Assessment of Occupational Health and Safety Management Systems Status and Effectiveness in Manufacturing Industry

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Abstract

Occupational injuries are a major problem worldwide and affect all countries, particularly developing ones. In recent decades, the application of approaches such as the Occupational Health and Safety Management System (OHSMS) has led to the successful control of workplace injuries in high-income countries. The Occupational Health and Safety Assessment Series (OHSAS) 18001 as a world-recognized OHSMS has gained considerable acceptance by a large number of organizations. However, few studies have examined the effectiveness of OHSAS 18001 on safety performance in certified organizations. This study consisted of four sub-studies, and was conducted to explore the effect of OHSAS 18001 on the occupational injury, safety climate, and Occupational Health and Safety (OHS) practices in OHSAS 18001-certified companies compared with a control group in Iran. OHSAS 18001 practices were also examined in the certified companies, where interviews were conducted to explore the influencing factors on the effectiveness of OHSAS 18001. A negative binomial regression indicated no significant effect of OHSAS 18001 certification on the occupational injury rate. The second sub-study applied a new safety climate questionnaire, and a hierarchical regression indicated that the safety climate was influenced by the implementation of OHSAS 18001 and safety training. The third sub-study pointed to the better OHS practices of the certified companies compared with the control ones. The results also showed that adopting the OHSAS 18001 standard improved the documentation for the management of OHS, but did not lead to continuous improvement in the required practices. The evaluation of the collected evidence revealed the main reasons for a poor safety culture. The interviewees emphasized the internal and external influencing factors in the effectiveness of OHSAS including commitment of top management and the enforcement of OHS legal requirements. It can be concluded that the implementation of OHSAS 18001 in an organization is not a guarantee of improved safety performance and of the existence of a high-quality management system. This study suggests that certified companies should focus on proper improvement and maintenance of the implemented management systems by

escalating their commitment to the requirements of the established management systems and by participating their employees in OHSAS 18001 practices. This study also emphasized the importance of providing safety training for employees who work in the certified companies. These efforts may help the companies in the creation of a good safety culture and the transforming the paper systems into effective management systems to make improvement in OHS performance.

To

All Iranian employees who are injured in unsafe workplaces as a result of negligence of themselves and inappropriate decisions/actions of their managers to effective management of safety

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II. GHAHRAMANI, A., KHALKHALI, H. R. (2015). Development and validation of a safety climate scale for manufacturing industry, *Safety and Health at Work* 6 (2), 97–103.

III. GHAHRAMANI, A. (2016). An investigation of safety climate in OHSAS 18001-certified and non-certified organizations, *International Journal of Occupational Safety and Ergonomics* 22, 414-421.

IV. GHAHRAMANI, A. (2016). Factors that influence the maintenance and improvement of OHSAS 18001 in adopting companies: A qualitative study. *Journal of Cleaner Production* 137, 283-290.

V. GHAHRAMANI, A. Diagnosis of poor safety culture as a main shortcoming in OHSAS 18001-certified organizations, *Industrial Health* (Submitted).

Abbreviations

ANOVA	Analysis of variance
AMOS	Analysis of a MOment Structures
CB	Certifying Body
CFA	Confirmatory Factor Analysis
EFA	Exploratory Factor Analysis
JSA	Job Safety Analysis
ICC	Intraclass Correlation Coefficient
ISO	International Standards Organization
ISRS	International Safety Rating System
ISSO	Iranian Social Security Organization
MISHA	Method for Industrial Safety and Health activity Assessment
NGO	Non-governmental organization
NOSA	National Occupational Safety Association
OHS	Occupational Health and Safety
OHSAS	Occupational Health and Safety Assessment Series
OHSMS	Occupational Health and Safety Management System
OIR	Occupational Injury Rate
PCB	Printed Circuit Board
PDCA	Plan, Do, Check, Act
SOP	Standard Operating Procedures
SPSS	Statistical Package for the Social Sciences

1 Introduction

1.1 General Introduction

It is estimated that 321,000 fatalities and 317 million nonfatal injuries occur for employees worldwide annually due to occupational accidents (ILO, 2013). Occupational injuries fatality in the United States and the European Union are 4,628 and 4,395 respectively (BLS, 2013; Kotzeva, 2013). Prior studies estimated that the rate of occupational fatalities in the industrially developing countries is at least two to five times higher than the industrially developed countries such as North America and Western Europe (Concha-Barrientos et al., 2004). According to the last report of Iranian Social Security Organization (ISSO), 19,907 occupational accidents occurred for insured employees (n = 12,764,566) by the organization in Iranian workplaces (n = 1,214,277) in 2015 (ISSO, 2016). A scientific estimation showed that Iran had about 23,000,000 active workers who experienced 3,068 fatal injuries and 2,885,714 non-fatal injuries (≥ 4 days' absence) in 2003. The annual occupational fatality rate was 13.3 per 100,000 in the same year (Hämäläinen et al., 2009).

The high and growing number of occupational injuries in recent decades has led to the creation and application of approaches such as Occupational Health and Safety Management System (OHSMS) *inter alia* for effective management of safety and health. Dalrymple et al. (1998) pointed out that the use of OHSMSs had been a successful approach for control of workplace injuries in high-income countries. Occupational Health and Safety Assessment Series (OHSAS) 18001 is a worldwide-recognized voluntary OHSMS that published in 1999. Since the publication of this standard, a large number of organizations have implemented it worldwide (BSI, 2007, 2009; Chang & Liang, 2009; Hohnen & Hasle, 2011). In line with other workplaces, some Iranian organizations have had an interest in the implementation of the requirements of this standard with the aim of control and prevention of occupational injuries (Frick, 2011).

The implementation of OHSMSs does not guarantee the improvement of safety performance, and several factors influence the effectiveness of OHSMSs in organizations. These factors include the senior management commitment to safety, employee involvement, communication, safety training, how the adopting organizations implement the requirements of the management standard or guideline, the maintenance of the management system, the features of the interested enterprises, and the external environment (Gallagher, 2000; Bluff, 2003; LaMontagne et al., 2004; Robson et al., 2007; Fernández-Muñiz et al., 2009; Fernández-Muñiz et al., 2012a).

Researchers have investigated the quality of OHSMSs through the assessment of the association between proxy measures and intermediate outcomes of safety performance, such as safety climate, employees' beliefs, perceptions, and behaviors (Robson et al., 2007). The applied methodologies for the studies have been criticized by their subjective character (Ramli et al., 2011; Abad et al., 2013).

Despite the considerable acceptance of organizations for implementation of the OHSAS 18001 standard, few studies have examined the effectiveness of these interventions. Assessment of the safety literature shows that there is no study that has determined the effectiveness of implemented systems in OHSAS 18001-certified companies in Iran. Thus, it is necessary to examine the effectiveness of the systems in the companies. The aim of this thesis is to determine the effect of OHSAS 18001 on the objective measures of Occupational Injury Rate (OIR) and Occupational Health and Safety (OHS) practices in addition to the subjective measure of safety climate in OHSAS 18001-certified companies compared with control companies in Iran. It is also to clarify the status of OHSAS 18001 through the assessment of OHSAS 18001 practices and to explore the influencing factors on the effectiveness of OHSAS 18001 in the certified companies.

1.2 Safety management

Earlier studies have identified the significant effect of management factors in the safety performance of organizations. According to OHS legislations and

regulations, management (employer) is responsible for assuring safe working conditions for all employees and for accidents that occur in workplace due to the contribution of the events to unsafe acts and conditions that are under the control of the management (IRIC, 1990; OSHA, 2015). Moreover, supervisors and front-line-managers are key individuals in accident prevention. Obadia et al. (2007) have indicated that hazardous organizations must include the safety management in their strategic policy to improve safety performance. Comparison of organizations with low and high accident rates revealed the significance of the management commitment to safety and the involvement of managers and supervisors in safety practices to accident prevention (Bentley & Haslam, 2001). Lack of leadership, commitment, competence, consultation, or supervision can make a hazardous environment that can increase the occurrence probability of accidents (Vassie & Lucas, 2001; Makin & Winder, 2008). Reason (1993) also identified the faulty management decisions as latent errors for the occurrence of accidents. Therefore, it should be an adequate level of safety management in place to achieve a satisfactory safety performance in an organization.

Safety management plays a significant role in achieving and maintaining a high level of safety (Bottani et al., 2009). Good safety management is necessary to achieve an acceptable level of safety, to minimize the safety risks and losses, as well as to improve the whole safety performance, productivity, economic, and financial results (Fernández-Muñiz et al., 2012b). Safety management is usually regarded as the aspect of the total organizational management that involves a broad range of technical, human, and organizational functions to promote a strong safety culture and to achieve a good safety performance (Harms-Ringdahl, 2004; Grote, 2012).

The main purpose of safety management is to ensure that an organization maintains an acceptable level of safety throughout the life cycle of systems in its premises (Van den Berghe et al., 2006). It relates to the actual practices, roles, and functions of an organization to create and maintain a safe situation (Vinodkumar & Bhasi, 2011). It is also a great profit to the manufacturing industry (Chen et al., 2009). Several factors such as the requirements of safety regulations and

legislation, safety culture, company size, and business type influence the safety management in an organization (McGuinness & Utne, 2014). The common safety management practices associated with the safety performance of an organization include worker participation; hiring practices; reward systems; management commitment; giving high rank to safety officers; personally engagement of managers in safety activities; providing a high-quality training for new employees; existing employees frequently received safety training; safety posters demonstrated for identifying hazards in workstations; clearly defined safety procedures; workers and supervisors communicated about OHS on a daily basis; periodic safety inspections; giving a higher priority to safety in meetings and decisions concerning work practices, and proper investigation of accidents (Vinodkumar & Bhasi, 2010; Vredenburgh, 2002).

Two types of safety management that commonly used in organizations include the traditional (program) and systematic approaches (Herrero et al., 2002). The following sections provide a brief description of these approaches.

1.2.1 Traditional (program) approach

A traditional safety management approach is a control-oriented approach to separately analyze workers, technology, and the work context (Costella et al., 2009; Hadjimanolis & Boustras, 2013). Workers were directed and controlled to complete the requirements of safety standards and regulations. The safety laws and government' regulations enforced and workers get information about the new safety regulations. The managers of the organization, who apply the traditional safety management approach, use their authority to ensure compliance with safety laws and regulations in order to improve the level of safety (Herrero et al., 2002; Hadjimanolis & Boustras, 2013).

The programmatic safety management is always unable to enhance the performance of safety due to the existence of some shortcomings. The ultimate aim of these programs is complying with the technical requirements in a workplace to achieve short-term results. The programs are usually not integrated with the rest of

practices of an organization. Safety director; safety committees; safety meetings; a list of rules pertaining to safety; posting of slogans and posters, and safety incentives are the common elements of traditional safety management programs. Safety director is a key person to handle the safety programs and usually he/she does not have the authority to make changes in an organization (Herrero et al., 2002). There are OHS legislations and regulations in most of countries that required employers to obey their requirements in workplaces.

According to Iranian labor law (article 85), two governmental bodies undertake the enactment and enforcement of OHS regulations. The Ministry of Health and Medical Education (MHME) is responsible for enforcement of occupational health legislation, regulation, and standards. The Ministry of Labor and Social Affairs is accountable for enforcement of legal issues related to occupational and technical safety (IRIC, 1990; Vigeh et al., 2011). All employers obliged to provide safe equipments and facilities for employees, provide training for them to operate safely with the equipments, perform OHS measurements and inspections, and conduct health check-ups for employees (Jahangiri et al., 2016; IRIC, 1990). Companies having 50-499 employees obliged for establishment of a worker's health house to provide OHS services and first aid for employees (Jahangiri et al., 2016). The existing regulation obliged Iranian organizations to comply with the OHS regulations and legislations; however, it is not required to follow international standards and guidelines e.g., OHSAS 18001. Researchers discussed the improper enforcement of OHS regulation in developing countries (Giuffrida et al., 2002; Rosenstock et al., 2005) and it is identified as an important barrier to establish OHS in Iran (Arastoo et al., 2015).

1.2.2 Systemic approach

The concept of OHSMS has become common over the past three decades and a high number of organizations have implemented the requirements of various OHSMS standards and guidelines for the effective management of OHS worldwide (Robson et al., 2007). An OHSMS is a set of policies, strategies, practices,

procedures, roles, and functions to control OHS hazards and to minimize possible damage and losses in an adopted organization. It reflects the organization's commitment to OHS, and it is more than a paper system of OHS policies and procedures. The purpose of an OHSMS is to increase the awareness, understanding, motivation, and commitment of employees as well as a positive impact on their attitude and behaviors (Fernández-Muñiz et al., 2007).

The main purpose of an OHSMS is the identification of occupational injury sources in the production process and application of countermeasures before the occurrence of injuries (Zanko & Dawson, 2012). It also aims to continuously improve the OHS performance (Rocha, 2010). An OHSMS reflects the perception of employees about the importance of OHS in an adopting organization (Bottani et al., 2009). An OHSMS is an aspect of the overall management function regarding OHS (Santos-Reyes & Santos-Reyes, 2002). A safety management system focuses on the commitment of management to safety and the involvement of employees in the management of safety through training, information sharing, and participation in safety-related decisions (Hadjimanolis & Boustras, 2013). The OHSMS-adopting organizations can easily comply with the relevant OHS legislation (Fernández-Muñiz et al., 2009). Hsu et al. (2010) have specified three main characteristic of an OHSMS as systematic (activities of the system are in accordance with a pre-determined plan, and apply in a consistent manner throughout the organization), proactive (emphasizing prevention of adverse events before their occurrence, through hazards identification and risk control and mitigation measures), and explicit (the adopting organization visibly document safety management activities, and they perform independently from other management activities).

