Journal of Health and safety at Work 2021; 11(1): 32-35

ORIGINAL RESEARCH PAPER

Evaluation and Comparison of Health, Safety and Environmental Management System in Oil and Petrochemical Downstream Industries (Case Study of Textile Factories)

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Received: 2019-12-15 Accepted: 2020-06-10

ABSTRACT

Introduction: The oil and petrochemical industries had been amongst the first industries which developed the HSE-MS. This system aims to maintain and protect human resources along with reducing the environmental impact of the industry. Although it has been mulling over this system in a plethora of studies, unfortunately, most of the assessments have been carried out in a qualitative manner. In recent years, the evaluation of the performance of HSE-MS has been limited due to the lack of appropriate quantitative evaluations.

Material and Methods: In the present study, the development of criteria and sub-criteria of health, safety and environment management system was investigated using a different approach. Using the opinion of experts and according to the performed categories, a questionnaire was developed to determine the pairwise comparisons. Decision making trial and evaluation (DEMATEL) technique was used to determine the relationships between the criteria and network analysis method was used to determine their importance weight. the developed methodology was then evaluated and compared between two factories in a case study.

Results: The performance evaluation showed that the leadership and commitment criterion with a final score of 1.8; Risk assessment and management with a final score of 0.8; Planning criterion with a final score of .0.40; Policy criterion with final score of 0.33, Organization, resources, and documentation with a final score of 0.31, implementation and follow-up with a final score of 0.22, and Evaluation and Review criterion with a final score of 0.12 were ranked from the first to the seventh, respectively.

Conclusion: The results of the study demonstrated that the most important criterion for health, safety and the environment is leadership. The significant difference between the final score of the leadership criterion and the other criteria reflects its crucial importance in HSE-MS performance evaluation. Participation of employees, allocation of appropriate funding and support of innovativeness are factors to be implemented in order to improve HSE-MS program as a better and successful management.

Keywords: *HSE-MS, Performance Evaluation, Textile Industries*

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1. INTRODUCTION

Textile Factories as a key part of the oil industry are considered to be one of the most hazardous occupational places exposed to high potential of risk occurrence. Performance evaluation of Textile Factories, therefore, has to receive particular attention. HSE Performance Evaluation in big textile factories is an essential tool applied to improve safety management and the promotion of continuous improvement. HSE-MS performance evaluation system is also used as an effective alternative to eliminate outdated evaluations and to help administrators adopt corrective measures. The HSE-MS system is an integrated tool composed of several factors, i.e., the systematic framework, management tasks, and determination of operations. These factors create a structured management system to eliminate injuries, undesirable health effects and prevent possible damages to the environment. The main goal of this system is to carry out an advanced risk analysis to identify the consequences of hazards making it appropriate to take suitable measures to prevent and control the risks. Therefore, it can contribute to the profitability of the industry and is widely accepted by modern companies (1-4). The application of Health, safety and environmental (HSEs) performance evaluation indicators has a long history firstly used in 1959. New investigations on the HSE performance evaluation focused on Key Performance Indicators (KPIs). KPIs are key building blocks for the HSE-MS evaluation and monitoring process (5-7). Performance evaluation closely deals with quality evaluation and the performance evaluation of health, safety and environmental management is a prerequisite for a continuous improvement policy that is known as the spirit of a management system (6). There exists a significant correlation between productivity and health and organizational features. In other words, some of the HSE-MS elements significantly affect overall performance, so that it should give special attention to design (8).

2. MATERIAL AND METHODS

This is an analytical-practical study aimed at providing a quantitative model for assessing the HSE-MS system widely applicable for the textile factories, conducted by multi-criteria decision making (MCDM) analysis methods to prioritize and select appropriate indicators. These methods include various techniques such as ANP and DEMATEL. As the ANP network analysis allocated general state of AHP with all of its positive featuresi.e., simplicity, flexibility, the use of quantitative and qualitative criteria simultaneously, and the ability to assess the compatibility of judgments, the complex communication between decision elements was considered, therefore, using network structure instead of hierarchical structure. Moreover, applying DEMATEL technique, reciprocal relations of criteria, sub criteria were also evaluated.At the first step, the criteria and sub-criteria by were determind by Delphi method, then, the questionnaire number 1 is prepared based on the OGP model (International Oil and Gas Association), consisted of seven criteria accompanied with the twenty-five sub-criteria all of which were accessible for A number of experts. Furthermore, the questionnaire number 2 was also prepared and presented to A number of experts to perform a paired comparison and to determine the priority of the criteria and sub-criteria. These questionnaires are based on the 9-degree spectrum of Saaty. Using this model, the relative importance of criteria could be estimated by numbers as the principle of ANP. In the expert questionnaire, which is based on the paired comparison of all elements with each other, the probability of a non-applicable variable is considered zero. After initial prioritization of criteria, sub criteria of HSE-MS performance evaluation, using the geometric mean and normalization, one can calculate the specific vector. The output numbers demonstrate the importance factor. To determine the final priority of the criteria, sub-criteria, final priority is calculated by the primary super-matric (irregular), regular super-matric, and finally, the limit super-matric. (9,10)

3. RESULTS AND DISCUSSION

Based on the special derived vector: The leadership; risk assessment and management; planning; policy; organization; implementation and monitoring; auditing and reviewing criteria with a normalized weight of 0.450; 0.200; 0.101; 0.083; 0.078; 0.056 and 0.032 are from the first to the seventh priority, respectively.

