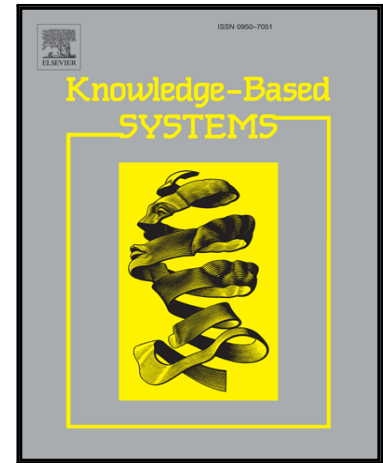


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# A multi-experts and multi-criteria risk assessment model for safety risks in oil and gas industry integrating risk attitudes <sup>1</sup>

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## Abstract

This paper mainly proposes a novel method to establish a risk matrix for assessing safety risks in oil and gas industry. The frequency and the consequence of risk are two desired criteria in the establishment process of a risk matrix. In fact, more than two criteria and several experts are often involved, so a multi-criteria and multi-experts information integration (MEMCII) model is constructed in this paper. Firstly, the method of the determination of experts' weights is introduced to integrate experts' assessment scores based on the objective weights and the subjective weights. Secondly, the weighted ordered weighted operator (WOWA) with a utility interpolation function is proposed to derive the overall consequence integrating people's risk attitudes. Finally, a risk matrix is established to show which risks are highly dangerous and which can be ignored. In addition, an application is demonstrated to illustrate the efficiency and flexibility of the proposed model.

### Keywords:

Safety risk; Risk matrix; OWA operator; Risk attitude; Utility function; Multi-criteria.

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## 1. Introduction

In recent years, some unwanted accidents such as personal injuries, explosions, fire, man-made destructions and oil evaporations possibly occurred in Chinese oil and gas industry. For example, on December 23, 2011, a blowout accident occurred in Sichuan Qionglai No.1 well, four people were injured and one was missing[1]; on November 22, 2013, an explosion in Qingdao east yellow oil pipeline killed 62 people and injured 136 people, and the direct economic loss was 751.72 million yuan(RMB)[2]; on September 21, 2016, a deflagration accident occurred in the third engineering branch of petrochina pipeline, four people were injured and two died[3]. In order to prevent these accidents, oil and gas company must carry out effective risk management.

How to manage safety risks effectively in oil and gas industry is an important issue, and risk assessment is a primary and key process within risk management. Traditionally, qualitative way, semi-quantitative way and quantitative way are three ways to carry out risk assessment. The qualitative methods are used to assess risks when credible and accurate data are missing[4, 5]. Quantitative risk assessment methods are frequently used in situations where there are sufficient data or data can be derived based on simulation[6–10]. The semi-quantitative way that is suitable for data with quantitative and qualitative characteristics is often used in risk assessment[11–15]. The risk matrix approach(RMA), which is a semi-quantitative way, is a classical tool for risk assessment. Many scholars have devoted major efforts to construct a reasonable risk matrix in

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