A key purpose of an OHSMS is to develop a systematic structure in an adopting organization to ultimately reduce OHS risks and to prevent the occurrence of unwanted events. The failure of an OHSMS to make these changes might be resulted from the lack of anticipation and control of all possible work situations; slowly adopting to changing situations or uncertainties due to the rigid, controlled, and complicated structures. Human errors of the personnel who involved in an

OHSMS activity can be associated with the failure of an OHSMS in an adopting organization (Wachter and Yorio, 2014).

The OHSMS certification is increasingly being used by organizations to document and develop conformance with applicable OHS legal obligations and the requirements of the adopting OHSMS standard or guideline. It also demonstrates an organization's management commitment to improving the safety performance (Granerud & Rocha, 2011; Santos et al., 2013). The certification is an important obligation for remaining competitive in manufacturing (Vinodkumar & Bhasi, 2011). Improvement of working conditions, ensuring compliance with regulations, notice to workers about the OHS risks and dangers at work identified as the main benefits of OHSMS certification in Portuguese small and medium enterprises (Santos et al., 2013). It is also identified that lack of adequate safety management system is associated with the occurrence of a great majority of industrial disasters (Vinodkumar & Bhasi, 2010).

The implementation of the requirements of an OHSMS standard or guideline in an organization triggers a learning process for improvements in OHS to undergone systematic safety controls and to design a benchmarking process (Rocha, 2010). Zanko and Dawson (2012) stated that it is difficult to operationalize an OHSMS in an organization. Based on the previous studies, the authors also identified the integration of OHSM into other business activities, commitment of management to safety, effective communication, employee involvement and consultation as main elements of an effective OHSMS. Fernández-Muñiz et al. (2009) concluded that well-developed OHSMSs in adopting organizations had a positive influence on the quality of the firm's products and services, productivity, customer satisfaction, the firm's reputation and image, and the firm's degree of innovation. It is also able to reduce the interrupts in an adopting organization due to undesirable incidents e.g., accidents.

In addition, the organizations which implemented the requirements of an OHSMS should combine the system with a genuine change of safety culture in order to avoid the existence of a paper system. Because such system unable to

improve safety performance (Fernández-Muñiz et al., 2007). According to the past studies, Rocha (2010) stated that implementation of an OHSMS had a significant impact on the reducing of direct health care costs and improved productivity. The application of an OHSMS also enables a company to develop policy statements and to perform risk assessments. In addition, the implementation of the requirements of an OHSMS affects the different organizational groups to interact in the process and to learn from it that how to deal better with OHS problems.

1.2.2.1 Mandatory and voluntary OHSMS

Since the 1980s, the approach for management of safety in most western economies was changed from programmatic, reactive, and command-control perspective to a more self-regulatory model, proactive, and process-based management standards (Gunningham & Johnstone, 1999; Gallagher & Underhill, 2012). Therefore, the OHSMS approach has been the main international strategy for safety improvement in workplaces (Frick et al., 2000). Mandatory and voluntary OHSMSs are mainly differed in their specifications to manage the OHS. Regulations of mandatory OHSMSs are public politics codified into laws that aim to protect employees from OHS risk by employers. The ultimate objective of these OHSMSs is a no risk workplace and defined by OHS results. Labor inspectorate supervised these OHSMSs and ultimately decided in a court. Voluntarily OHSMSs are managed through correct procedures and verified by audits and certificates (Frick, 2011).

Despite the considerable acceptance of OHSMS to manage OHS in a systematic way worldwide, some authors criticized the use of OHSMS. They claimed that the implementation of the requirements of an OHSMS standard or guideline in a company is incompatible with genuine employee engagement in OHS activities and will lead to the bureaucratization of OHS issues. It can hide OHS problems from viewing, mislead the adopted organization into understanding that OHS is managed in an effective way, and divert the efforts and resources of an adopting company away from OHS towards the OHSMS itself. Adopting organizations

cannot be used OHSMS as substitutes for OHS regulation (Rocha, 2010). Criticisms for mandatory OHSMSs are being too bureaucratic, which results in excessive high administrative costs for employers. It has been reported the lack of compliance with OHS regulations. The voluntary OHSMSs have been criticized for reducing the scope of systems to safety. The voluntary OHSMSs mostly sold on the market. The regulated OHS cannot replace with voluntary OHSMSs (Frick 2011). According to prior studies, Podgorski (2015) stated that voluntary OHSMS models are too formal, frequently bureaucratic, and paperwork-intensive. The compliance of OHSMS models is checked through auditing that conducted by certification bodies based on the models' requirements, but they did not assess the OHS performance of these systems.

1.2.2.2 OHSAS 18001

Several OHSMS standards and guidelines published in recent decades. The number of OHSMS-adopting enterprises has also increased worldwide, especially after the publication of the OHSAS 18001 standard in 1999 (Frick, 2011). OHSAS 18001 is a worldwide-recognized OHSMS that formulated by international certifying bodies based on a British standard (BS 8800) (BSI, 2007). This BS standard as an international guideline document provides a common specification for any type of companies to comply with the requirements of an OHSMS. The main objective of this standard is minimizing OHS risks and assuring the protection of human resources. The requirements of the OHSAS 18001 standard are based on Plan, Do, Check, Act (PDCA) cycle, and this feature makes it more compatible with other international standards, e.g., ISO 9001 and ISO 14001 (De Oliveira, 2013).

OHSAS 18001 establishes a framework to consistently identify and control OHS risks, decrease the probability of workplace accidents, assist compliance with applicable OHS legislations, facilitate the management of OHS risks and enhance overall performance in adopting firms (Fernández-Muñiz et al., 2012b). The OHSAS 18001 standard offers a good framework for improvement of safety performance in organizations. It is directed to control the OHS risks in adopting

organizations in a proactive way and improve the organizations' OHS performance (Vinodkumar & Bhasi, 2011). The implementation of the requirements of the OHSAS 18001 standard is a valid mechanism for improving safety conditions and business performance in the adopting workplace (Abad, et al., 2013). The study of Hohnen and Hasle (2011) in a large Danish manufacturing business revealed that the certification by OHSAS 18001 creates and promotes an auditable work environment.

If a voluntary OHSMS e.g., OHSAS 18001 design and implement in an appropriate way, it can improve the safety performance (Fan & Lo, 2012). According to the past studies, De Oliveira (2013) listed the main challenges for the implementation of OHSAS 18001 in organizations. They include low educational levels of workers, complexity of procedures and instructions, internal communication failures, low involvement by other sectors, lack of performance indicators, allocation of the responsibility of the OHSMS to the health or safety department alone, lack of management commitment, low awareness indices among workers, failure to establish safety and health as a strategic objective, and low involvement by the human resources area in training efforts. The study of Chen et al. (2009) stressed on the role of top management commitment to provide the necessary financial resources in the successful implementation of OHSAS 18001. It concluded that decisions for the implementation of OHSAS 18001 in Taiwan Printed Circuit Board (PCB) manufactures affected by domestic and foreign customer requirement, improvement of company image, and top management requirement. These authors also identified the top management promises and supports as a key factor for successful implementation of OHSAS 18001.

The study of Fan and Lo (2012) in 44 textile and fashion businesses revealed that the OHSAS 18001 adopting firms showed a significantly higher rate of sales growth. Lo et al. (2011) found that management systems such as OHSAS 18001 *inter alia* were not correlated with the certified company's financial performance in 193 Chinese manufacturing organizations when the reason for adaptation is customer pressure. The study of Abad et al. (2013) in Spanish OHSAS 18001-

certified companies revealed that these companies were more likely to exhibit better safety outcomes and higher performance compared to non-certified firms. Nevertheless, empirical evidence examining the relation between OHSAS 18001 certification, safety outcomes, and business performance provides inconclusive results.

Vinodkumar and Bhasi (2011) studied the safety management practices in eight chemical businesses in India. They found that employees in firms with OHSAS 18001 had the highest level of safety management practices and a better self-reported safety behavior compared with employees working in non-OHSAS firms. In 131 OHSAS-certified companies in Spain, Fernández-Muñiz et al. (2012a) indicated that the senior management commitment and communication positively influenced the safety performance (safety behavior, employee satisfaction, and business competitiveness).

1.2.3 Effectiveness of an OHSMS

Organizations typically implement safety interventions such as OHSMS *inter alia* to achieve OHS goals. These organizations should consider efficiency 'do things right' and effectiveness 'do the right things' of it. The efficiency refers to obtaining the best safety performance from applying available resources. The effectiveness is the extent to which safety objectives are achieved (Aksorn & Hadikusumo, 2008). Further, effect is any changes which take place due to implementation of a safety measure in a workplace (adopted from Oxford dictionary). Most of OHSMSs aim to prevent occupational injuries and illnesses, but the objectives in paper differ from practice (Frick, 2011). Robson et al. (2007) did not find a clear indication in their systematic review to make a clear conclusion in favor or against the implementation of a mandatory or voluntary OHSMS. Based on the study of Gardner (2000) that showed the failure rate of quality management systems ranging from 67% to 93%, Robson et al. (2007) expected that the failure rate of OHSMSs would be at least as high. Therefore, the implementation of an OHSMS in an organization does not guarantee the improvement of safety performance.

The level of OHSMS effectiveness depends on the commitment of all levels of an organization, especially the top management, management promises and support, employee involvement, how the adopting organizations implement the requirements of the standard, the features of the interested enterprises, and the external environment (Gallagher, 2000; LaMontagne, Barbeau et al., 2004; BSI, 2007; Robson et al., 2007; Chen et al., 2009; Fernández-Muñiz et al., 2012a). In addition, factors such as training, communication, preventive and emergency planning, the monitoring and review of the activities, the degree of OHSMS implementation, the features of the employed OHSMS, financial resources, the number of employees available to perform OHS activities, and the maintenance of the system affect the effectiveness of an OHSMS in an organization (Gallagher, 2000; Bluff, 2003; Fernández-Muñiz et al., 2009; 2012a).

A good OHSMS must be integrated into day-to-day operations of an adopting organization. The preventive approach in OHSMS must be more organizational and strategic due to the significant role of the human component in the causal chain of accidents occurred in a workplace. The improvement of an OHSMS should be regarded as means of creating awareness, understanding, motivation and commitment among all personnel, who worked in an organization (Fernández-Muñiz et al., 2009). It seems that the characteristics of an adopting organization impact the successfulness of an OHSMS. The implementation and development of an OHSMS are demanding for both individuals and organizations. The sustained partnership, extensive training and support, and organizational receptivity to change are necessary to have a successful OHSMS (Rocha, 2010). An OHSMS identified as a social system and the success of it rely on the employees who operate the OHSMS. The scope of an implemented OHSMS, the knowledge of employees about it, and the commitment of them to operate the requirements of the OHSMS can impact the success of an OHSMS (Lee & Harrison, 2000).

According to the earlier studies, Abad et al. (2013) categorized the drivers of the adaptation to the requirements of an OHSMS standard or guideline into two external and internal factors. External factors include complying with suppliers'

demands, strengthen relations with different stakeholders, OHSMS certification as a market signal for entry into new markets, customers' requirements, and by top management decisions related to the improvement of corporate image. The authors stated that the reduction of occupational accidents and the increase of productivity were not found as affecting factors for the adaptation with an OHSMS. The internal influencing factors include the introduction of a preventive safety framework to control OHS risks, the declining number of accidents and their economic costs, decreasing material losses and interruptions in the production process, and improvement of the well-being of employees. The functioning of an OHSMS and mechanisms of enforcement for OHS used by an OHSMS' adopting organization is also influencing the performance of safety (Rocha, 2010).

1.2.4 Measurement of OHSMS' effectiveness

The effectiveness assessment of OHS interventions will help organizations to determine whether they have used their resources to achieve OHS objectives. The ultimate aim of organizations in conducting the interventions is the prevention of occupational injuries and diseases (Rivara & Thompson, 2000). Organizations attempt to apply prevention strategies in an effective way; however, some enterprises do not measure their effectiveness. Frick (2011) stated that the monitoring of OHS outcomes is essential in OHSMS' effectiveness studies to determine whether the management system is effective in practice. Robson et al. (2007) identified that researchers commonly interested to evaluate the quality of OHSMSs through using the safety performance measures associated with intermediate outcomes such as safety climate and safety behaviors.

Several factors, including employee participation in safety activities, safety training, the commitment of managers and their involvement in safety, as well as good communication between managers and employees are related to lower rates of occupational injuries in organizations. The organizations with low OIRs typically investigate their accidents, have good recordkeeping and reward systems, use safety rules and procedures to perform activities in a safe manner, and employ a

feedback system for safety management practices that affect the safety performance. Hazard identification, machine guarding, the existence of a safety committee, housekeeping, and the supply of personal protective equipment enhances the safety performance in workplaces (Harper et al., 1996; Shannon et al., 1997; Bentley & Haslam, 2001; Mearns et al., 2003; Vinodkumar & Bhasi, 2011). National regulation and management systems also influence the safety performance (Kjellén, 2012).

