Journal of Cleaner Production 127 (2016) 119–133

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Developing an integrated decision making approach to assess and promote the effectiveness of occupational health and safety management systems

Iraj Mohammadfam [a, b], Mojtaba Kamalinia [a, *], Mansour Momeni [c], Rostam Golmohammadi [a, b], Yadollah Hamidi [d], Alireza Soltanian [e]

[a] Department of Occupational Hygiene, School of Public Health, Hamadan University of Medical Sciences, Hamadan, Iran
[b] Research Center for Health Sciences, Hamadan University of Medical Sciences, Hamadan, Iran
[c] Department of Management, University of Tehran, Tehran, Iran
[d] Department of Health Management, School of Public Health, Hamadan University of Medical Sciences, Hamadan, Iran
[e] Department of Biostatistics, School of Public Health, Hamadan University of Medical Sciences, Hamadan, Iran

ARTICLE INFO

Article history:
Received 4 April 2015
Received in revised form
14 February 2016
Accepted 16 March 2016
Available online 8 April 2016

Keywords:
Safety management systems
Effectiveness
Decision making
Assessment

ABSTRACT

Occupational Health and Safety Assessment Series (OHSAS) 18001 standard has been recommended as a tool for managing and controlling occupational risks through a systematic and structured management. However, controversy exists as to the effectiveness of OHSAS 18001 in reducing occupational risks at workplace. The current study introduces an integrated decision making approach by merging two techniques including Analytical Network Process (ANP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to assess and improve the effectiveness of OHSAS 18001 standard. Our findings indicate that the most influential factors to be taken into account to improve the effectiveness of OHSAS 18001 standard are management commitment, workers' participation, allocation financial resources, training, risk assessment, definite responsibility, communication and dissemination of occupational health and safety results and activities. The study offers this approach as a tool to evaluate and promote the effectiveness of OHSAS 18001 standard.

1. Introduction

Despite the undeniable efforts that have been invested in safety and health at workplace, occupational accidents and incidents continue to occur, at a large scale, globally (Cadieux et al., 2006; Cagno et al., 2014). Occupational accidents and illnesses have serious adverse effects on the workforce, assets, equipment, environment and economics. They harm the staff, damage the equipment and consequently decrease productivity, public reputation and market competitiveness of companies (Fernandez-Muniz et al., 2007).

In industrialized countries occupational accidents and illnesses are responsible for 5–7% of all deaths. According to a report by the International Labor Organization (ILO), approximately 2 million fatal and 268 million non-fatal occupational accidents take place annually (ILO, 2003). Furthermore, the ILO estimates that production loss, absenteeism, medical treatments and compensation payments to injured employees would be equivalent to 4% of annual global gross domestic product (Takala et al., 2014). This means that occupational accidents and illnesses are serious problems in industries (Fernandez-Muniz et al., 2012a; Ramli et al., 2011).

Therefore, devising new preventive strategies to reduce the accidents and their adverse impacts is a top priority in occupational health and safety (Fernandez-Muniz et al., 2007, 2012b). Within the past decades, newer methods for managing the occupational health and safety (OHS) areas in an effective manner have been introduced. These methods have focused on more complex aspects of OHS such as safety management systems rather than on specific aspects such as technical and human factors (Abad et al., 2013; Mengolini and Debarberis, 2008).

Research findings on occupational health and safety have revealed that many OHS risks could be prevented or controlled via

* Corresponding author. Hamadan Medical Science University, Hamadan 689, Iran. Tel.: +98 8118380025; fax: +98 8118380509.
E-mail addresses: m.kamalinia@umsha.ac.ir, mokamalinia@gmail.com (M. Kamalinia).

http://dx.doi.org/10.1016/j.jclepro.2016.03.123
0959-6526/

implementation of occupational health and safety management systems (OHSMSs). Nowadays, various OHS models or guidelines have been developed by national and international organizations and institutions in response to the demands of firms to manage occupational risks (Abad et al., 2013; Robson et al., 2007).

The most commonly used OHSMS for assessing health and safety management processes is OHSAS (Occupational Health and Safety Assessment Series) 18001 standard (Granerud and Rocha, 2011). It was first introduced by British Standard Institution (BSI) in April 1999 and was updated in July 2007 (Fernandez-Muniz et al., 2012b). OHSAS 18001 standard is based on a management system framework and involves Plan-Do-Check-Act cycle of Deming. Although its structure is similar to ISO 9001 and ISO 14001 standards, it has the advantages to identify, reduce and control work hazards (Vinodkumar and Bhasi, 2011; Zeng et al., 2007). Indeed, it includes OHSMS requirements such as policy, planning, implementation and operation, checking, management review, responsibility, documentation, audits, records, communication and continuous improvement (Robson et al., 2007; Zeng et al., 2007).

Thus, it can be viewed as a tool that can manage and control occupational risks through a systematic and structured management (Chen et al., 2009; Santos et al., 2013). This standard, due to its compatibility with quality and environmental management systems, has become more widespread (Fernandez-Muniz et al., 2012a; Santos et al., 2013). About 56,251 companies in 116 countries have received OHSAS 18001 certification at the end of 2009 (Hasle and Zwetsloot, 2011).

