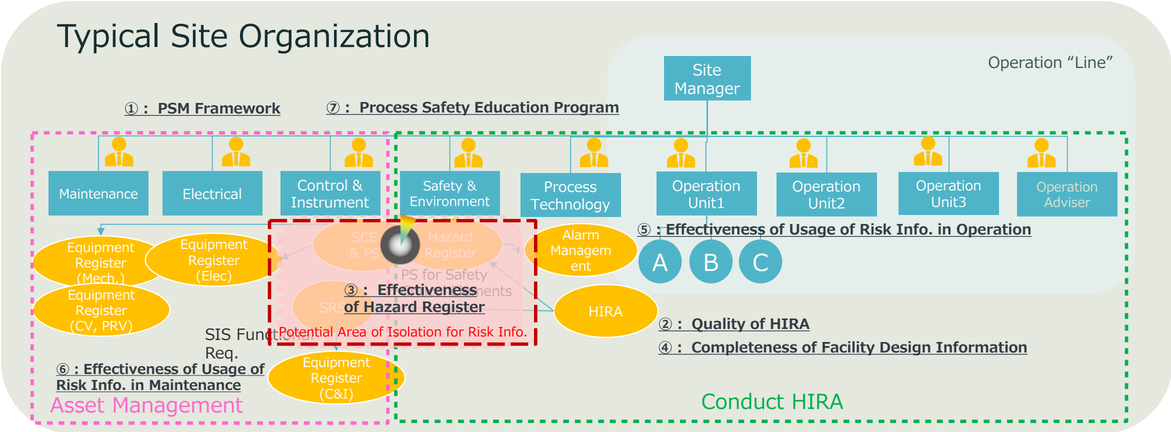
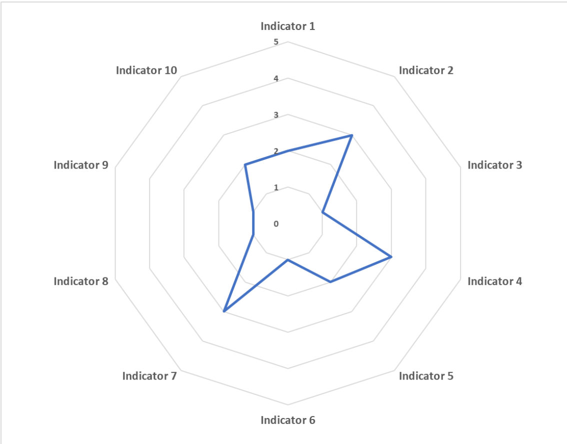


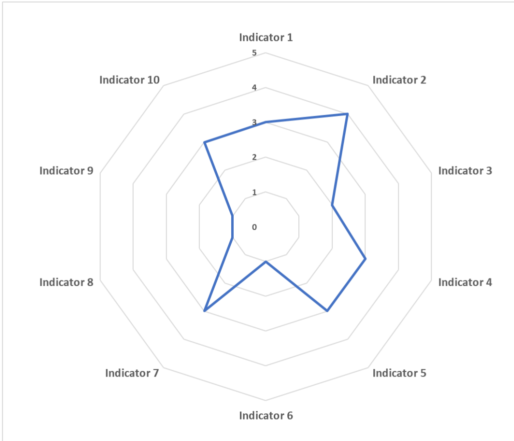
Figure 8: Concept of Organizational Risk Information Flow Assessment

Table 2: 10 Indicators for PSM Framework Assessment

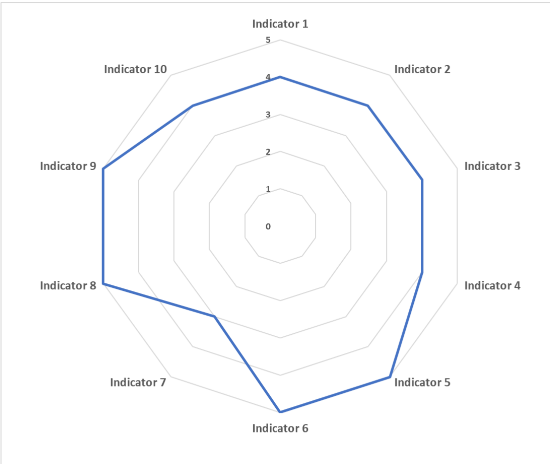
Number	Category	Indicator	Average	Rating (L 1~5 H)
1	PSM Framework	Degree of Risk Based for PSMS	Conduct of LOPA	-
2		Differentiation of PS related work from O&M	No dedicated PS role but O&M functions fulfil PS role requirements	-
3		Specify PS activities & competency	No dedicated PS role but required activities and competency for PS role is specified	-
4		Effectiveness designated PS KPI	No dedicated PS KPI, but PS related leading indicators are included in KPI system	-
5	HIRA	Coverage of HIRA	Completed HAZOP/LOPA with strict hazard identification rule (no overlook for low frequency-high consequence scenarios)	-
6	Hazard Register	Application and usage of hazard register	No dedicated hazard register, but design accident scenario and functional requirements for risk reduction measures are properly implemented to equipment register	-
7	Facility Design Information	Continuity of facility design information	Easy to access to latest facility design information	-
8	Operation Management	Degree of usage of PS risk information in operation	Design accident scenarios identified in HAZOP/LOPA are listed and shared in operation manual or used in training program	-
9	Maintenance Management	Degree of usage of PS risk information in maintenance management program	Design accident scenarios identified in HAZOP/LOPA are listed and shared in equipment register	-
10	Process Safety Education System	Management system for organizational process safety competency	Educational program is constructed systematically and covers overall process safety knowledge area, HAZOP/LOPA, PSM	-



(a) Common Safety Management System with OHS



(b) Partial RBPS and Inline PS Engineer



(c) RBPS with Requirement Management Tool

Figure 9: potential Improvement by Proposed Measures

5. Conclusion

The SPSM concept and potential improvement RBPS application in organization were examined. Multidisciplinary risk communication within the organization improved by appointing inline process safety leaders to reduce information bottle necks and by using process safety requirement management tools, such as CoreSafety® for effective risk-based operation and maintenance management (e.g., prioritize training for alarm/operator intervention, regular inspection, and functional testing for high-risk contributors). In summary, SPSM can improve the effectiveness of RBPS application in organizations especially with the use of design accident scenario information from HIRA. However, SPSM is not usually utilized for operation and asset management due to organizational silos.

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