The evaluation of safety performance in an adopting organization is one of the important requirements of OHSMSs such as OHSAS 18001 that provides useful information about the quality of the system (BSI 2007; Sgourou et al., 2010). An organization certified by OHSAS 18001 should employ an adequate level of safety management and a positive safety culture in order to achieve a satisfactory safety performance, and which reflects the visible commitment of management to safety (Vecchio-Sadus & Griffiths, 2004; Van den Berghe et al., 2006). Previous studies indicated that the effective safety management depends on the existing safety culture of an organization and on safety management practices considered as indicators for safety culture of the upper management (Kennedy & Kirwan, 1998; Mearns et al., 2003). Moreover, the existence of a positive safety culture has demonstrated a positive influence on safety performance in many industrial settings (O'Toole, 2002).

Safety performance is traditionally evaluated through the application of statistical methods for the analysis of accident and injury data. The indicators of accidents or injuries include the number, frequency, severity, rates, and their costs that are usually referred as lagging (retrospective) indicators. These indicators focus on safety outcomes and measure the failures of safety programs. Recently, leading (prospective) indicators such as safety audits, hazard analysis, and safety climate have been applied by OHSMS adopting organizations to measure the success of a system (Cooper & Phillips, 2004; Yule et al., 2007; Ma & Yuan, 2009). Safety climate typically employs as a leading indicator for assessing of safety performance in organizations. Of course, Kongsvik et al. (2011) found it as both

lagging and leading indicators. Although, it is common to separately employ the lagging and leading indicators for measurement of safety performance, Cooper & Phillips (2004) suggested the application of a combination of these indicators for measuring the impacts of safety programs on an organization. Hohnen and Hasle (2011) stated that it is necessary to evaluate a certified management system through the application of scale estimation in work environments and the qualitative assessment of the influence of an OHSMS. Certified organizations usually apply the quantitative results of audits to measure the performance of an implemented OHSMS (Robson et al., 2010).

A certified organization should apply systematic means to achieve and maintain a high level of safety performance (Obadia et al., 2007). The evaluation of safety management factors is a preferred approach for the assessment of safety performance, and provides information regarding failures of ongoing safety programs prior to the occurrence of an accident (Tinmannsvik & Hovden, 2003). Application of an active monitoring system can measure the success of a certified management system before accidents occur and can reinforce the achievement of the organization in a positive way (Teo & Ling, 2006). Failure to conduct the proper analysis of safety performance in a certified organization may ignore the existing shortcomings of the system and lead to the occurrence of adverse events.
Despite the numerous advantages of safety performance assessment in certified organizations, some certified companies failed to conduct a proper evaluation of safety performance (Chang & Liang, 2009). OHSAS 18001-certified companies should evaluate the safety performance of their systems internally and externally. However, some fail to conduct proper evaluations and few studies have examined the effectiveness of OHSAS 18001 interventions. In their systematic review, Robson et al. (2007) identified a small number of studies on OHSMS interventions that showed positive effects on safety climate and injury rates in organizations. The study of Chen et al. (2009) in PCB manufactures in Taiwan showed that poor personnel cooperation, increased equipment investment, and difficulties in selecting performance indicators were the key influencing failure factors thorough

the of OHSAS 18001. Chang and Liang (2009) stated that most of the OHSAS 18001-certified organizations in Taiwan had compliances regarding the increases of paperwork, cost, and the workload of OHS. These companies weakly follow the certification and inappropriately evaluate the safety performance. In addition, several authors criticized the application of lagging indicators due to shortcomings such as under-reporting and measuring the system failures without disclosing cause-effect relationships of these indicators (Cooper & Phillips, 2004). Furthermore, Hopkins (2000) advised that an OHSMS audit does not guarantee the expected level of safety in a certified organization. Despite the interest of most organizations in implementing the requirements of an OHSMS, there is no clear consensus on its effectiveness (Goh & Chua, 2013).

1.2.4.1 Occupational injury

ISSO (2011) defines occupational accidents as those accidents that occur for an insured person while working in a workplace, being in a mission assigned by employer, attempting to rescue other injured persons, commuting from home to work or vice versa (ISSO, 2011). Iranian companies usually register sever occupational injuries that occur during work hours resulting more than three days away from work. The rate of injury reduction is an important indicator for the measurement of intervention effectiveness, and it is the principal criterion for OHSMS success (Gallagher, 2000). This measurement can be carried out using a quantitative measure as well as by determining the association between an interventional program and the injury rate (Iyer et al., 2005; Robson et al., 2007). Therefore, the measurement of safety performance enables organizations to become aware of the effectiveness of implemented interventions such as OHSAS 18001 in improving the safety performance level.

Furthermore, a limited number of investigations have considered OHSMS effectiveness in reducing occupational injury (LaMontagne et al., 2004; Robson et al., 2007; Fan & Lo, 2012). Past studies have found that an OHSMS has a positive and direct effect on decreasing the injury rates in organizations (O'Toole, 2002;

Fernández-Muñiz et al., 2007). Further, Vinodkumar and Bhasi (2011) stated that organizations certified with OHSAS 18001 had better safety management practices and fewer accidents. Bottani et al. (2009) found that safety management system adaptors experienced substantially lower accident rates. The development of an OHSMS is also an important factor in reducing occupational injuries. Likewise, Fernández-Muñiz et al. (2009) indicated that organizations with more developed systems experience a lower number and severity of injuries.

In contrast, some authors have claimed that OHSMS interventions are not effective enough. Eisner and Leger (1988) demonstrated that the international safety rating system (ISRS) was not effective in the improving safety and decreasing the fatality rate in South African mines. Frick (2011) stated that the ISRS does not significantly correlate with fatalities and reported accidents. The European agency for safety and health at work studied the effects of OHSMSs in 11 companies around Europe. The number of occupational accidents decreased in five companies after the implementation of an OHSMS and increased in one of the firms (EASHW 2002). Frick and Kempa (2011) stated that the implementation of an OHSMS in an organization will not guarantee the prevention of severe occupational accidents, and they pointed out the occurrence of an accident in a Swedish company with a fatal outcome and a large explosion in Esso plant as examples.

1.2.4.2 Safety climate

An effective OHSMS results from the combination of the system structure and the safety culture of an adopting organization (Santos-Reyes & Santos-Reyes, 2002). An OHSMS adopting organization must pay attention to human factors as system components and create a positive safety climate in which every employee is convinced of the importance of safety acts accordingly (Fernández-Muñiz et al., 2012a). Safety climate is an important leading indicator that reflects the safety performance of an organization. This also has employed to predict the safety-related outcomes such as safety behavior and occupational accidents/injuries

(Meliá et al., 2008; Olsen, 2010). However, few studies have investigated the effect of safety climate in OHSAS 18001-certified companies (Fernández-Muñiz et al., 2012a).

Earlier studies found that the frequent dimensions of safety climate include management commitment to safety, employee involvement, safety communication, safety training, safety systems (e.g. compliance), risk, competence, work pressure, procedures and rules, supportive and supervisory environment (Flin et al., 2000; Rundmo & Hale 2003; Seo et al., 2004; Evans et al., 2007; Guldenmund, 2007). However, still there is no consensus regarding safety climate dimensions among researchers.

Safety climate is distinct from safety culture, and it is a more preferred measure to assess the safety performance of an organization (Seo et al., 2004). Safety climate considered as a sub-constituent or superficial characteristic of safety culture, defined as a snapshot of safety culture, and emphasized on employees' shared perceptions concerning to the safety management (Tharaldsen et al., 2008; Zohar, 2008; Lu & Yang, 2011). Safety climate typically measures using a questionnaire that designed to ask questions from active employees in an organization regarding their top managers' commitment to safety (Guldenmund, 2000; DeJoy et al., 2004; Tharaldsen et al., 2008). However, safety culture is a deeper phenomenon that reflects an organization' values, norms, beliefs, expectations and assumptions regarding safety (Flin et al., 2000; Salminen & Seppälä, 2005; Tharaldsen et al., 2008). Safety culture measures by the application of qualitative methods such as performing interviews with employees and safety audit (Tharaldsen et al., 2008). This kind of evaluation does not only need more time, but also difficult to conduct.

Researchers have studied the association between safety climate and safety performance in various industries (Zohar, 1980; Mearns et al., 2003; Yule et al., 2007; Ma & Yuan, 2009; Allen et al., 2010). This interest especially increased after introducing safety management systems to study the role of safety climate in the prevention of occupational accidents/injuries (Hahn & Murphy, 2008). They found

that positive level of safety climate is correlated with accident rates (Varonen & Mattila, 2000; Yule et al., 2007; Ma & Yuan, 2009; Allen et al., 2010; Huang et al., 2010). Other researchers applied safety climate scores to predict safety outcomes such as accident/injury rates and safety behavior (Meliá et al., 2008; Olsen, 2010).

Earlier studies suggest that safety climate is linked to organizational and individual factors in various industries. O'Toole (2002) indicated that the implementation of organizational safety interventions resulted in changes in the safety climate. Ma and Yuan (2009) claimed that the improvement of workplace safety in any type of industries depends on the safety climate. DeJoy et al. (2004) demonstrated that adopting with the elements of a safety management system such as safety policies and programs, communication, and organizational support enhance the safety climate. Fernández-Muñiz et al. (2012a) suggested that it is necessary for OHSAS 18001-certified companies to have a satisfactory level of safety climate in their workplaces to achieve the goal of zero accidents. They also emphasized the importance of communication and management commitment. A review of 13 empirical OHSMS studies by Robson et al. (2007) revealed that the safety climate improvement was evidence for the effectiveness of the voluntary OHSMS interventions. However, those authors did not find enough evidence in their review to make a clear conclusion for or against the implementation of voluntary or mandatory OHSMSs. DeJoy et al. (2010) found that OHS policies and programs have a positive effect on safety climate and organizational commitment in a large US retailer. According to the past studies, Yule et al. (2007) stated that employee perceptions of safety climate directly and indirectly associated with safety outcomes. The above mentioned studies generally suggest that a positive safety climate is an important organizational asset and it can influence the safety performance of an organization.

1.2.4.3 Safety practices

The integration of an OHSMS into the daily practices of an adopting organization and the encouragement of employees to involve in OHS practices is necessary to

achieve an effective system (Fernández-Muñiz et al., 2007). Researchers found that the effective safety management depends on the existing safety culture and on safety management practices in an organization (Kennedy & Kirwan, 1998; Mearns et al., 2003). The safety culture reflects the observable practices that conducted by all organizational members towards improving OHS on a daily basis (Vecchio-Sadus & Griffiths, 2004). The study of Vinodkumar and Bhasi (2011) in India found the highest level of safety management practices and better self-reported safety behaviors for employees in firms with OHSAS 18001 compared with employees working in non-OHSAS firms.

Audit is one of the important elements of an OHSMS (Cox, 1996). The international Standards Organization (ISO) defines an audit as "systematic, independent, and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which audit criteria are fulfilled" (ISO, 2003). The safety audit is a structured process whereby required information is gathered regarding the efficiency, effectiveness, and reliability of an OHSMS to identify potential OHS problems and new plans is formulated for conducting corrective actions (HSE, 1997). It is also a significant way for the evaluation of the effectiveness of a certified system. Herrero et al. (2002) suggested the application of audit to a more precise measurement of the actions performed by top management in an organization. Two types of audit may apply in OHSAS 18001-certified organizations. The first approach referred as compliance audit and evaluates the conformance level of a certified system with the audit criteria. Another approach is the auditing for continuous improvement. This approach provides recommendations and suggestions for the improvement of a certified system in addition to the conformance assessment with the OHSAS 18001 requisites (Power & Terziovski, 2007; Fernández-Muñiz et al., 2012b).

Prior studies have identified the failures of an auditing process that should be considered during the audit process to increase the reliability of an audit. These failures include errors or intended fraud by the auditor, undue influence arising from the financial interest of auditor in a company, improper influence caused by

personal auditor-client relationships, lack of employee involvement in the auditing process; paperwork in the company due to the audit; unintended goal displacement of audit scoring; the confusion of OHSMS audit criteria, and inadequate independence and skill of OHSMS auditor (Tackett et al., 2004; Blewett & O'Keeffe, 2011). These failures show that conducting an audit cannot guarantee the existence of a high-quality system and a good safety performance in an OHSAS 18001-adopting organization. A good example is the occurrence of catastrophic accident reported by Hopkins in 2000. Thus, the utilization of a policy by the accreditation bodies for checking the quality of OHSAS 18001 audits conducted by Certifying Bodies (CBs) could identify the shortcomings of the audit process and help to increase their quality.

2 Aims of the present study

The overall aim of this study was to investigate the status of systematic safety management in OHSAS 18001-certified companies, the effect of OHSAS 18001 certification on the OIR, safety climate, and OHS practices in the certified companies compared to a group of companies that implemented the requirements of the OHSAS 18001 standard, and to explore the facilitators and barriers of maintenance and improvement of OHSAS 18001' effectiveness in the certified companies.

