

# Developing a Metric System to Measure IIPS's Process Safety Management System Performance

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## Abstract

*A metric system was proposed on how to measure the performance of Indonesian Institute for Process and Safety's Process Safety Management (PSM) system, which will be implemented in Indonesian chemical industries. The metric system consist of an index that can evaluate the rate of PSM performance. That is, the increment of PSM performance can be calculated based on each specific question that has a point value, and the points are distributed across the PSM elements.*

## 1. Introduction

Indonesian Institute for Process and Safety (IIPS), a professional organization which is weighting it's activity on process safety, recognized from its very beginning that to prevent catastrophic events, such as at that happen to PT Petrowidada, enhancement on process technologies alone would not be enough. The development of process safety from a purely technical issue to one that demanded management approaches was essential to continued process safety improvement. Performance metric itself should drive the continuous improvement process. This allows technical staffs to communicate in a language that management understands.

A process driven by performance metrics avoids many of the unforeseen pitfalls associated with continuous improvement based on nothing more than management's slogans, exhortations, and targets. The metric is developed from a comprehensive list of questions, developed from each of the IIPS's PSM elements. While all element have an important to play, a relative weighting is reflective of both the number of specific requirement included within the element, and company experience regarding the significant in contributing to the prevention of the incidents.

## 2. Process Safety Management Models

Process safety is the operation of the facilities that handle, use, process or store hazardous material in a manner free from episodic or catastrophic events. Process safety management (PSM) ensures that a property

designed facility is operated according to the safe manner intended.

PSM is the application of management principles and systems to identification, understanding and control of process hazards to prevent process related injuries and incidents.<sup>[1],[2]</sup> PSM systems that use the four essential features of management system (i.e. planning, organizing, implementing, and controlling) are comprehensive sets of policies, procedures, guidelines, and practices designed to ensure that barriers to major accident are in place, in use, effective and measured. The systems serve to integrate process safety concept into the ongoing activities of everyone involved in operations – from the plant operator or maintenance technician to the chief executive officer.

By observing the process safety regulations that recently endorsed internationally by agency or industrial association, it seems that prescriptive standard (i.e. API 14C) or a cookbook alike are no longer adequate according to the complexity of the unforeseen pitfalls which never been predicted before. Differ from prescriptive standard which based on historical data or "what has happened" and tends to be conservative (worst case scenario), performance based standard (i.e. CCPS PSM) foresee the problems based on "what could happened" and actual risk identified. Using performance based, solution of lessening the actual risk will be fit in, not more nor less. This lead the performance based standard to be more cost effective compare to the prescriptive standard that world-wide used before.

Since first introduced by American Chemistry Council (was Chemical Manufacturers Association) in the middle of 1988, more than ten of the PSM models was conceptualized. The most wide-range industrial implemented models is OSHA's PSM since it backed up by US Federal regulation. For better frameworking, PSM models are defined into some activities or elements. The comparison of the PSM elements from several organizations can be shown on Table 1.

IIPS itself developing a new PSM model consists of 14 activities / elements. Those 14 elements is derivated from other PSM models. Despite IIPS's 14 elements, however alternative ways of organizing the same components can be postulated. The structures and titles used within a company's PSM system are not important, so long as the appropriated content is present.

IIPS listed its elements as follow: Accountability,

**Table 1**  
**Comparison of Different Procees Safety Management Programs**

	IIPS PSM	CCPS PSM	OSHA PSM	EPA RMP	API RP750
Commitment and Accountability	V	V			
Employee Participation			V		
Management System	V	V		V	
Process Safety Information	V	V	V	V	V
Process Hazard Analysis	V	V	V	V	V
Hazard Assessment	V	V		V	
Operating Procedures/Practices	V	V	V	V	V
Training	V	V	V	V	V
Contractors	V		V		
Pre StartUp Safety Review	V	V	V	V	V
Maintenance/Mechanical Integrity	V	V	V	V	V
Hot Work Permits	V	V	V		V
Management of Change	V	V	V	V	V
Accident/Incident Investigation	V	V	V	V	V
Emergency Planning & Response	V	V	V	V	V
Audit	V	V	V	V	V
Safety Lifecycle Management	V				
Trade Secret			V		
Risk Management Plan				V	
Registration				V	

Process Safety Information and Documentation, Capital Project Review and Process Design Procedure, Process Hazards and Risks Management, Management of Change, Process and Equipment Quality Assurance and Mechanical Integrity, Safety Lifecycle Management, Human Factors, Contractor and Supplier Safety Management Systems, Training and Performance, Incident Investigation, Standards, Codes and Laws, Process Safety Audits, and Enhancement of Process Safety Knowledge.

