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Framework of Japanese Management System

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Process safety management (PSM) of chemical industries in Japan is based on small group activities, which is called the Japanese style management system depending on the quality of the operators, which is different from PSM in EU and US. In this paper, Japanese PSM style was examined firstly by investigating the articles on a magazine published by Japan Society for Safety Engineering (JSSE). The result of the investigation showed about 18 kinds of safety activities are extracted from the articles. These activities are categorized into three kinds of activity, which are the activity directly relevant to incident prevention, the activity activating individual activity and the activity activating more than two activities. To investigate the feature of Japanese Management style in detail, all safety activities of Mitsubishi Chemical Corporation are extracted and compared the elements corresponding to the purpose of these safety activities with the elements of Risk Based Process Safety by CCPS. Based on the result, Mitsubishi Chemical's framework of management system is developed.

1. Introduction

Process Safety Management system in EU and US has top down style which is based on the construction of Framework. On the other side, process safety management in Japan has bottom up style which is based on the small group activity at plant sites.
In Japan, there are a lot of problems such as deterioration of facility, retirement of large number of veteran employees, downsizing of employee and reduction of OJT educational opportunity due to a decrease of plant construction opportunity. So, new concept of process safety management is called for.

2. Process Safety Management System in EU and US government

From the 1970s to the 1980s, there were many serious incidents in the chemical industry. In 1982, the EU established the Seveso Directive and introduced the "Safety Management System (SMS)", as a lesson of the wide area pollution caused by dioxin in Northern Italy in 1976. Meanwhile, Federal OSHA introduced "Process Safety Management (PSM)" in 1992 to legislation because the massive spill incident of harmful substances was occurred in India Bhopal in 1984.

2.1 Elements of PSM System

PSM is a management system that focuses on how to prevent the leakage of chemical substances and energy from processes at a facility, prepare in advance, mitigate the influence at the time of leakage, respond and restore. Element is basic division in a PSM system that correlates to the type of work that must be done. Elements are slightly different in each management system. Table1 shows elements which are frame work of Safety Management System of Seveso directive, PSM of OSHA and PSM of CCPS. Each country examines the trends of the world in detail, and builds a process safety structure based on the latest best practices in the industry. Therefore, each country's management system may have similar elements or may not.

2.2 Elements of Process Safety Management by Industrial trade Association

By Industrial Groups, Chemical Process Safety Centre (CCPS) of the American Chemical Engineering Society (AIChE) was established in 1985 with the accident of Bhopal as a trigger. In 2007 CCPS published Guidelines

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for Risk Based Process Safety (RBPS) advocating 20 elements. This guideline book has been influential to date as a way to lower the risk of serious accidents and improve the performance of the process industry.

Table 1: EU,US and CCPS PSM Element

EU PSM Element	US PSM Element	CCPS PSM Element
- Organization and Personnel	- Employee Participation	- Process Safety Culture
- Identification and Evaluation of Major Hazards	- Process Safety Information	- Compliance with Standards
	- Process Hazard Analysis	- Process Safety Competency
- Operational Control	- Operating Procedures	- Workforce Involvement
- Management of Change	- Training	- Stakeholder Outreach
- Planning for Emergencies	- Contractors	- Process Knowledge Management
- Monitoring Performance	- Pre-start up Safety Review	- Hazard Identification and Risk Analysis
- Audit and Review	- Mechanical Integrity	
	- Hot Work Permit	- Operating Procedure
	- Management of Change	- Safe Work Practices
	- Incident Investigation	- Asset Integrity and Reliability
	- Emergency Planning and Response	- Contractor management
		- Training and Performance Assurance
	- Compliance Audit	
	- Trade Secrets	- Management of Change
		- Operational Readiness
		- Conduct of Operations
		- Emergency Management
		- Incident Investigation
		- Measurement and Metrics
		- Auditing
		- Management Review and Continuous Improvement

3. Study on Safety Management in Japan

Safety Management in Japan is based on small group activities unlike management systems in EU and US. Japanese management is said to be safety management dependent on the quality of operators. In this section, process safety activities of Japanese chemical industry are investigated.