Despite the increased use of OHSMSs all over the world, no unanimous agreement exists as to their effectiveness in controlling and reducing occupational risks at workplace (Hasle and Zwetsloot, 2011).

This might be due to improper audits and OHS progression measurement tools (Blewett and O'Keeffe, 2011; Cadieux et al., 2006; Chang and Liang, 2009). Auditors often use audit tools during evaluation process which are based on subjective and intangible data. These neither objectively assess the effectiveness of OHSMSs nor provide robust information about OHS practices.

Therefore, paperwork of audits and auditor teams without considering OHSMSs performance aspect cause many managers feel that OHSMSs are just more paperwork and nothing more than another expenditure job (Chang and Liang, 2009; Podgórski, 2015).

Most companies utilize lagging indicators to measure the status of the occupational health and safety (Laitinen et al., 2013; Podgórski, 2015). Performance indicators based on traditional data, such as number of Lost Time Injuries (LTI), number of sick leave days due to injuries, Injury Frequency Rate (IFR) and Injury Severity Rate (ISR), due to the inherent complexity of OHS cannot reflect the real OHS conditions (Chang and Liang, 2009; Hinze et al., 2013).

These indicators are retrospective and provide imprecise and unreliable information about improvement to management (Laitinen et al., 2013; Ramli et al., 2011). On the other hand, proactive indicators provide early warnings and signs in time in relation to the occurrence of occupational risks, irregularities, faults and forecast future status (Harms-Ringdahl, 2009; Øien et al., 2011; Shafiee, 2015).

Thus, it is necessary to develop a comprehensive evaluation system that consists of both lagging and leading measurable and achievable indicators to continuously assess and improve the effectiveness of OHSMSs (Chang and Liang, 2009; Reiman and Pietikainen, 2012). Assessing the effectiveness of OHSMSs and identifying their influential factors enable managers to realize what the status of OHS is and how to make decisions for promoting OHS conditions (Cagno et al., 2011).

In this context, the main objectives of this study were as follows: (1) to develop an integrated decision making approach (ANP-TOPSIS) in order to evaluate and promote the effectiveness of occupational health and safety management systems (2) to identify appropriate criteria and key performance indicators and to quantitatively prioritize them as parts of an effective occupational health and safety management system and (3) to assess the effects of such criteria on performance of occupational health and safety management systems.

In the following section, the literature concerning the effectiveness of OHSMSs based on OHSAS 18001 standard is reviewed. Then the research methodology is described and demonstrated with a case study. Furthermore, the results are reported. The final section gives discussion and conclusion for promotion the effectiveness of OHSMSs.

2. Literature review

The mission of OHSAS 18001 standard is managing occupational risks and promoting work conditions through a systematic and structured approach (Vinodkumar and Bhasi, 2011). Most studies related to OHSMSs are mainly concerned with certification process, performance evaluation, motivation for the adoption of OHSMSs and benefits of OHSMSs, not directly dealing with the effectiveness of OHSMSs (Fernandez-Muniz et al., 2012a; Hohnen and Hasle, 2011; Ismail et al., 2012; Santos et al., 2013; Vinodkumar and Bhasi, 2011). Few studies have tried to identify key factors contributing to success and the effectiveness of OHSMSs. Ramli et al. (2011) proposed a method to determine influential factors for successful planning and implementation of OHSMSs. This approach determined a limited number of influential factors such as policy and program, risk assessment and risk control. Chang and Liang (2009) developed a quantitative model to evaluate safety management system performance in manufacturing facilities using multi attribute decision making method.

Teo and Ling (2006) used Analytic Hierarchy Process (AHP) method to develop a model to measure the effectiveness of safety management systems of construction sites. Another research was carried out to measure the effectiveness of safety management system implementation on-board ships. In this study, authors utilized AHP and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) techniques to monitor safety management system performance through a limited number of key performance indicators (KPIs) (Akyuz and Celik, 2014).

Recently, a research attempting to select KPIs for components of OHSMSs has been performed (Podgórski, 2015). OHSMSs are effective and efficient when they achieve their own expected results. Thus, they should be monitored and interpreted continuously. Continuous improvement of OHSMSs requires an appropriate method for analysis to provide high quality results (Gallagher et al., 2001). Some researchers have used multi-criteria decision-making (MCDA) techniques, especially AHP, for assessing the effectiveness of OHSMSs.

It is essential to know that OHSMSs are dynamic, complex and depend on many complicated factors. Thus, there are some interactions, interdependencies and feedback between components of OHSMSs. For instance, management with high commitment to health and safety communicates the importance of health and safety to workers through attending safety training courses, safety inspections, safety meetings and safety committees. Such measures can involve workers in safety processes such as hazard identification and reporting and this can lead to positive safety performance such as fewer work related accidents.

The literature review leads us to conclude that most researches have considered these factors in a hierarchy and independent from one another without paying attention to interactions, feedback and dependency among elements and the contributing factors of