These elements play interactive roles in process safety management, provide overlapping layers of assurance to achieve safe operations, and must be considered when making decisions regarding manufacturing and transportation of raw materials, products, and waste. Particular attention must be paid during organizational transitions, such as downsizing, mergers, acquisitions and divestitures.

### 3. Metric System

Performance measurement has two section : minimum standard and "best practices. Minimum standards are paraphrased directly from corresponding element of PSM. That are currently more than 70 minimum standards in 14 elements. The number of minimum standards within a given element varies from 2 to 10. A single minimum standards may also have multiple components. Minimum standards may spesifically require a procedure such as having a hot work permit procedure; a schedule of activities such as schedule of process hazards analyses for site units; or system require

ments such as an incident investigation system which included a written procedure, reporting and investigation requirements, action tracking and a evaluation of system effectiveness withfollow up improvement actions.

The scoring scaled used for minimum standard ranged from 1 to 3.

- |   |   |                                      |
|---|---|--------------------------------------|
| 1 | = | No activity on a particular standard |
| 2 | = | Standard partially met               |
| 3 | = | Standard fully met                   |

Each minimum standard is rated using the scale. The minimum standards score within a given element is the average of each individual score. If the average is 3.0 then the best practices are evaluated for that section. If the average is less than 3.0 then the best practices are not rated. The rationale is that minimum standards should be met before any consideration of best practices will be given.

Best practices have several characteristics and come from various sources. They are meant to add value to the site process safety programs, but they may not be of value to all sites. Small sites with no hazardous chemicals do not have the same needs as larger sites that handle hazardous chemical in large volumes. IIPS has gathered these practices from several sources such as Rhodia, Bayer, Acutech, CCPS books, and other opportunities for practice sharing within the industry. There are currently more than 80 best practices in the 14 elements. Examples of best practices included are electronic Management of Change program on site network, process safety information files electronically available to all on a site network, specific audits of individual elements to assess quality of information,

adherence to procedure, completion of action items, etc.

Best practices are rated in following way.

- ❖ No activity of practices implementation is underway will be scored 0
- ❖ Practices is fully implemented at the site or unit being evaluated will be scored 5

Since 5 was the targeted as the top score for given section, the best practices score is twice the number of 5s achieved divided by the total number of best practices within an element. The final score for a section becomes 3.0 + the best practices score. Maximum score is 5 if all best practices implemented. An overall score for the site or unit is also calculated. It is based upon a factored average of each section. Each section has a factor from 1 to 5 based on complexity, importance, and the whim of the team developing the factors. Factor for each elements are shown in the example in Table 2.

The scoring system is very nonlinear when minimum standard are not met. This skews the final score also. However when all the minimum standards are met the scores typically jump significantly. A Visual Basic program is used to record the results. The use of Visual Basic also helps facilitate analysis and display of the results

**Table 2. Example of elements rating and factored score**

Element	Element Score	Factor	Factor x Score
Accountability	4.0	1	4.0
PSI and Documentation	2.8	5	14.0
CPR and Design Proc.	4.5	5	22.5
PH and Risk Management	4.1	5	20.5
Management of Change	4.3	4	17.2
Pro. & Eq. QA & Mech Int.	2.8	4	11.2
Safety Lifecycle Mgmt	2.1	4	8.4
Contractor & Supplier SMS	3.9	2	7.8
Human Factors	2.0	4	8.0
Incident Investigation	3.2	3	9.6
Process Safety Audit	4.0	1	4.0
Training	4.7	4	18.8
Standards, Code, & Laws	4.0	2	8.0
Enhancement of PSK	2.2	1	2.2
Total		45	156.2

**Overall Rating 3.5**

#### 4. Further Development

As the process become more ingrained in Indonesian proces safety culture, the assessment has become more quality focused. In 2005 key areas were chosen for more in-depth review to ensure that not only was the required information and program in-place but that the quality of those elements was appropriate. Also, over time of IIPS's approach to the minimum standards and best practices has become more specific as opposed to compliance specific. IIPS still include the compliance points but have added more system requirements: to plan, do, check, act, cycle.

#### 5. Reference

- [1] Center for Chemical Process Safety of the AIChE, *Plant Guidelines for Technical Management of Chemical Process Safety*, 1995
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- [6] Institute of Chemical Engineers Symposium Series, *Hazards XVII: Process Safety – Fulfilling Our Responsibility*, 2003
- [7] American Petroleum Institute, *Process Safety Management – Sharing Best Practices*, 2004

#### 6. Biography



Darmawan Ahmad Mukharror was born in Pandaan, East Java, Indonesia on January, 1974. He obtained his B.Sc. from ITB in 1999. In 1999 – 2000 he served as Well Production Services Engineer for Schlumberger.

He is currently worked as Process Engineer for VICO Indonesia from the end of year 2000. From 2004 to 2006 he has been voted as the President of Indonesian Institute for Process and Safety (IIPS)