3.1 Research Method

To clarify the factors that comprise or influence Safety Management in Japan, a qualitative study is used to analyze safety activity. This study utilized qualitative data obtained from articles which relate safety activity at plant sites in Japan.

“Safety Engineering” which is published by Japan Society for Safety Engineering (JSSE) once in two month is used this survey. Safety activities are described in the article "Our company's safety measures" and "Our company's environmental safety activities" which are posted irregularly in the "Safety Engineering". These articles introduce the safety activities that Japanese chemical companies carry out at each plant site every time, though the articles do not have fixed formats. 99 articles are covered. In the survey, the extraction was carried out separately for items such as the type of safety activity, the contents of safety activity, etc. Activities of the same objective out of the extracted safety activities were conceptualized.

The research scope is as follows,

Magazine: “Safety Engineering” (written in Japanese)

Period：1981-2014

Survey Articles: 1981-1999 “Our company's safety measures”

2000-2014 “Our company's environmental safety activities”

Article Survey Number ：99 Articles（59 companies, 93 plant sites）

3.2 Result

Safety Management in Japan set policy firstly, then safety activities are implemented based on the policy. About 30 % articles describe how safety activities are managed, as follows,

a) Setting safety policy at a plant site firstly in accordance with the company's policy.

b) Setting the action plans by a safety committee at the plant site.

c) Safety activities are being carried out to achieve the safety policies.
d) Audits are implemented to check the performance of the activities.
e) To improve the weak points, the results of the audit reflect to next year's safety policy.

Table 2: Categories of Safety Activity

Category	Safety Activity
- Activities directly related to incident prevention	- Education/Training
	- Hiyari Hatt (HH)Activity
	- Kiken Yochi (KY) Activity
	- Patrol
	- Audit
	- Safety Assessment
	- Safety Analysis Procedure
	- Contractor Management
	- 5S Activity
	- Emergency Management
	- Utilization of Incident Information
	- Small Group Activity
	- Operational management
	- Equipment Management
- Activities to activate individual activities	- Award System
	- Achievement Presentation
	- Small Group Activity
- Activities to activate multiple activities	- Recreation

Activities collected through investigation of safety activities are conceptualized (Table 2). The classification concept of activities is divided into 3 categories and 18 activities are extracted from the articles. Activities can be classified into three types. "Activities directly related to incident prevention", "Activities to activate individual activities" and "Activities to activate multiple activities" (Figure 1a).

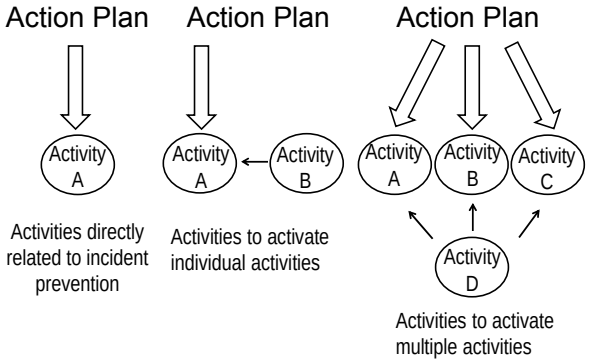

Figure 1a: Safety Activity category

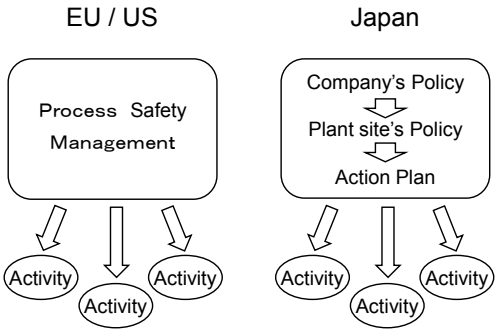

Figure 1b: Difference of Management Style

3.3 Discussion

Figure 1b shows the difference between EU/US management system and Japanese Management Style. In EU and US management systems, safety activities are carried out according to each element of the management system. On the other hand, in Japan's management system, safety activities are carried out according to a plant site's policy. The policy does not necessarily show the overall picture of safety activities. As weak points pointed out by the audit are strengthened, although there are effects of incident prevention, it is not known whether all the hazards were eliminated or not. Presumably, there should be something corresponding to the elements of the management system of the EU and US management system in the Japanese activity, however this is not clearly indicated and it is a state of being hidden in the activity. Therefore, it is difficult to see the whole image of safety activity. Each activity looks to be done not systematically but individually.
Table 2 shows there are many activities in which all employees participate, such as 5S activity, KY activity and Small group activity, etc. The reason why is that basically Japanese safety activity focuses on people. There are some articles that mention these points in the surveyed articles as follows.

