

Accepted Manuscript

Title: Human factors risk assessment and management:
process safety in engineering

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PII: S0957-5820(17)30403-2
DOI: <https://doi.org/10.1016/j.psep.2017.11.018>
Reference: PSEP 1238

To appear in: *Process Safety and Environment Protection*

Received date: 25-9-2017
Revised date: 6-11-2017
Accepted date: 29-11-2017

Please cite this article as: Xie, Xuecai, Guo, Deyong, Human factors risk assessment and management: process safety in engineering. *Process Safety and Environment Protection* <https://doi.org/10.1016/j.psep.2017.11.018>

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Human factors risk assessment and management: process safety in engineering

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Abstract: Human factors are the primary factors leading to accidents. Therefore, managing human factors is an important way to prevent accidents. This paper aims to introduce a new method to assess and manage human factors. First, the accident causation model was improved based on Reason's "Swiss-cheese" model, which was then combined with the Human Factor Analysis and Classification System (HFACS) to establish the human factors risk assessment model. The evaluation model includes 5 levels (organization influence, unsafe supervision, preconditions for unsafe acts, unsafe acts, and emergency influence) and 25 human factors. In the risk assessment process, the set pair analysis method was used to calculate the connection number and the partial connection number of each factor, level and whole system. The safety score and risk development interval were calculated by using the connection number, and the risk grade is determined. Thus, the dynamic quantitative evaluation of human risk is realized. By using the partial connection number, the risk development trend of each factor is predicted. Due to the lack of human managed enterprises, the safety status of people is approximately discrete. Therefore, this paper establishes the SPA-Markov chain risk prediction model to predict human risk. The verification results show that the prediction error is less than 2%. This indicates that the prediction model can be applied in practice. To reduce human risk, ABC analysis and the "S-O-R" model were used for human risk management. The application results show that this method has a significant effect on improving human safety factors. Finally, this paper summarizes 12 common unsafe factors and their effective safety "stimulus" measure, researching the accident path. According to the organizational level and individual level of human factors, different kinds of human factors management methods are suggested.

Keywords: Human factors; Risk assessment and management; Set pair analysis; SPA-Markov risk prediction method; ABC analysis and "S-O-R" analysis model

1. Introduction

With the growth of the economy and the development of science and technology, the number of deaths and accidents has decreased significantly. However, the safety situation is still grim. In an analysis of accident-induced factors, human factors led to the vast majority of accidents. The study found that 70%~80% of aviation accidents, 60% of petrochemical accidents, 90% of iron and steel metallurgy accidents, and 90% of road traffic accidents are caused by human factors (Cai, 2008). Therefore, human factors are the main factors leading to accidents.

Many scholars have applied a great number of research methods to analyse and study human factors resulting in accidents. Early human factors are confined to the individual's perspective. Farmer and Chamber introduced the concept of the accident prone

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