The four sub-studies forming this thesis include the following research questions:

- Is OHSAS 18001 had an effect on the OIR in OHSAS 18001-certified companies compared with a group of companies that had not implemented OHSAS 18001? (Sub-Study I)
- How to develop a safety climate scale specific to Iranian manufacturing companies? (Sub-Study II)
- Is OHSAS 18001 had an influence on safety climate in the companies? (Sub-Study II)
- Are there differences between the certified and the companies that had not implemented OHSAS 18001 in regard to the average OHS practices? (Sub-Study III)
- What is the compliance level of OHSMS in the certified companies comparing with the OHSAS 18001 standard? (Sub-Study III)
- What are the influencing factors, barriers, and facilitators of OHSAS 18001' effectiveness in the certified companies? (Sub-Study IV)

3 Methods

3.1 Overall study design

The present study was conducted in six manufacturing companies and consisted of four sub-studies. The first and second sub-studies applied quantitative methods and evaluated the safety performance in three certified companies, which implemented the requirements of the OHSAS 18001 standard and were certified by a CB compared to three companies that had not implemented the standard requirements in their sites through the assessment of occupational injury and safety climate. The third sub-study performed in all six companies and used both quantitative and qualitative methods. The fourth sub-study used qualitative data and conducted in the certified companies. The written permissions have gotten from the companies to conduct this study. Table 1 shows overall information about the companies, participants, measures, and the statistical analyses used in each sub-study. Different study designs and information used in the sub-studies. Figure 1 presents the design of sub-studies and source of information.

Table 1. General information about the sub-studies of the present study

Sub-studies	Participants	Measures	Statistical Analyses*
Sub-study I	Three OHSAS 18001-certified and three control companies	Occupational injury data	t-test Generalized linear mixed models (negative binomial) Repeated measures ANOVA
Sub-study II	A total of 24 OHS experts A total of 26 employees	Safety climate scale	Descriptive Statistics
	A total of 269 employees	Safety climate scale	Factor analysis (EFA and CFA)
	A total of 269 employees	Safety climate scale Demographic information form	t-test ANOVA Hierarchical regression
Sub-study III	Three OHSAS 18001-certified and three control companies	OHSAS 18001 audit checklist	Descriptive Statistics
		MISHA	t-test
	A total of key informants (n = 3), managers (n = 15), supervisors (n = 10), and workers (n = 40) from the all six companies	Interview guide	Content analysis
Sub-study IV	A total of 16 managers from the certified companies	Interview guide	Grounded Theory

* All statistical analyses were conducted using SPSS, and only AMOS was used to conduct CFA.

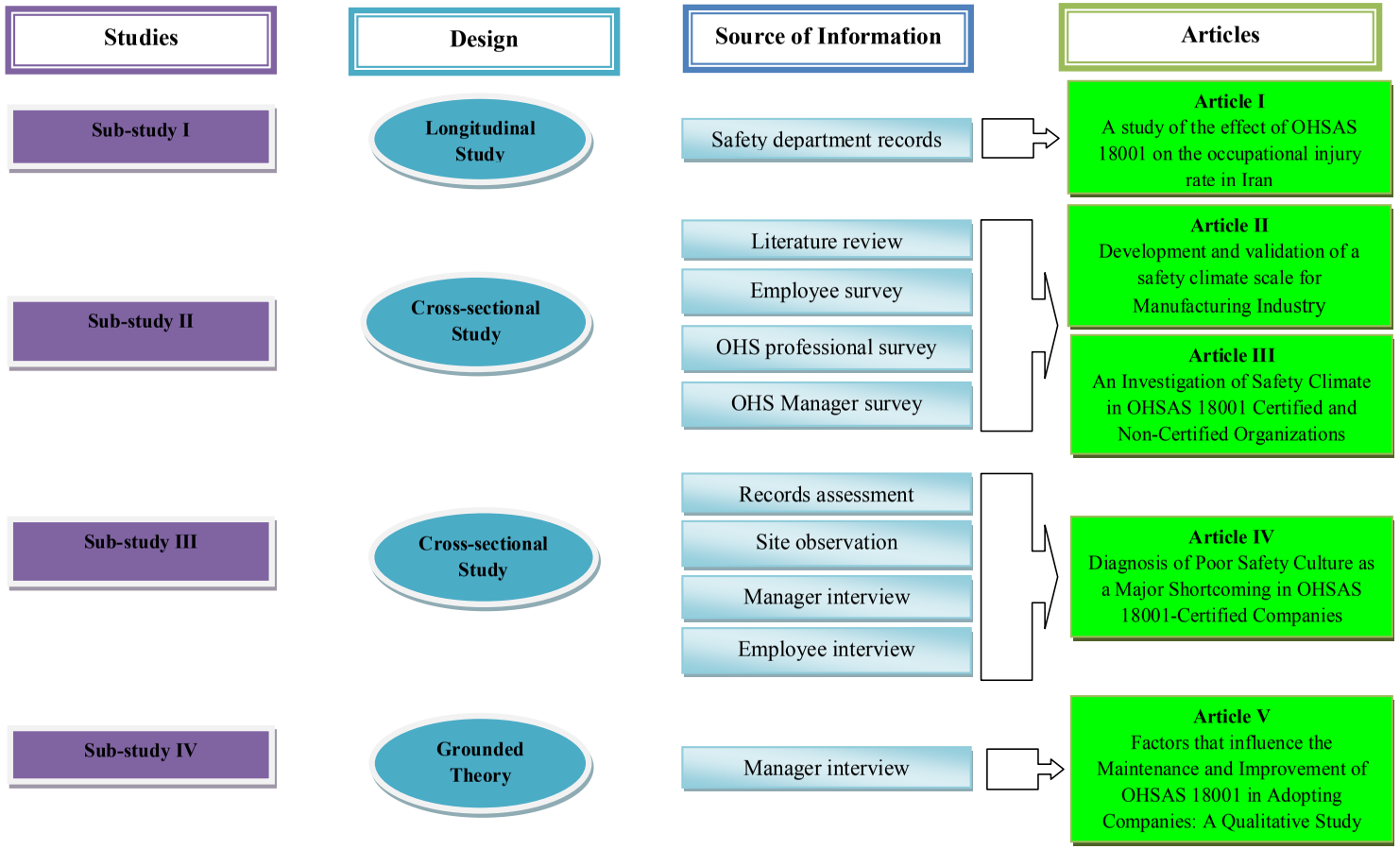

Figure 1. Study design and source of information

3.1.1 Companies and participants

Sub-Study I

The first sub-study conducted in six manufacturing companies. The companies were manufactures of beverages, chemical, and electrical products, as well as goods used in construction and agriculture. Table 2 provides information about the companies in sub-study 1. The occupational injury data were collected after getting permission from the companies.

Table 2. OHSAS 18001 certified year and average number of employees in the study

Companies	The year of certification	N
Certified 1	2002	427
Certified 2	2007	215
Certified 3	2002	208
Control 1	-	236
Control 2	-	140
Control 3	-	214

Sub-Study II

A total of 50 people (14 OHS faculty members, 10 OHS officers, and 26 employees) from the six companies participated in the employed content and face validity analyses of safety climate scale. The mean age of the faculty members was 40.7 (SD = 10.7), the OHS officers was 32.7 (SD = 7.00), and the employees was 35.5 (SD = 10). Another group of employees (n = 26) participated in the test-retest reliability analysis. The average age of this group was 41.85 (SD = 8.05) and the mean experience of them was 15.73 (SD = 7.65). A total of 269 employees participated in factor analysis and the examination of the effect of OHSAS 18001 implementation on safety climate. The mean age of the respondents was 37.63 years (SD = 7.01), and the mean working experience of them was 13.51 years (SD = 6.44).

Sub-Study III

This Sub-study consisted of two parts. The first part conducted in all six companies to compare the OHS practices between the certified and the control companies. The second part conducted in the certified companies to compare the OHSAS practices with the requirements of the OHSAS 18001 standard. A series of face-to-face interviews were conducted with key informants (n = 3) of OHSAS 18001 in the certified companies. In addition, a total of sixty-five people, including managers (n = 15), supervisors (n = 10), and randomly selected workers (n = 40) were shortly interviewed in the six companies.

Sub-Study IV

This Sub-study performed in the certified companies. A total of 16 managers (15 male and one female) from the companies participated in this Sub-study. All the participants participated in this study upon their personal acceptance.

3.1.2 Measures

Sub-study I

Occupational injury data were collected from the occupational injury documents in the workplaces for each year during 1999–2009. The OIR was calculated (annual number of occupational injury/ annual number of employees × 100) for each company. A t-test was used for before–after certification comparisons of the OIR. Generalized linear mixed modeling (negative binomial regression) was applied for comparisons of certified and non-certified years among both certified and all companies. Finally, a repeated measures analysis of variance (ANOVA) was employed to test the interaction between group (certified vs. control) and year (before vs. after certification).

Sub-study II

Safety climate scale development

A comprehensive literature review was conducted to find out the available safety climate questionnaires to the development of a safety climate scale. This review was resulted in a total of 662 safety climate items. After conducting a screening process for redundancy and general aim of our study, the number of items was reduced to 71. This preliminary scale translated to Farsi language (the official language in Iran). The OHS experts (faculty members and OHS officers) were asked to evaluate each item on three categories of 1) essential, 2) useful, but not essential, and 3) not necessary for examining the content validity in a quantitative way. Further, they were asked to write their comments about the ambiguity and clarity of the items for evaluation of face validity. The employees asked to rank each safety climate items for relevancy, clarity, and simplicity using four-point Likert-type arrangements. All items were rated on five-points Likert-type scales with phrases of strongly disagree and strongly agree on points 1 and 5 to conduct reliability analysis, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).

The final scale consisted of 45 items measuring seven safety climate dimensions. Internal consistency reliability for the final 45-item scale was 0.96 and for dimensions ranged from 0.63 to 0.93. The result of the test-retest reliability analysis showed that there is no difference between safety climate scores ($F_{(1, 25)} = 0.60$, $P > 0.05$), and the degree of reliability is high ($ICC = 0.93$). Figure 2 presents data flow for development and validation of safety climate scale.

Safety climate study

The developed scale was used to collect information about the employees' shared perceptions concerning to the safety management in the companies. All 45 safety climate items were rated on five points Likert-type scales with verbal phrases of strongly disagree, disagree, neutral, agree, and strongly agree from 1 to 5 points.

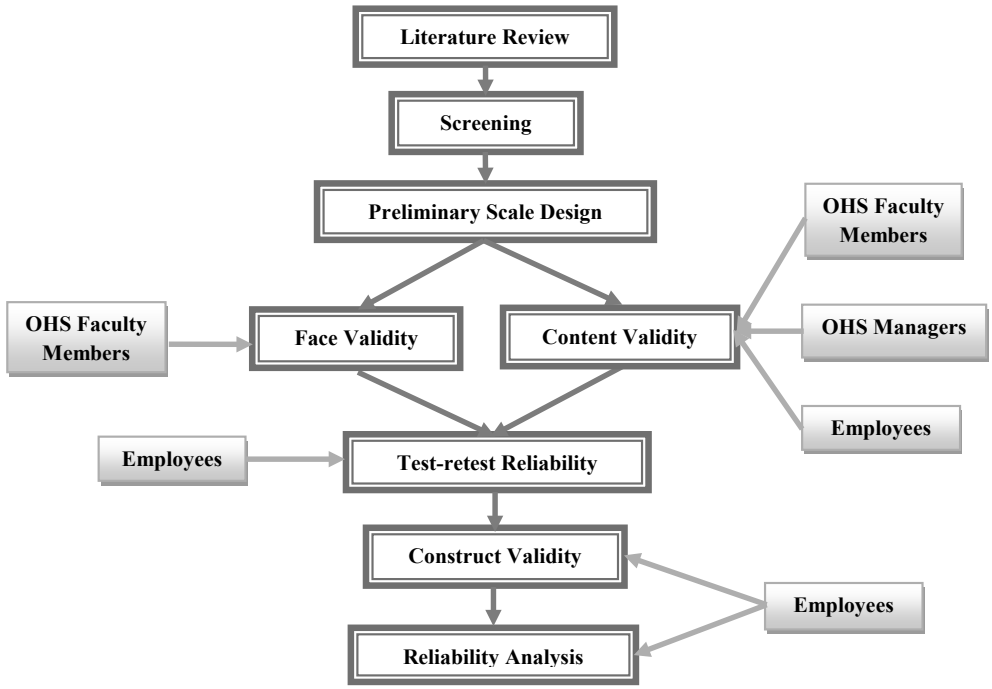

Figure 2. Data flow in safety climate scale development, validation, and reliability analysis

Sub-study III

The Method for Industrial Safety and Health activity Assessment (MISHA) was used to collect data regarding OHS practices in both certified and control companies in order to compare the OHS practices (Kuusisto, 2000). A checklist was prepared considering all requirements of the OHSAS 18001 standard (revision 2007) to collect data about OHSAS 18001 practices in the certified companies. Activity rates (*sum of scores for activity area / maximum available scores for activity area × 100*) were calculated for each element of the OHSAS 18001 standard, MISHA, and for total questions of the completed checklists (*sum of scores for activity areas / sum of maximum available scores for activity areas × 100*).

Sub-study IV

The face-to-face semi-structured interviews in Azerbaijani Turkish were conducted with the participants. An interview guide used for discovering the factors that can impact the effectiveness of OHSAS 18001.