"Even if excellent safety education and safety activities are introduced, incident cannot be prevented without motivation"," The base of safety measures is people and it is difficult to improve safety performance unless each people has a firm consciousness of safety. In order to activate each of these individuals, activities that all members participate, that is, bottom-up activities are necessary", "Safety activities cannot be expected to be effective if employee feel that they are enforced to do the safety activities", "It is necessary for employees to tackle safety activities as their own problems, and the creation of vigorous workplace environment through voluntary activities by all of them leads to improvement in safety performance.".

From these reasons, activities which urge everyone to participate voluntarily in safety activities, and activities to strengthen the connection between people to people link have been developed. Also, people's activities tend to fall into rut and become a mere facade. Therefore, activities to strengthen activities have developed to prevent them.

4. Safety management at Mitsubishi Chemical Corporation

4.1 Correspondence between Mitsubishi Chemical's Safety Activities and RBPS Elements

To investigate the feature of Japanese Management style in detail, all safety activities of Mitsubishi Chemical Corporation are extracted and compared the elements corresponding to the purpose of these safety activities with the elements of RBPS. The result of the investigation is shown in Table 3. It almost covered RBPS. On the contrary, there are many activities in Mitsubishi Chemical to activate people and organizations, though there was no element corresponding to RBPS for these activities.

Table 3: Correspondence between Mitsubishi Chemical's Safety Activity and RBPS Elements

Mitsubishi Chemical's Safety Activity	Contents of Mitsubishi Chemical's Safety Activity	Corresponding Element of RBPS
Management of Operation, Production and Operational Procedure	Management for stable operation and stable production, and management of operational procedure.	- Operating Procedures - Safe Work Practice
Process Technology	Collecting and maintaining process information.	- Process Knowledge Management
Plant Manager Audit, Director Audit, Head Office Audit	Checking and reviewing the performance of safety activities.	- Audit - Management Review and Continuous Improvement
Management of Change	Recognizing and managing change.	- Process Knowledge Management - Hazard Identification and Risk Analysis - Management of Change
Incident Investigation	Identification of causes of incidents and Implementation of recurrence prevention measure. Sharing internal and external incident information.	- Incident Investigation
Equipment Management Review	Review and improvement of equipment Management status.	- Asset Integrity and Reliability
Inspection and Commissioning Review	Ensuring that all equipment are operating properly.	-Asset Integrity and Reliability - Operational readiness
Contractor Management	Contractor Management.	- Contractor Management
Emergency management	Preparation and management assuming emergency situation.	- Emergency Management
Various types of Committee Meeting	Information sharing.	- Process Safety Culture -Process Safety Competency - Workforce Involvement
Hiyari Hatto (HH) Activity	Hiyari-Hatto (HH) is a Japanese term. HH is an incident which is avoided just before its actual occurrence. HH includes actual HH experience and latent HH. Reporting and sharing HH raise safety	- Process Safety Competency - Workforce Involvement - Incident Investigation - Conduct of Operations

Table 3: (Continued)

