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The effective control of major industrial accidents by the Major Industrial Accident Prevention Centers (MAPC) through the Process Safety Management (PSM) grading system in Korea

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ABSTRACT

This paper examines effectiveness of a regulatory enforcement organization (Major industrial Accident Prevention Center, MAPC), and a grading system for implementation of the Process Safety Management (PSM) regulation in Korea. A lot of chemical installations have been built in Korea since the 1960s. The frequent occurrence of major industrial accidents had made people's concerns grow. The Korean government enacted PSM regulations in 1996 in order to curb these accidents.

However, a key question is how to make sure companies comply with the PSM regulations. In order to improve company' compliance with PSM regulations the Ministry of Employment and Labor (MOEL) responsible for the regulation introduced a grading management system in 2001 and then established special supervisory centers for enforcement of PSM regulations in 2005. This paper reviews the role and effectiveness of the system in term of PSM enforcement. The author found that the grade-based approach has encouraged employers to implement the requirements of the PSM regulations. MAPCs play an effective role in enhancing enforcement performance. Although the more chemical plants have been established in Korea, the fewer major industrial accidents have occurred since the introduction of the system. The results may be useful for the policy maker to build an effective and efficient enforcement system.

1. Introduction

Controlling major industrial hazards is still a challenging issue for regulatory bodies in many countries. Therefore, governments have established supervisory authorities in charge of enforcing related rules and regulations to prevent major industrial accidents (Rosenthal, Kleindorfer, & Elliott, 2006; Wood et al., 2008). For example, the U.S. Chemical Safety Board (CSB), which has been operating from 1998, is in charge of investigating chemical accidents (CSB, 2012). The U.S. Occupational Safety and Health Administration (OSHA) is an agency charged with enforcing a variety of regulations for major hazardous workplaces, such as chemical plants. The U.S. Environmental Protection Agency (EPA) is responsible for preventing environmental accidents. They are all independent bodies but work together to control major industrial accidents. On the other hand, EU required that member states to develop regulations and regulatory systems dealing with major industrial accident in chemical plants by EU Council Directive 82/501/EEC called Seveso directive in 1982 (Directive 2012/18/EU, the latest amendment). In the U.K. for example, the Health and Safety Executive (HSE) has a division in charge of enforcing regulations for major hazard installations. And a governmental supervisory body, called the COMAH Competent Authority, enforces the Control of Major Accident Hazard (COMAH) Regulations. The COMAH Competent Authority consists of three different government agencies, namely, the HSE, the Environment Agency (EA) for England and Wales, and the Scottish Environment Protection Agency (SEPA) (HSE, 2010a,2010b). It works as a strategic management group mainly setting up strategies and work plans. The purpose of a safety regime applicable to workplaces causing major industrial hazards is (1) to ensure that they fulfill their responsibility to control such hazards; (2) to make industry aware of potential hazards; and (3) to help them improve their safety performance (HSE, 2010).

One of the key issues facing the government authority responsible for enforcing Process Safety Management (PSM) regulations is

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how to make employers maintain their PSM programs, re-evaluate them and modify them in a way to reflect changes in their installations (Luo, 2010). Regulatory authorities use safety performance indicators (SPI) to control major industrial accidents and hazards. "Safety performance indicator" is defined as 'a means of measuring changes in safety levels (related to chemical accident prevention, preparedness and response), as the results of actions taken' (OECD, 2003). Which workplaces should be inspected is decided based on these safety performance indicators. For instance, the HSE in the U.K. uses 'fatal injuries to workers', 'major injuries to workers', 'dangerous occurrence', etc. as safety performance indicators. However, safety performance indicators have a weak point because they are backward-looking. It is not easy to judge the PSM performance of a workplace only using safety performance indicators because a major industrial accident (low-frequency and high-consequence) rarely occurs. They are not reliable indicators for the Low-probability but High-consequence (LP-HC) industry, either. The fact that there has been no severe or frequent accident in a chemical installation does not guarantee that no major industrial accident will occur in that workplace in the future (Hale, 2009; Skogdalen, Utne, & Vinnem, 2010). Just one major industrial accident could bring serious and irreversible consequences for people and the environment near the workplace as well as workers.