4 Results

4.1 Comparison of OHSAS 18001-certified and control companies in terms of occupational injury (Sub-study I)

A series of statistical analysis conducted to compare occupational injuries in the companies. Descriptive analysis of the injury data indicated that the number of injuries in the certified (n=599) was higher than in the control (n=399) cohorts. The before–after analysis showed that one out of the three certified companies (certified 1) has a positive safety performance effect of the certification ($t_{(9)} = 5.74$, $P < 0.01$). A negative binomial regression indicated that the corrected model was significant ($F_{(9, 56)} = 10.32$, $p < 0.001$), and the workplace ($F_{(5, 56)} = 14.92$, $p < 0.001$) had significant effects on occupational injury for all 66 study years in the six companies. Further, occupational injuries were higher in certified 1 (β =1.27, CI=0.73-1.81, $p < 0.001$) during the pre-intervention years and the intervention year than during the certified years. Conducting the same analysis for the certified companies showed that the corrected model was significant ($F_{(6, 26)} = 9.51$, $p < 0.001$), and the workplace ($F_{(2, 26)} = 20.14$, $p < 0.001$) had significant effects on occupational injury. A negative binomial regression showed higher occupational injuries in certified 1 (β =1.62, CI=1.01-2.22, $p < 0.001$) during the non-certified years (pre-certified and non-certified) than the certified years when all 33 workplace years included. A repeated measures ANOVA was computed for five years (two years before, the intervention year, and two years after the intervention) in the certified cohort and the same years in paired companies from the control cohort. The interaction of the year and group did not reach a statistical significance ($F_{(1.03, 5.18)} = 1.42$, $P > 0.05$) indicating that the average OIRs did not change over the time in the certified versus control companies (Table 3).

Table 3. Means of the OIRs in the certified and the control companies

Companies	Pre-intervention	Intervention	Post-intervention
Certified 1	17.1	9.4	6.22
Certified 2	3.85	1.77	4.8
Certified 3	2.78	2.01	4.88
Control 1	9.75	5.83	4.8
Control 2	4.9	6.5	9.12
Control 3	7.12	4.19	4.31

4.2 Factor structure of safety climate in OHSAS 18001-certified and control companies (Sub-study II)

The safety climate scale developed through conducting a literature review about the safety climate. A question pool constructed, and the number of items was reduced to 71 after performing a screening process. The quantitative analysis of the content validity of the safety climate scales, which rated by the OHS experts showed that 61 of the 71 items (85.92%) had an excellent content validity. Therefore, 10 items removed from the scale and other two items deleted due to the unacceptable content validity by considering the result of scales rated by the employees. As a result, 12 items were removed from the initial scale, and 59 items retained.

The EFA used to identify the underlying dimensions of safety climate from the attributes that resulted in the retention of eight factors with 48 items. The final dimensions were identified as safety commitment and communication, safety involvement and training, positive safety practices, safety competency, safety procedures, accountability and responsibility, supportive environment, and safety prioritization. Safety prioritization removed from the final scale because of a low reliability. Therefore, the final scale consisted of seven factors including 45 items. The result of CFA showed that the model that previously identified by EFA is satisfactory.

4.3 Safety climate differences between OHSAS 18001-certified and control companies (Sub-study II)

The assessment of safety climate revealed that the personnel of the studied companies differed significantly in their perceptions of safety climate ($F_{(5,\ 257)} = 13.30$, $p < 0.01$), and the participants in one control company (control 2) reported a higher level of safety climate (3.77 ± 0.45, $p < 0.01$) than other companies. A hierarchical regression revealed that the models were statistically significant. The OHSAS 18001 implementation and safety training were significant predictors. However, the comparison of the certified and control companies revealed that safety climate level have not improved 4-9 years after certification $t_{(261)} = 0.08$, $p > 0.05$.

A descending order of the mean scores of safety climate dimensions was ranked as follows: safety procedures (3.75), safety competency (3.67), accountability and responsibility (3.39), safety commitment and communication (3.34), positive safety practices (3.25), supportive environment (3.16), in addition to safety involvement and training (2.95). The mean and standard deviation of safety climate dimensions in certified and control companies were presented in Table 4.

Table 4. Means and standard deviations of safety climate dimensions

Safety climate dimensions	Certified		control	
	Mean	SD	Mean	SD
Safety commitment and	3.37	0.71	3.28	0.92
Safety involvement and training	3.01	0.81	2.85	0.85
Positive safety practices	3.24	0.77	3.27	0.84
Safety competency	3.69	0.98	3.65	1.00
Safety procedures	3.76	0.71	3.74	0.83
Accountability and responsibility	3.38	0.78	3.40	0.87
Supportive environment	3.07	0.87	3.28	0.98

More than half of employees (52.5%) participated in safety training courses. Employees who received safety training had a better perception of safety climate than those who did not receive safety training ($t_{(261)} = 4.29$, $p < 0.01$). The case and the control companies significantly differed in terms of safety climate and its dimensions. Respondents who worked in the certified companies and received safety training reported a higher level of safety climate ($t_{(160)} = 4.40$, $p < 0.01$) and all safety climate dimensions than respondents who had not received safety training. The number of employees who received safety training in the certified companies was greater than in the control companies (60 / 40%).

More educated participants were better in accountability and responsibility ($F_{(3, 259)} = 3.32$, $p < 0.05$) and supportive environment ($F_{(3, 259)} = 5.10$, $p < 0.01$) compared to the participants who had a lower level of education. The occupational groups of the studied companies differ significantly in safety climate ($F_{(2, 260)} = 3.43$, $p < 0.05$) and its dimensions of safety commitment and communication ($F_{(2, 260)} = 3.93$, $p < 0.05$), safety involvement and training ($F_{(2, 260)} = 3.67$, $p < 0.05$), and positive safety practices ($F_{(2, 260)} = 4.57$, $p < 0.05$).

The numbers of employees who experienced accidents in the certified companies (n = 43, 26.54%) were higher than for the control companies (n = 17, 16.83%). There was no significant differences between the respondents reported that they had experienced at least one occupational accident within the past three years (22.8%) and the participants who had no accidents ($t_{(261)} = .89$, $p > 0.05$) on safety climate. The participants who worked for the certified companies and who experienced occupational accidents had a better perception of accountability and responsibility ($t_{(160)} = 2.18$, $p < 0.05$) than other respondents.

4.4 Comparison of OHSAS 18001-certified and control companies in terms of OHS practices (Sub-study III)

The comparison of the certified and the companies that had not implemented OHSAS 18001 using MISHA indicated a positive effect of certification on OHS practices ($t_{(4)} = 7.17$, $P < 0.01$). A descending order of the mean activity rates of the companies were ranked as follows: certified 1(53.93), certified 2 and 3 (42.42), control 2 (18.18), control 1 (12.12), and control 3 (9.69). The certified companies had better activity rates for all elements of MISHA comparing with the companies had not implemented OHSAS 18001.

The certified companies had the highest activity rates for organization and administration (m = 55.07) and the companies had not implemented OHSAS 18001 had the highest activity rates for work environment (m = 19.99). The activity rates of the follow-up element are the lowest one for all companies, particularly for the control companies. The control companies did not have a written safety policy and did not conduct any activity to follow-up the safety performance.

4.5 Compliance level of OHSAS 18001-certified companies with the requirements of the OHSAS 18001 standard

The assessment of activity rates for the main elements of OHSAS 18001 indicated that checking and OHS planning have the highest and lowest rates respectively. However, the companies fulfill about fifty percent of the requirements of the OHSAS 18001 standard in checking. Certified 1 has the highest, and certified 3 has the lowest activity

rates. The companies slightly differed in activity rates of the main elements of OHSAS 18001. They have identical rates for review, but certified 1 has a higher rate for OHS policy (Table 5). Detailed analysis of the activity rates for sub-elements of the OHSAS 18001 standard indicated that documentation has the highest, but the hazard identification, risk assessment, and determining controls' item has the lowest rates of activity. The rates of other sub-elements did not noticeably differ between the companies. The companies have identical rates for documentation, control of documents, control of records, and internal auditing.

Table 5. Activity rates for the OHSAS 18001 standard in the certified companies

	Certified 1	**Certified 2**	**Certified 3**
OHS Policy	61.11	50	48.15
Planning	43.81	40.95	40
Implementation and operation	52.91	49.58	50
Checking	55.26	52.63	53.07
Management review	48.71	48.71	48.71

The certified companies had considerably conducted hazard identification and risk assessment for recognition of unsafe conditions, but they had only slightly considered the behavior of employees in their workstations during such identifications. The presence of physical safety hazards such as improperly safeguarded machines, unsafe holes and obstacles in the surfaces showed that they had not suitably controlled such hazards. The companies documented a large number of procedures and instructions based on the requirements of the OHSAS 18001 standard; however, there were shortcomings in their implementation and maintenance. The procedures and instructions needed new revisions to safely perform job activities.

This study also identified gaps between actual practices and the existing documented procedures and safety instructions. The companies documented good procedures, but they had improperly implemented and maintained the requirements of the procedures. For instance, the procedure of hazard identification, risk assessment, and their controls in the companies required the identification of hazards and assessed the risks of all routine and non-routine activities. However, the companies did not conduct such identification for all non-routine job activities. There was also a lack of instructions for performing job activities in a safe manner. For example, two of the companies did not use a permit to work system for conducting high-risk job activities, and one of them only

applied hot and cold work permits for all high-risk jobs. Further, employees performed their job activities using their traditional methods not as exactly based on the provided instructions.

The evaluation of evidence gathered through the assessment of documents, site visits, and interviews indicated that the certified systems had problems in the implementation and the maintenance of the management system. The identified problems related to the presence of a poor safety culture include lack of management commitment, employee involvement and consultation, communication, and safety training.

4.6 Factors influencing the effectiveness of OHSAS 18001 (Sub-study IV)

The analysis of the data indicated eleven categories of factors influencing the effectiveness of OHSAS 18001. These categories include management commitment to safety, safety communication, employee involvement, integration, OHS training, safety culture, internal incentives, OHS enforcement, external incentives, OHS authority support, and OHSAS 18001 auditing. The categories were divided into two groups of factors related to inside and outside the organization. These factors can impact the OHSAS 18001-adopting companies during maintenance and improvement of the requirements of the standard. The detailed analysis of the data generated a model that was grounded in the data (Figure 3).

Factors inside the organization

Management commitment

The participants emphasized that the most important influencing factor on the effectiveness of OHSAS 18001 was senior management commitment to safety. They were satisfied with their senior managers' commitment to safety during the implementation of the requirements of the OHSAS 18001 standard. However, the managers' commitment decreased after the implementation and led to the existence of a superficial OHSMS in the companies.

Without the true commitment of a senior manager to safety, nothing can improve the OHS performance in an OHSAS 18001-certified company. The company performs OHS tasks in traditional ways and calls them as systematic. (Participant 13)

The participants stated that their top managers were not actively involved in the OHS and OHSAS 18001 practices. The specified tasks of the managers in OHSAS 18001 were entirely performed by their representatives in OHSAS. The interviewees also stated that individual engagement of senior managers in OHS and OHSAS 18001 practices can be a good way for improving the enthusiasm of employees to participate in the practices.

The practical meaning of the representative of the senior manager in our companies (in Iran) is that the senior managers do not have enough time for conducting their responsibilities in a management system; therefore, they appoint representatives to do their tasks in OHSMS. The managers assume that their management responsibilities in a certified company are separate from their responsibilities in a management system. (Participant 1)

The participants mentioned some situations that can be considered as evidence for the lack of senior managers' commitment to safety such as a lack of enough delegation of authorities to other managers, especially OHS managers; poor attitude of senior managers about OHSAS 18001 and safety; lack of priority to OHS compare with production; insufficient OHS knowledge of managers and employees, and inadequate financial support of the system. Senior managers did not ask other managers about their responsibilities in the system, and they did not try to determine the root causes of the existing shortcomings of OHSAS 18001 in the companies. Lack of top managers' commitment to the requirements of OHSAS 18001 was an obstacle to the effectiveness of OHSAS 18001 in improving the OHS performance.

A management representative in OHSAS 18001 receives power from the top manager. If the manager does not sincerely believe in the positive effect of the existence and improvement of the system, the management representative will not get enough authority to carry out his duties in the system. This situation can lead to an organization without a system for management of OHS. (Participant 1)

Top managers of Iranian organizations do not give enough priority to OHS compared with production. They look at OHS issues as minor issues in the companies. Creating a positive mindset for the managers about the effect of OHS will be a more effective way to improve the OHS and OHSAS 18001. (Participant 12)

Safety communication

The interviewees pointed out that there was a lack of internal and external safety communication in the companies. The managers who conducted the majority of OHSAS 18001 practices did not communicate and consult with employees about OHS issues. The internal communication procedure did not consult with and involve employees in OHSAS 18001 practices, such as hazard identification and risk assessment, incident investigation, and proposal and application of control measures in their workstations. Thus, employees did not understand their responsibilities in OHSAS 18001. Employees were not interested in communicating with their managers and supervisors about OHS issues, because they feared dismissal from the companies due to the lack of job security.