According to the extracted results, leadership and commitment is the most important criterion for the performance of HSE-MS in textile factories with normalized weight of 0.45. The inconsistency rate was also calculated 0.77, indicating that the paired

comparisons were desirable indicator for all sub-criteria identified in the acceptable range. Table 1 showas the direct-relation matrix, normalized direct-relation matrix, and the total-relation matrix calculated through performing the DEMATEL methodology.

In Table 1, the sum of the elements in each row, "D", indicates the extent to which this criterion is influenced by other criteria of the model. On this basis, "leadership and commitment" criterion has got the greatest impact among all criteria. The sum of elements in each column, "R", for each criterion demonstrates the extent of the effects that the criterion may induce on the other criteria. On this basis, the "planning" criterion has a very high impact level. The "leadership and commitment" criterion has also the least impact on other criteria. Also, the horizontal vector of "D+R", determines the effect of the considered criterion on the system. In other words, greater "D+R" implies more interaction of the criterion with other criteria. On this basis, "risk evaluation and management" criterion has the most interaction with the other criteria. "leadership and commitment" has the least interaction with other criteria. The vertical vector of "D-R",on the other hand, shows the influence of each criterion. Principally, if "D-R" is positive, the variable is a causal variable, and if it is negative, it is considered as an affected variable. In the model developed in this study, the "commitment and leadership" criterion is the causal variable and the other variables are the affected variables. After preparing the final weights of the criteria, the final score of the criteria can be achieved with the help of Delphi and DMATEL methods and network analysis. The total final score of the main criteria is 4, and by the final score of the main criteria, the performance of textile factories can be compared with each other.

Then, two factories were randomly selected and the main criteria of their performance were compared according to the final score. Also, the criteria of "leadership and commitment" in factory 1 received a full final score of 1.8 while the final factory's score was closer to the final score of the ideal main criteria. Totally, the performance evaluation of the factory NO. 1 was found to be better than that of the factory No. 2.

Table 1. The causal relationships model of the main criteria.

Criteria	D	R	D+R	D-R
Leadership and commitment	5.273	2.393	7.666	**2.880**
Policy and strategic objectives	3.722	4.522	8.244	**- 0.800**
Organization/ resources/ and documentation	4.395	4.590	8.985	**- 0.194**
Risk evaluation and management	4.763	4.794	9.557	**- 0.031**
Planning	4.197	4.925	9.122	**- 0.729**
Implementation and monitoring	4.163	4.875	9.038	**- 0.713**
Auditing and reviewing	4.381	4.794	9.175	**- 0.412**

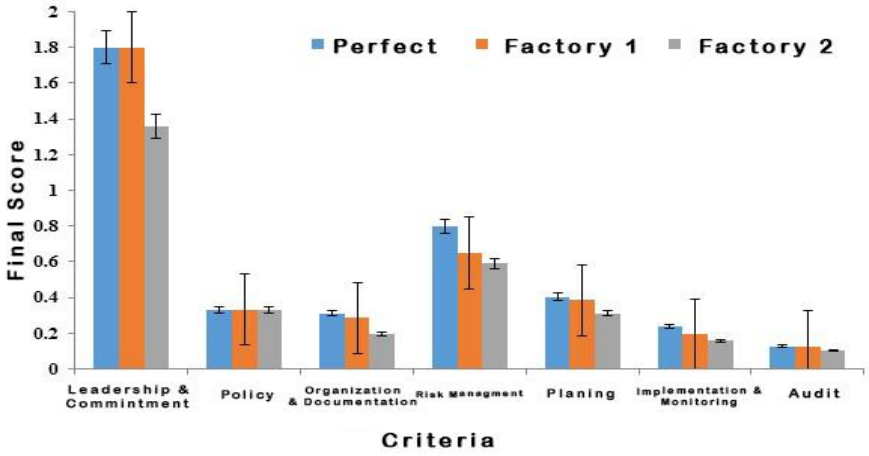

Fig. 1. Comparison of the final scores of the ideal state, Factory No. 1 and Factory No. 2 (Textile Industries).

4. CONCLUSIONS

The performance evaluation of HSE-MS is a key stage in continuous improvement and a good tool is required to meet this purpose. However, during HSE-MS performance evaluation, no indicator could be helpful significantly. After final determination of the criteria, sub criteria will be prioritized. Finally, leadership and commitment criterion with a final score of 1.8; risk assessment and management with a final score of 0.8; planning criterion with a final score of .0.40; policy criterion with final score of 0.33, organization, resources, and documentation with a final score of 0.31, implementation and follow-up with a final score of 0.22, and evaluation and review criterion with a final score of 0.12 were ranked from the first to the seventh, respectively.

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