In Korea, labor inspectors in each of the 47 regional offices of the Ministry of Employment and Labor (MOEL) are responsible for enforcing occupational safety and health regulations and ensuring workplaces' compliance. And the Korea Occupational Safety and Health Agency (KOSHA), an independent government agency, is charged with examining the fulfillment of occupational safety and health requirements (such as process safety reports), providing related technical support and conducting R&D activities concerning accident prevention. KOSHA provides workplaces with technical information and advice on the PSM regulations. KOSHA has 23 branches around the country. KOSHA has a certification program called KOSHA-18001, which was developed from the previous KOSHA-2000. The program is used to certify the safety management systems of workplaces including chemical companies.

The specific measures being implemented by the authorities in relation to the PSM regulations are: (1) examining process safety reports (PSR); (2) making a follow-up check on PSRs during on-site visits; (3) evaluating compliance with the PSM regulations (grading system); (4) inspecting the implementation of PSRs; and (5) investigating accidents and complaints.

Inspections can be divided into two types, that is, scheduled inspections and special inspections. During scheduled inspections, the previous safety and health records of workplaces are examined.

An investigation is conducted by a labor inspector if there is a major industrial accident, severe injury or death. If a worker or any other person raises a complaint about safety and health in the workplace, a labor inspector may investigate the case, and if necessary, conduct an inspection.

This paper examines the PSM grading system and the roles of Major industrial Accident Prevention Centers in the context of enforcing the PSM regulations in Korea. Their benefits and shortcomings are also discussed in detail.

2. Development of chemical industry and PSM regulation in Korea

Korea is one of the countries that have many petroleum refineries and chemical production facilities. Since the 1960s when Korea's economic development plan was focused on the chemical industry, its petroleum and chemical industry has gone through some major changes (Aliyev, 2002; KPIA, 2007). Table 1 shows characteristics and development of petroleum and chemical industry in Korea. In Korea, there are now four major chemical complexes. To begin with, the Ulsan Industrial Complex (south-east region) was established in the 1970s. It was followed by the Yeosu Industrial Complex (south–west region) and then the Daesan Complex (central region). Korea is ranked 5th in the world in terms of ethylene manufacturing capacity in 2003.

The more chemical factories were built in Korea, the more concerned people living close to major hazardous workplaces as well as workers at those workplaces were about industrial accidents because a major industrial accident could affect people and the environment as well as workers and facilities in the workplace. For instant, there was a big explosion in a chemical production facility in the Yeosu Chemical Complex in October 1989, which left 16 workers dead and 17 injured and destroyed facilities. In March 1991 the Nakdong River in the south-east region of Korea was

Table 1
Development of the petroleum and chemical industry in Korea.[a]

	1960s–1970s (development period)	1980s (growth period)	Late 1980s ~ Mid-1990s (take-off period)	Since the second half of 1990s (restructuring period)
Leading operator	Government Government-led (operation of Ulsan Complex)	Establishment of foundation (operation of Yeosu Complex)	Private sector Large-scale extension of installations (operation of Daesan Complex)	Business reorganization Active M&A
GDP elasticity (demand growth)	2.9 (28.0%)	1.4 (12.0%)	1.3 (10.0%)	1.0 (3.0%)
Balance between import and export	Net import	Balance import	Balance export	Net export
Leading industry	Light industries	Light industries, Heavy chemical industries	Heavy chemical industries	High-tech industries (IT, BT, NT)
Government policies	Enactment of the Petrochemical Industry Promotion Act (PChiPA), Industry led by government	Provision of government support & liberalization of government-owned enterprises (abolition of PChiPA)	Liberalization of investment and price	Liberalization of industrial policy & business restructuring
Global trend in chemical industry	Expansion of petrochemical industry dominated by advanced countries	Business diversification & higher-value products	M&A & growth of Asia (China, Southeastern Asian countries)	Intensifying competition, super multinational enterprises & fast growth of Middle East petrochemical industry

[a] Statistic data from the Korean Petrochemical Industry Association (2011).