There is lack of communication between managers and employees in our company. The managers did not communicate with the employees about OHS/OHSAS 18001 practices that they are responsible to conduct them and did not share OHS information with the employees. The employees did not communicate with their managers and supervisors about existing OHS problems and questions. (Participant 4)

Employee involvement

According to the participants, the employees of the companies were not actively involved in OHS/OHSAS 18001 practices. The employees did not engage in crucial practices to minimize the OHS risks in the companies such as hazard identification and risk assessment. The OHS/OHSAS 18001 practices were not seen as routine activities by employees, because they were mainly performed by OHS officers. The interviewees identified employee engagement as an important factor in the transformation of documentation (mechanical system) to practice (operational system). One participant noted, "The practices of OHSAS 18001 are usually seen as extra work; therefore, we cannot expect a successful system in our company" (Participant 3). Another participant added further:

The implementation of the requirements of the OHSAS 18001 in a company creates a huge amount of documentation. The sole way to transform the written OHSAS 18001 procedures and OHS instructions to practical habits for employees is use of them in practice. Therefore, without involvement of employees in OHSAS 18001/OHS practices, the requirements of the OHSAS 18001 standard remain on paper. (Participant 13)

The interviewees pointed out the main obstacles to employee participation in OHS/OHSAS 18001 practices. These factors included inadequate knowledge about OHS/OHSAS 18001, a lack of familiarity with the need for participation in OHS, shortage of information about the positive impacts of OHS participation, a poor attitude about OHS/OHSAS 18001, insufficient motivation, and scant job satisfaction.

Integration

Participants raised the lack of integration of OHSAS 18001 throughout the process and organizational frameworks as another important barrier to create an effective management system. The interviewees explained that the employees of the organizations considered OHS/OHSAS 18001 practices as the duties of safety managers. The OHSAS 18001 practices were assumed as extra tasks compared with their routine work activities. There was a common viewpoint that the practices of the OHSAS 18001 were separate from their traditional (routine) activities in the companies even some years after the certification.

In most of the Iranian organizations, the practices of management systems were employed in such a way that personnel of a certified company presume them as separate actions from their routine activities. Therefore, they perform the routine tasks of their jobs and are not interested in performing tasks involved with OHS/OHSAS 18001 practices. (Participant 3)

They mentioned the point that the OHS/OHSAS 18001 practices were not performed on a daily basis. The companies mostly created the required documents a short time before external audits to prove the existence of required evidence to external auditors.

In our company, the majority of required documents were made one month before external audits. Unfortunately, OHS/OHSAS 18001 practices were not conducted daily because employees did not sincerely believe the importance of OHS and OHSAS for improving OHS performance. They also did not know why they had to carry out such practices. (Participant 14)

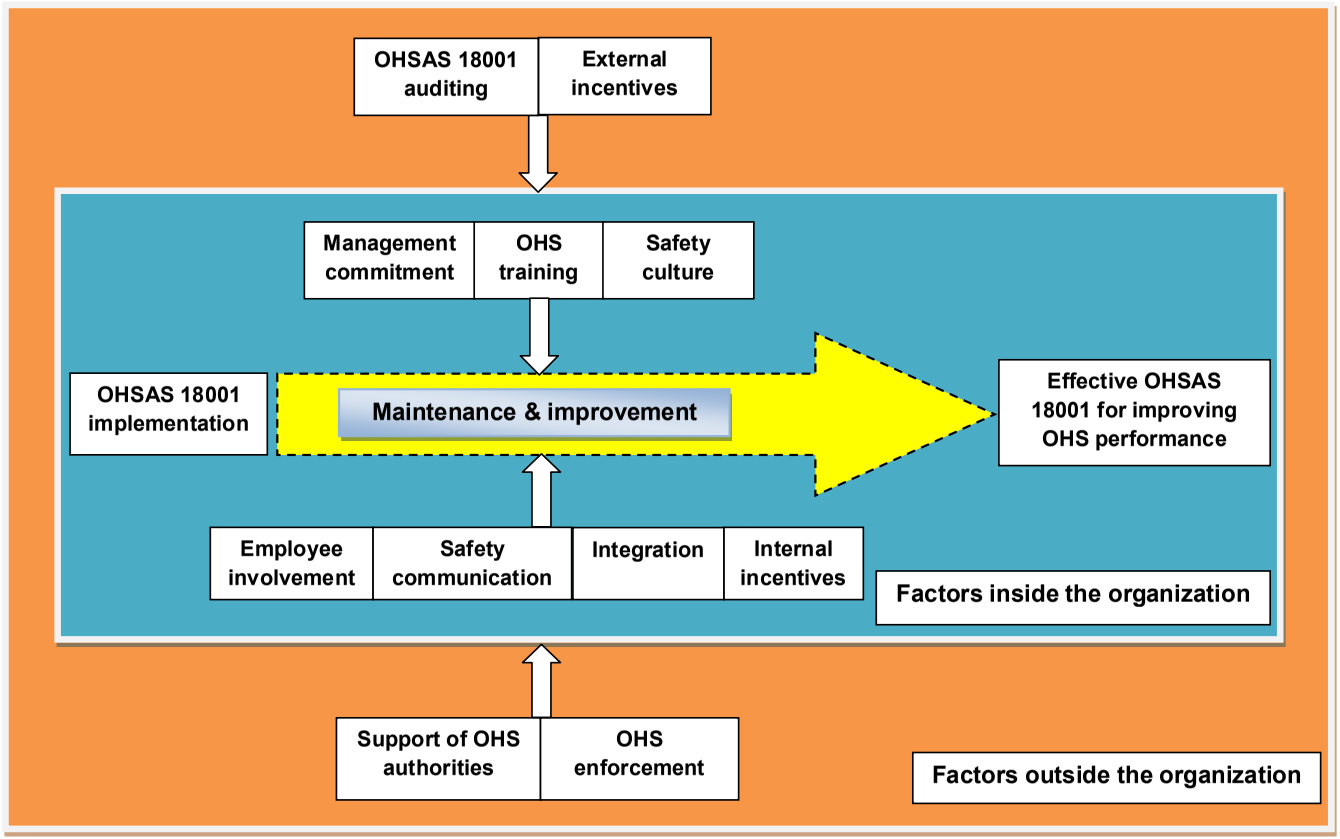

Figure 3. Model of factors influencing the effectiveness of OHSAS 18001

OHS training

Most of the participants emphasized that providing OHS training for employees could improve the effectiveness of OHSAS 18001. They stated that OHS training for employees is a continuous process. The use of different methods of training such as on/off the job training, provision of bulletins and videos, as well as displaying OHS posters can help employees to gain a better understanding of OHS. A lower level of workers' education was an obstacle to providing good safety training. In addition, the quality of safety training impacted the employees' attitude and behavior regarding OHS and OHSAS 18001. The interviewees stated that personnel of the companies usually know how they should carry out their responsibilities, but they do not know why they should perform them. One participant pointed out the role of high-quality safety training in the improvement of safety culture and its influence on the effectiveness of OHSAS 18001: "Personnel have to learn about why they conduct OHS/OHSAS 18001 practices. They should learn about the positive effects of OHS and OHSAS 18001 on their work and the company" (Participant 15).

Safety culture

The participants reported that the safety culture of an OHSAS 18001-adopting company influences the effectiveness of OHSAS 18001. Lack of practical efforts to improve the level of safety culture was an obstacle to the effectiveness of OHSAS 18001 and could lead to the existence of a paper-only system. They described how the companies can enhance the culture of safety.

The improvement of safety culture can be achieved through providing high-quality safety training and explanations of OHSAS 18001 procedures and instructions by all staff, especially the front-line employees. Otherwise, the system remains as a system only on paper and it is not used by employees in daily practice. (Participant 9)

The interviewees pointed out that the efforts conducted by an OHSAS 18001-adopting company can increase the level of safety culture and help to achieve a satisfactory safety performance. They also affirmed that the certification of OHSAS 18001 and the existence of procedures/instructions cannot alone automatically lead to

the improvement of OHS performance. One participant expressed an opinion about the need for a good safety culture in the companies:

It is impossible to observe and to supervise all employees every minute to ensure that they perform their practices in a safe manner. Therefore, it is essential to improve the level of safety culture to a point that every employee in a certified company thinks and behaves safely without the direct supervision of OHS officers; that is, they would be self-controlled. (Participant 7)

The participants stated that the implementation of OHSAS 18001 and certification by a CB are not difficult tasks. Whether managers and employees of a company be interested in implementing the requirements of the OHSAS18001 standard, they would eagerly conduct the OHSAS practices to achieve continuous improvement in OHS performance. This factor was stated as one of the important factors in the success of OHSAS 18001. More time is needed for the institutionalization of a positive safety culture, and more efforts must be made by personnel to replace unsafe behaviors with safe ones. One participant suggested:

The best time for the implementation of the requirements of the OHSAS 18001 standard is the time that the personnel of a company sincerely believe in the importance of the management system, and have an interest in practically implementing its requirements. The most difficult part of the task occurs during the time that a certified company wants to perform and maintain the requirements of the OHSAS 18001 standard in practice. (Participant 6)

The interviewees explained that the companies have extended only a low-level of effort regarding safety culture. They asserted that it may result from societal attitudes that place a lower priority on OHS, the managers' poor attitudes toward safety, managers' insufficient knowledge of the OHS, and lack of enforcement of OHS legislation in the society.

Internal incentives

The participants expressed the opinion that the application of incentive programs can motivate the employees to perform their OHS/OHSAS 18001 tasks safely. It can also impact the effectiveness of OHSAS 18001.

Incentive programs could be used to encourage the employees who give more value to OHS issues and who have the best performance in OHS to persuade other employees to eagerly perform the OHS/OHSAS 18001 practices. Our experience shows that incentives can make employees more motivated to uphold OHS. (Participant 5)

Factors outside the organization

OHS enforcement

The participants reported that there is a lot of OHS legislation on paper in Iran. However, the problem is related to the enforcement policy regarding the implementation of the requirements of the OHS legislation. They believe that the implementation of the legislation can help to improve OHS and OHSAS status in the adopting companies. The interviewees were concerned with the OHS inspections that were conducted by the OHS authorities. Sometimes, non-scientific suggestions of OHS inspectors negatively affect the company, particularly the top managers. The participants pointed out that external organizations e.g., the OHS authorities did not have any program for inspecting the quality of the implemented systems. They noted that the development of new programs for inspecting OHSAS 18001-adopting companies and for checking the quality of safety products such as personal protective equipment can help the OHSAS 18001-adopting companies to better maintain the system.

Enforcing OHS legislation and having a special program for conducting inspections in the OHSAS 18001-certified companies by the OHS authorities can be more useful for improving the effectiveness of OHSAS 18001 in the certified companies. (Participant 13)

OHS authorities, national standards organization or non-governmental organizations (NGOs) must inspect and control the quality and appropriateness of OHSAS 18001 in certified companies. Such inspections can lead to increasing the quality of OHSAS 18001 and preventing the existence of decorative systems in the certified companies. (Participant 2)

OHS authorities' support

Most of the respondents expressed that the OHS authorities' support for the OHSAS 18001-adopting companies can help to improve the system. These supports can include financial aid, OHS training, as well as providing guidance and consultation regarding OHS issues. The participants stated that the companies did not communicate enough or

communicate with the OHS authorities about their OHS problems or questions. The participants also stressed that the OHS training that is prepared by the authorities should use mass media, especially TV.

The OHS authorities must properly guide and make suggestions to companies about their OHS problems and questions. The support of the authorities to persuade the companies can include providing OHS training courses or videos, creating a consultation center to respond to OHS questions, and suggesting tax discounts and financial support for conducting OHS programs. (Participant 8)

Auditing

Most of the participants criticized the quality of third-party audits. They mentioned that there is a high number of CBs in Iran that compete to audit OHSAS 18001-adopting companies. The CBs conduct superficial audits in the certified companies. They lack technical knowledge of their auditors' qualifications concerning industrial processes and other special OHS related issues in the companies being audited. Sometimes consulting companies have been re-organized to work as CB companies. In certain cases, the external auditors missed auditing important elements of the OHSAS 18001 standard, such as the role of top management and its commitment to OHS in the companies. The participants described some cases in which the auditors made proposals for adopting companies to conduct their OHS training courses or their OHS measurements with a specific company with which they had work relations. Considering these proposed actions, they did not conduct a serious audit of an adopting company.

CB companies compete to persuade more organizations to implement the OHSAS 18001 standard and to certify implemented systems. Then they also try to encourage their customers to extend their agreements with the certified companies for future audits. Such situations influence the quality of their audits. Sometimes, it leads them to conduct a superficial audit in OHSAS 18001-adopting companies to certify or extend the certification period. Moreover, only later did the certified companies learn the manner in which the OHSAS 18001 auditors had conducted their audits. (Participant 10)

Iranian organizations usually implement the requirements of the OHSAS 18001 standard with the assistance of consulting companies. The companies help the organizations prepare their required procedures, instructions, and other documents based on the requirements of the standard. They also conduct training courses for the

personnel of the organizations so that they are familiar with the requirements of the standard or OHS issues. Some of the companies changed their activities and became CBs some years after they had worked as a consulting company.