Hiyari Hatto (HH) Activity	awareness and achieve organized improvement of the work environment.	
Kiken Yochi Activity	Kiken Yochi (KY) is a Japanese term. KY refers to avoiding hazards and conducting operations safely through prediction of risk and revisions to work procedures and methods prior to carrying out tasks.	- Process Safety Competency - Workforce Involvement - Hazard Identification and Risk Analysis - Conduct of Operations
Safety Review	Safety Review is the full inspection of existing manufacturing processes, safety reassessment and confirmation of countermeasure effectiveness.	- Process Knowledge Management - Hazard Identification and Risk Analysis - Incident Investigation
Safety Assessment	Safety Assessment is implemented when beginning the manufacture of new products and when improving and upgrading existing manufacturing processes.	- Management of Change - Asset Integrity and Reliability - Hazard Identification and Risk Analysis - Operational Readiness
Patrol	Various safety patrols are carried out at plants, ranging from daily patrols to patrols conducted by the general manager of the plant .Patrol has many effects which are educational effect by seeing other departments, improvement of safety awareness and extraction of trouble spots at a plant site, etc.	- Process Safety Culture - Process Safety Competency - Conduct of Operations
Process Investigative Committee	Identification of latent hazards at a process.	- Process Knowledge Management - Hazard Identification and Risk Analysis
Education / Training	Improvement of skill to ensure reliable performance.	- Training and Performance Assurance
Instruction Course	Providing a field for noticing through dialogue.	- Process Safety Culture
External Communication	It is an activity to build a relationship on trust with the administration and the community, there are regional dialogue, RC report, neighbourhood cleaning and so on.	- Stakeholder Outreach
Various types of Presentation Meeting	Presentation of activity result.	N/A
Compliance with Standards	Understanding and maintaining adherence to applicable standards, codes, regulations and lows.	- Compliance with Standards
President Award, Plant manager Award, Director Award	Evaluating results and efforts.	N/A
A Lecture by Top Management	Showing an attitude towards safety by giving a message directly from top management.	- Process Safety Culture
Recreational Event	Improving a sense of unity of the workplace and motivation by holding various kinds of recreation.	N/A
Orientation and Training of Contractor	Education for employees of contractors.	- Contractor management
Director Liaison Meeting, Director Meeting, Section Manager Meeting, Foreman meeting	Information sharing.	- Process Safety Culture - Workforce Involvement - Incident Investigation
Morning Meeting (Plant Section)	In the morning regular meeting, reporting is carried out and information such as problems and issues is shared.	- Workforce Involvement
5S Activity	Activities that everyone participates. Improvement of	- Process Safety Culture

Table 3: (Continued)

5S Activity	workplace safety by beautification of workplace environment, improvement of morale of employees, improvement of work efficiency, prevention of defects and compliance with regulations.	- Asset Integrity and Reliability - Workforce Involvement - Compliance with Standard
Small Group Activity	Improving productivity by employee's teamwork, improving motivation of employees, looking back on themselves in a small group and promoting mutual enlightenment	- Process Safety Culture - Workforce Involvement
Kaizen Activity	Each Manufacturing frontline employee personally takes suitable improvement steps to address issues discovered in daily patrols and tasks and thereby create a safer workplace.	- Process Safety Culture - Asset Integrity and Reliability - Workforce Involvement
Process Safety Incident Occurrence status	Incident statistics.	- Measurement and Metrics

4.2 Future Plan : Framework of Mitsubishi Chemical's process safety management system

Based on the results, Mitsubishi Chemical's management system was created. Activation of personnel and organizations is one of the important management elements within Mitsubishi Chemical. So this element is added to the management frame and created a management system frame according to Mitsubishi Chemical's actual situation (Table 4).

Table 4: Mitsubishi Chemical's Elements

People and Organization	Daily Operation Management
- Improvement of safety culture	- Operation and work control
- Understanding and observance of rules	- Control of high-risk operations and work
- Well-disciplined operations and work	- Preparations for operations
- Activation of personnel and organizations	- Change management
- Participation of employees	- Equipment management
- Staff development	- Management of partner companies
Dealing with Risk Occurrence	- Active use of technical information and knowledge
- Response to emergency situations	- Identification of sources of hazards and risk management
- Studies on accidents, problems and use	
Coexistence with Local Communities	Check, Evaluation and Improvement of Mechanisms and Activity

5. Conclusions

The difference between EU/US safety management system and Japan's safety management was shown.
There are three types of activities in Japan's safety management activities. "Activities directly related to incident prevention", "activities to activate individual activities" and "activities to activate multiple activities".
As a result of correlating activities of safety activities with elements of RBPS, it was found that there is no element corresponding to RPBS with respect to the elements appealing to the hearts of people such as activation of people and organizations. Based on this result, the foundation of the framework of Mitsubishi Chemical's guidelines which added the activation of employees to the element is created.

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