In some cases, consultants of a company for the implementation of the requirements of the OHSAS 18001 standard who knew the shortcomings of the implemented system come along with a CB's auditing team to conduct an audit. Thus, auditors would only report minor non-conformities of the system, not the major ones. For example, I expected some major non-conformities in some external audits of our company that could result in the cancellation of the OHSAS 18001 certificate, but that did not occur possibly due to these previous activities. (Participant 16)

External incentives

According to the participants, the existence of incentive programs for the OHSAS 18001-certified companies that experienced a better OHS performance in a specified period can be a good motivator for other companies to place more value on the OHS. It can considerably impact the effectiveness of the OHSAS 18001 to improve OHS performance in the adopting companies. The participants did also point out the usefulness of an incentive program for quality and environmental management systems in Iran.

When a company had a good level of improvements in its OHS performance as audited by an external company (i.e., NGOs), it was motivated to increase efforts to improve the OHS performance. Other companies also learned about their success and were encouraged to take part in such competitions. (Participant 11)

The participants also pointed out other internal and external factors that can be considered as obstacles to the effectiveness of OHSAS 18001. These factors were the complexity of the implemented system, lack of job security for the employees who work for the companies, the unemployment rate, lack of human development, and economical problems.

The application of a high number of documents such as instructions and forms for the management of OHSAS 18001 practices in the times of implementation and improvement can lead to the existence of a complex system in an organization. (Participant 1)

5 Discussion

5.1 Comparison of OHSAS 18001-certified and control companies in terms of safety performance

According to the results of Sub-study I, the comparisons of the OIRs before and after the certification revealed that the OIR decreased in one of the certified companies (certified 1). A negative binomial regression for all 66 study years did not show a significant effect of OHSAS 18001 certification. Similarly, the application of a repeated measures ANOVA did not indicate a significant interaction between the certification group and the intervention. Therefore, the result of this Sub-study failed to show any effect of the certification. These findings do not support the previous research (Robson et al., 2007; Bottani et al., 2009; Vinodkumar & Bhasi, 2011), which indicated the reduction of OIR as a positive effect of OHSMS implementation. Further, the findings are in contrast with the ultimate aim of the OHSAS 18001 standard to provide a no risk workplace and to prevent occupational injuries (BSI, 2007; Frick, 2001). A possible explanation for this might be that the companies did not properly implement and maintain the requirements of OHSAS 18001 due to lack of management commitment and employee involvement. Another possible explanation for this is that the companies use the certification as a market signal to improve corporate image in marketing, and they did not efficiently use the OHSAS 18001 for managing OHS to improve safety performance. Since, safety culture of an organization is associated with behavior of employees and with accidents/injuries (Neal & Griffin, 2006), the inappropriate reduction of OIR in the certified companies might link with safety culture of the companies.

Considering the effect of OHSAS 18001-certification on the safety climate, a hierarchical regression revealed that the OHSAS implementation was a significant predictor of safety climate. However, the comparison of the certified and the control companies demonstrated that safety climate level has not improved 4-9 years after certification. The result of ANOVA indicated a significant differences in safety climate and its dimensions across the companies. The certified companies reported a higher level of safety commitment and communication, safety involvement and training, safety competency, and safety procedures than for the control companies. However, the participants of one of the control companies reported the highest level of safety climate

perception. The safety culture of an OHSAS 18001-certified organization is manifested in the safety climate and the implemented management system in the organization (Kennedy & Kirwan, 1998; Cooper, 2000; Mearns et al., 2003). The adaptation of proper tools to manage safety identified as key aspects of safety climate and improves the level of safety climate in an organization (Zohar 1980; Glendon & Stanton, 2000; DeJoy et al., 2004). Therefore, the certified companies did not adopt with the requirements of the OHSMS to improve the level of safety culture. The results also showed that the number of employees who received safety training in the certified companies was greater than for the control companies. Participation in safety training courses was found to be another significant predictor of safety climate, which suggests that this has an important role in the improvement of safety climate of certified organizations. These findings agree with the results of previous studies such as Lu and Shang (2005) and Wu et al. (2007) that found a significant relationship between safety climate and safety training. These findings strongly indicate that receiving safety training is an important factor that increases the employees' perceptions about safety climate in the certified companies. The highest values of safety climate in the second control company may associate with the high level of safety training activity (57%) for the same company.

According to the results of Sub-study III, the certified companies have a better OHS practices than the control companies. The analysis of the activity rates for main and sub-elements of the OHSAS 18001 standard indicated that checking and documentation have the highest, but OHS planning and hazard identification, risk assessment and determining controls have the lowest rates of activity. Certified 1 has the highest activity rate in both analyses. The certified companies only fulfill about fifty percent of the requirements of the OHSAS 18001 standard in the checking element. They prepared a large number of documents that were required by the OHSAS 18001 standard. It is evident that the number of documents and OHS practices in the certified companies to be higher than the control companies due to the machanically implementd OHSMS. The practice of an OHSMS is an indicator of an adopted organization's commitment to safety and perception of employees about safety (Fernández-Muñiz et al., 2007). The study of Vinodkumar and Bhasi (2010) in Indian major hazard facilities indicated that management commitment directly associated with the safety practices. The findings also

advocate the poor management commitment to safety in the companies. The existence of a large number of documents and complying with about fifty percent of the requirements of the OHSAS standard in the certified companies might result from the failure of the companies to properly implement and maintain essential arrangements and actions required by the OHSAS 18001 standard to develop a high-quality OHSMS, and the situations suggest the existence of a paper system in the companies. Since, culture is "the way we do things around here", it also shows the low level of safety culture in the companies.

The findings of the sub-studies indicated that the implementation of the requirements of the OHSAS 18001 standard had a positive effect on the reduction of OIR, improving the safety climate, increasing the OHS and OHSAS practices in the certified 1. The findings suggest that the OHSMS implemented, maintained, and improved by the company better than other certified companies. The explanations might be that the company practically used OHSAS 18001 as a tool for management of OHS or conducted more efforts to enhance the level of safety culture better than other certified companies.

The existence of a gap between safety procedures and instructions with practices, which found in the Sub-study III, has been highlighted previously in the safety literature (Dekker 2003; Stave & Törner, 2007). The certified companies did not follow their documented procedures and instructions at least four years after the certification. It is required to follow safety procedures and regulations by management and employees of all organizations. The safety culture of an organization impacts on how much OHS procedures and regulations are followed by managers and employees (Nordlöf et al., 2015). Safety should be regarded as an important issue that concerns everyone in an organization with a positive safety culture. In such organization, safety rules should be understood and adhered to (Choudhry et al., 2007). Lack of knowledge by the workers who were interviewed regarding the OHSAS 18001 and the lack of their participation in OHSAS 18001 and OHS practices, suggests that the system is mostly operated by the higher level personnel (i.e., white-collar managers) and only slightly by the lower levels of the companies. These findings indicate a poor safety culture in the companies. Therefore, the companies should revise their practical procedures, even for the most important elements of the OHSAS 18001 standard, such as hazard identification, risk

assessment and management, safety training, and operational control to improve the safety culture. These OHSAS practices are prerequisites for the continual improvement of OHSAS 18001. The practical commitment of top management to safety and the involvement of employees in the system activities were required for this improvement in the companies (Fernández-Muñiz et al., 2012a; Vinodkumar & Bhasi, 2010). Although the employees were needed to follow the OHSAS procedures and safety instructions, to participate in OHSAS and safety activities, to communicate with their supervisors and managers regarding safety concerns, they are unresponsive and passive towards safety threats when observing a lack of commitment from their supervisors, especially senior managers (Cui et al., 2013). Therefore the commitment of senior management of the companies a key factor for the continual improvement of the OHSMS.

The identification of evidence for the existence of a poor safety culture in the certified companies indicated that the companies implemented the requirements of the OHSAS 18001 standard and maintained them in a way that has not improved the safety culture. Several researchers recognized the lack of management commitment to safety, workers involvement and consultation, communication, and safety training as important indicators of poor safety culture (Arboleda et al., 2003; Cox et al., 1998; Fernández-Muñiz et al., 2007; Mohamed, 2002; Seo, 2005; Flin et al., 2006; Evans et al., 2007; Yorio & Wachter, 2014). These variables have been identified as essential factors in developing an effective system for continuously improving safety performance (Van den Berghe et al., 2006). An effective OHSMS in an organization results from the combination of the mechanical implementation of an adopted system and a positive safety culture (Santos-Reyes & Beard, 2002). The establishment of a positive safety culture is also a primary objective of an OHSMS, which can identify and correct safety related problems prior to the occurrence of an accident (Chen & Chen, 2014). Therefore, the companies should conduct practical efforts for improving the level of safety culture to develop an effective OHSMS.

5.2 Barriers and facilitators of OHSAS 18001 in the certified companies

The results of the Sub-study IV indicated that senior management commitment to safety, participation of employees in OHS and OHSAS practices, safety communication, integration, OHS training, safety culture, incentives, OHS enforcement, OHS authority support, OHSAS auditing, and OHS inspection can inhibit or facilitate the effectiveness of OHSAS 18001 in the adopting companies.

Lack of senior management commitment to safety was the main barrier for the effectiveness of OHSAS 18001. Vredenburgh (2002) stated that the managers can manifest their commitment to safety through job training programs, management participation in safety committees, consideration of safety in job design, and review of the pace of work. Tappura et al. (2016) also found that top managers should provide resources and supports for middle and frontline managers to perform OHS activities. Likewise, providing supportive environment enhanced the supervisors involvement in safety leadership (Conchie et al., 2013). The findings of the Sub-study IV concerned with issues such as inadequate delegation of authority, lacking OHS support, lack of giving priority to OHS, unsatisfactory feedback from other managers, and insufficient knowledge of personnel about the OHS. These problems may result from the poor attitude of senior managers to OHS and the instability of top managers of the companies.

The inadequate participation of employees in the OHS and OHSAS practices discovered as another hindrance for the effectiveness of OHSAS 18001. This finding is in line with the studies of Lai et al. (2011) and Vinodkumar and Bhasi (2011), which reported employee involvement as a decisive factor in the improvement of safety performance. In an organization that has a positive safety culture, the responsibility for safety should devote to every employee (Lee, 1998). It is found that the involvement of managers and employees are critical for the actual implementation and development of OHS interventions e.g., OHSAS 18001. They also should understand the aim of the interventions. Ttappura et al. (2016) found the engagement of managers in OHS activities as major OHS tasks in Finnish industrial organizations. The study of Managers should support the interventions and employees actively participate in OHS practices

specified in the interventions (Nielsen et al., 2010). The resistance of personnel to participate in the OHS and OHSAS practices that found in this study may resulted from the insufficient OHS and OHSAS knowledge, their less empowerment, poor OHS attitude, unsuitable job satisfaction, and the lack of commitment to safety. Because the empowering personnel provide them with authority, responsibility, and accountability for required decisions and ensures that both employees and management are involved in setting goals and objectives (Cohen & Cleveland, 1983). Therefore, the companies' efforts to empower personnel can enhance their participation in OHS/OHSAS 18001 practices.

An OHSAS 18001-certified organization should use proper tools to communicate with their employees about OHS problems and transfer information to employees about the possible OHS risks in the workplace. The lack of safety communication in the companies is an important factor to hinder for transferring safety information and proper improvement of OHSAS 18001. A two-way safety communication between managements, supervisors, and workers previously identified as an important management practices to improve safety performance (Vinodkumar & Bhasi, 2010). The poor communication may result from the failure of the companies to provide a good structure to facilitate OHS communication, insufficient OHS knowledge of personnel of the companies and the lack of interest to consult about OHS issues.

The existence of proper OHS instructions and providing appropriate training increase the involvement of employees in safety. Safety training is also a key aspect of safety culture. Appropriate safety training to employees plays an important role in the improvement of safety culture and the enhancement of an OHSMS' effectiveness (Bottani et al., 2009). The certified companies provided insufficient training courses for their employees about OHS and OHSAS especially regarding the positive effects of OHS and the systematic management of it, and why the employees should perform the OHS and OHSAS practices. These findings indicate the lack of OHS training as an obstacle for the effectiveness of OHSAS 18001. The findings are in line with a study of Teixeira and Sampaio (2013), which according to prior studies found that the lack of confidence in food safety management system resulted from the lack of information and the insufficient support and guidance.

Integration of OHSAS 18001 throughout the process and organizational frameworks could improve the performance of OHS in reality, not on paper. Organizational actions such as involvement of employees in OHS/OHSAS 18001 practices, OHS training, and enhancement of safety culture could facilitate this integration (Badri et al., 2012; Yazdani et al., 2015). Such integration could result in continuous improvement of OHS and OHSAS 18001 performance, and sustainable prevention of occupational injuries, illnesses, and accidents.

The existence of a poor safety culture in the companies identified as another obstacle for the effectiveness of OHSAS 18001. Prior studies have reported that the implementation of OHSAS 18001 is not enough to create an effective system and adopting companies should conduct more efforts to improve the safety culture (Gordon et al., 2007; Granerud & Rocha, 2011). Iranian national culture is characterized by intermediate power distance and collectivism (Hofstede, 2015). Previous research has indicated that organizational and safety culture affected by national culture (Mearns & Yule, 2009). Employees who worked in organizations, which are located in intermediate power distance nationalities i.e., Iran may be less likely to follow Standard Operating Procedures (SOP) about safety. For this reason, it seems that they do not actively participate in safety and OHSAS practices (Bahari & Clarke, 2013). Thus, the consideration of national and organizational culture is an important issue when implementation and maintenance of safety interventions e.g., OHSAS 18001. It can help managers to develop measures to control their employees' behavior in implementation, improvement, and maintenance of the interventions.

Krause (1993) identified downstream of safety culture, OHSMS, and exposure as three main causes of incidents. This author also stated that the behavior of employees resulted directly from the operation of OHSMS in organizations. An OHSMS, in turn, is affected by the culture of an organization. An organization with a positive safety culture has the ability to effectively manage elements associated with the safety in their operations (Glendon & Stanton, 2000). Therefore, the certified companies should train their employees and involve them in OHS and OHSAS practices till the practices conduct in a daily manner and performs as their habits. It is important to note that the creation of a significant modification in the safety culture required more time. Other

companies that plan to adopt with the OHSAS 18001 standard should not be in a hurry in the implementation of the requirement of it and certification by a CB company.

The insufficient application of rewards and incentive programs for encouraging companies and employees recognized as a barrier for the effectiveness of OHSAS 18001. Teo et al. (2005) found incentives and rewards as good management practices for working safely that can lead to a strong safety culture, the finding from the current study is mainly concerned with lack of incentive program inside and outside the companies. Companies usually use safety incentive programs by considering the aim of encouraging safety behavior of their employees. The combination of monetary, feedback, and social influence are good motivators for employees to have safe behaviors (Yeow & Goomas, 2014). The application of a well-designed incentive program offers recognition that can help to modify the behavior of employees (Vredenburgh, 2002). Thus, the use of proper incentive programs by the OHS authorities and the companies to increase the safe behaviors of employees will help the certified companies to enhance safety performance.

The lack of the OHS authorities' support and the lack of enforcement for OHS regulations were identified as other external barriers to the effectiveness of OHSAS 18001. Organizations comply with the requirements of OHS legal and regulations out of the sense of duty or due to the expected benefits for their business (Johnstone & Frick, 2011). All OHSMSs stress on the consideration of OHS legal requirements in OHS planning. Mandatory OHSMSs required by legislation and voluntary OHSMSs e.g., the OHSAS 18001 standard specified that an adopting organization shall ensure that applicable OHS legal requirements are taken into account in establishing, implementing, and maintaining of an OHSMS (BSI 2007; Niskanen et al., 2014). OHSMS-certified organizations do not comply with the requirements of OHS legislation, but violate them in a systematic way that results in the occurrence of accidents (Frick, 2011). It is obvious that the existence of an item in a document does not guarantee the implementation of its requirements by an organization. Effective enforcement is vital to the successful implementation of OHS legislation (Gunningham & Sinclair, 2007). Studies have indicated that small businesses experience the increase of compliance regulation through the training of the requirements of such regulations (Stokols et al., 2001; Fairman & Yapp, 2005). Thus, the support of OHS authorities, i.e., providing safety training for the employees who work in the enterprises with limited recourses

may enhance the compliance with OHS legislation. Moreover, the support of OHS authorities will help the companies to develop appropriate OHS programs to prevent the occupational injuries and illnesses. The importance of OHS enforcement in the improvement of safety performance has been identified in safety literature. However, the enforcement of OHS legal requirements has remained more or less uncharged for decades (Mischke et al., 2013). The style of enforcement influences how motivated company managers intended to comply with OHS regulations (Hale et al., 2015). The ultimate objective of OHS enforcing authorities is to ensure that duty holders effectively manage and control OHS risks (Niskanen et al., 2014). The main purpose of the OHS enforcement activities conducted by OHS authorities should make sure that the requirements of the OHSAS 18001 standard, including applicable OHS legislation are implemented in practice in adopting companies. Therefore, the enforcement of OHS regulation and the authorities' support will result in the improvement of safety performance and the enhancement of the effectiveness of implemented OHSAS 18001.

The present study also indicated that third-party auditing of OHSAS 18001 was other important factors that impact the effectiveness of OHSAS 18001. Safety inspection and safety audit are the two most important tools used to ensure the quality of safety management (Salazar, 1989). These tools have also been used to measure the success of an OHSMS (Cooper & Phillips, 2004). The appropriate application of these tools can help an OHSMS-adopting organization to know about the quality of the system. The lack of experience and relative training of the OHS inspectors identified as a significant obstacle for effective enforcement (Gunningham, 2005). Routine inspections without any form of enforcement apparently have no injury reducing effects (Gunningham & Sinclair, 2007). The sufficient experience and training of OHS inspectors is necessary for a better assessment of the quality of the application of OHS legislation in an OHSAS 18001-certified company. Auditing is an entirely voluntary activity, but safety inspections conducted by the OHS authorities is a mandatory task. The study of Hedlund (2014) in National Occupational Safety Association (NOSA) five-star OHSMS adopting companies showed that companies with higher star rating have lower fatal and permanently disabling injury rates than companies with low star rating. Therefore, CBs must check and control the performance of their branches in Iran. The OHSAS 18001-auditors should recruited based on the competency including appropriate OHS

education, OHSAS 18001 and industry processes training, and experience. CBs should revise their auditing and certification procedures. The proper selections of appropriate samples for audit to check the real performance of the system and the application of a star-based rating method by considering the improvement of safety culture in the OHSAS 18001-adopting companies help to enhance safety performance.

5.3 Implications of the present study

The present study might be a small step to understand the current situation of OHSAS 18001 and its effectiveness in the OHSAS 18001-certified companies in Iran. This study is a pioneering research about the effect of OHSAS 18001 on safety performance in Iran. Results of the sub-studies I, II, and III demonstrated that the implementation of OHSAS 18001 in an organization cannot automatically improve safety performance. It emphasized on the role of providing safety training for employees in the certified companies to improve the level of safety climate. Since the safety climate is an important indicator of an OHSMS in an organization; this improvement can enhance the effectiveness of OHSAS 18001 in the companies. Although the OHSAS 18001 standard offers a good framework for improvement of safety performance, the safety culture of an adopting company impacts the effectiveness of the OHSMS. The inappropriate level of the main elements of safety culture, including management commitment, employee involvement and consultation, safety communication, and safety training indicated the important role of safety culture to develop an effective OHSMS.

Another implication of the present study is the development and validation of a new safety climate scale specific to manufacturing company in Iran. The scale is a comprehensive one that considered all available documents and mostly used safety climate factors and items. The scale was developed in response to a need for a safety climate scale in the manufacturing industry in Iran. It can be used to investigate the perception of manufacturing employees about safety.

The identification of internal and external influencing factors on the effectiveness of OHSAS 18001 in the certified companies can be a guideline for other OHSAS 18001-certified companies or the companies, which intended to implement the requirements of

the standard, to have an effective system for the management of OHS, and to control or minimize the effect of the factors. Since, the implementation and development of an OHSMS in a company need more cost, considering these factors can help the companies to decrease the cost of implementation and development of an effective system. The OHSAS 18001-certified companies and the companies, which intended to implement the requirements of the OHSAS 18001 standard, must make a good infrastructure by considering the internal influencing factors to develop an effective OHSMS. Since, the implementation of OHSAS in an organization does not guarantee the complying with the OHS legislation; OHS authorities should conduct efforts to enforce OHS legislation in the certified companies. They should support the companies to a better implantation and development of an effective OHSMS. The authorities should design a good incentive program to encourage the certified companies to enhance the safety performance.

The present study investigated the effect of OHSAS 18001 on lagging safety performance indicator of occupational injury, as well as leading indicators of safety climate, and OHS practices in the OHSAS 18001-certified companies compared with a group of control companies. The application of these indicators facilitates the judgment regarding the effect of OHSAS 18001 on safety performance in reactive and proactive manners. In addition, the design of the present study facilitates to compare the safety performance indicators before and after the certification in the certified companies and with the control companies.

5.4 Critical remarks

The limitations of the sub-studies were presented in the discussion parts of each original article, but a few remarks can be made related to the general limitations of the whole study. A major limitation of this study can be not using a representative sample of OHSAS 18001–certified companies from manufacturing companies in Iran. It was difficult to make a country-wide measurement of the effect of OHSAS 18001 on safety performance due to the confidentiality of injury data and lack of interest of the companies to participate in such study. This study includes only three OHSAS 18001-certified manufacturing companies in the West Azerbaijan province due to the limited number of OHSAS 18001–certified companies at the time of study in the place of study.

The corresponding control companies were chosen to perform a comparison of safety performance. The control group selected based on the existence of injury data and their' acceptance to conduct the study. It is important to note that the finding out the companies, which interested to conduct this study and getting their acceptance to collect the used data, was not an easy task.

The data used in sub-study I consisted of the injuries reported to and registered with the safety department within the studied companies. The author of this thesis tried to collect data from ISSO, but the organization was not agreed to share the injury data for the manufacturing companies.

Other limitations of this study were the use of questionnaire and checklist for gathering the required data for the purpose of analysis in the sub-studies II and III. The application of these tools is routine ways to collect the safety climate and OHS/OHSAS practices. For the purpose of sub-study III, different methods used to collect the required data, including observation, document analysis, and interview to collect a valid data to assess OHS/OHSAS practices. The data checked for few times to find out the required evidence for calculating activity rates. The cross-sectional design of these sub-studies also might be included as another limitation.

The mentioned limitations make the findings of the present study less generalizable to OHSAS 18001-certified companies in Iran. Bearing in mind the approximately similar situation of the OHS legal enforcement, the attitude of managers to OHS, the manner used for implementation of the requirements of the OHSAS 18001 standard by organizations in Iran, the findings of the current study are a good example for presenting the status and effectiveness of the application of the OHSAS 18001 standard for managing OHS in OHSAS 18001-certified companies in Iran or even in developing countries.

5.5 Conculding remarks

The present study was set out to explore the status and the effectiveness of OHSAS 18001 in manufacturing companies in Iran. The results revealed that the certified companies did not conduct a satisfactory level of efforts to develop an effective OHSMS. The mechanical implementation of the requirement of the OHSAS 18001 standard

(documentation) and certification by a CB is not a difficult task. The implementation provides a good foundation for achieving a safe working environment, but it cannot guarantee it. The transferring the documented system to daily tasks that conduct by employees require the commitment of all personnel and the actively involvement of managers and employees in OHS/OHSAS 18001 practices. One reason why it has been difficult to find successful organizational-level interventions to improve OHS in organizations is that the interventions are very complex and require cooperation and commitment from union leaders, management, and employees (Saksvik et al., 2003).

This study emphasized on the cultural development of safety in the certified companies to build up an effective OHSMS. The achievement of a good safety performance may be impossible through only a mechanical application of an OHSMS (Hudson 2007), and the existence of an adequate level of OHSMS and engineering controls in place is critical for improving safety culture (Miller 1998). OHSAS 18001 is a management tool, and its success depends on how adopting organizations employ the standard requirements to manage OHS. To develop an effective system, a certified company should conduct more efforts to improve the safety culture (HSE 2001; Santos-Reyes and Santos-Reyes 2002; Gordon et al., 2007), implementing all standard requirements and maintaining OHS practices on a daily basis. The safety culture of a certified organization enhances by advancing in the management commitment, involving employees in safety activities and decision making, empowering the management support, improving the communication, and training of employees about safety (Hudson 2007; Parker et al., 2006; Vecchio-Sadus and Griffiths 2004; Vredenburgh, 2002). These efforts would help the companies to create a positive safety culture and to transform the paper system to an effective management system.

The results indicated shortcomings in third-party auditing of OHSAS 18001 and inspections conducted by OHS authorities. The utilization of a policy by the accreditation bodies for checking the quality of OHSAS 18001 audits conducted by CBs could identify the shortcomings of the audit process and help to increase their quality. The authorities should develop a new inspection program with more emphasizing on the enforcement of OHS legislation to inspect the quality of OHSAS in the companies. It would help the companies to improve the effectiveness of their systems for a better management of the OHS in the OHSAS 18001-certified organizations.

The present study indicated that the implementation of the requirements of the OHSAS 18001 standard had a positive effect on occupational injury reduction, improving the safety climate and OHS/OHSAS practices in one of the certified companies. It can be concluded that the characteristics of a certified company, especially the level of safety culture in it and how to use OHSAS 18001 for the management of OHS by a certified company impact the effectiveness of OHSMS. The implementation of OHSAS 18001 facilitates the improvement of safety performance by making a good infrastructure to systematically managing of OHS. Therefore, the OHSAS 18001-certified companies should use this opportunity to improve their systems from paper compliance to a practical system for having an effective tool, for a better management of OHS issues, and for improving safety performance. Otherwise, the system did not improve in an appropriate manner.

Because there is a scarce number of studies about the effectiveness of OHSAS 18001 in adopting companies, more research is needed to be conducted in this field. The studies might investigate the effects of OHSAS 18001 certification on the used or other lagging or leading safety performance indicators. It is suggested that the application of a combination of these performance indicators would help researchers to assess the effect of OHSAS 18001 on safety performance in both reactive and proactive manners. It is recommended the researchers include more certified and control companies in their studies to better understand the effects of OHSAS 18001. It is also needed to conduct more research to re-examining the validity and the reliability of the scale with a larger and more diverse sample of manufacturing employees and to identify applicable evidence about the developed conceptual model.

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