

# Review of Occupational Health and Safety Management System and Hazards Controls in the Motion & Industrial Automation Products Manufacturing Industries

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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 ISO 45001 on safety performance in certified organizations. This study consisted of four sub-studies, and was conducted to explore the effect of ISO 45001 on the occupational injury, safety climate, and Occupational Health and Safety (OHS) practices in ISO 45001-certified companies compared with a control group in Iran. ISO 45001 practices were also examined in the certified companies, where interviews were conducted to explore the influencing factors on the effectiveness of ISO 45001. A negative binomial regression indicated no significant effect of ISO 45001 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 ISO 45001 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 ISO 45001 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 ISO 45001 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 ISO 45001 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.

The aim of this report to assess and evaluate the effective implementation of occupational health & management system and hazards controls in the Motion & Industrial Automation products manufacturing Industries as per the relevant ISO standards and hierarchy of hazards controls, which is a system used in industry to minimize or eliminate exposure to hazards.

Falls, chemical spills, fire, explosions, working at height, confined space working, mechanical material handling, etc. are few kinds of incidents that can happen in a manufacturing environment. Such incidents are not only tragic and frequently fatal for workers, but also extremely expensive for the employers. Between worker's compensation, regulatory penalties, reduced/diminished productivity

*and the costs of fixing or replacing damaged equipment, a single incident can financially devastate a business. To avoid industrial accidents / catastrophes, keep your people from harm, ensure manufacturing compliance, and protect your bottom line, you need to get serious about safety.*

*Manufacturing Safety is everything organizations does to ensure the physical well-being of the workers in the manufacturing facility or facilities. Manufacturing Safety is also about more than checking a few boxes or putting up 'safety first' signage.*

- Manufacturing Safety keeps people alive and unharmed.*
- Manufacturing Safety is also tied to workforce productivity.*
- Manufacturing Safety is an essential form of risk management.*
- Manufacturing Safety is a legal requirement.*
- Manufacturing Safety and Profitability go hand-in-hand. Safe companies perform better and sustain in the business longer than unsafe companies.*

**Keywords:** Health and Safety Management System

## **I. INTRODUCTION**

### **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).

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).

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 aim of this thesis is to determine the effect of ISO 45001 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 ISO 45001-certified companies compared with control companies in Iran. It is also to clarify the status of ISO 45001 through the assessment of ISO 45001 practices and to explore the influencing factors on the effectiveness of ISO 45001 in the certified companies.

### **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).

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).

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 Bergh 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).

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.

### **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 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.

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).

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.

### **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.

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).

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).

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).

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 able to reduce the interrupts in an adopting organization due to undesirable incidents e.g., accidents.

### **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).

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).

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 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.

### **ISO 45001**

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 ISO 45001 standard in 1999 (Frick, 2011). ISO 45001 is a worldwide-recognized OHSMS that formulated by international certifying bodies based on a British standard (BS 8800) (BSI, 2007).

The requirements of the ISO 45001 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).

If a voluntary OHSMS e.g., ISO 45001 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 ISO 45001 in organizations. 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 ISO 45001.

The study of Fan and Lo (2012) in 44 textile and fashion businesses revealed that the ISO 45001 adopting firms showed a significantly higher rate of sales growth. Nevertheless, empirical evidence examining the relation between ISO 45001 certification, safety outcomes, and business performance provides inconclusive results.

### **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).

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.

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-Muñoz et al., 2012a).

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. 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 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).

### **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.

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.

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).

The evaluation of safety performance in an adopting organization is one of the important requirements of OHSMSs such as ISO 45001 that provides useful information about the quality of the system (BSI 2007; Sgourou et al., 2010).

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).

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. 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.

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). ISO 45001-certified companies should evaluate the safety performance of their systems internally and externally.

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 through the of ISO 45001.

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.

### **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.

Therefore, the measurement of safety performance enables organizations to become aware of the effectiveness of implemented interventions such as ISO 45001 in improving the safety performance level.

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 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.

### **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. However, few studies have investigated the effect of safety climate in ISO 45001-certified companies (Fernández-Muñiz et al., 2012a).

However, safety culture is a deeper phenomenon that reflects an organization's 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.

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.

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. 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.

### **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).

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).

Two types of audit may apply in ISO 45001- 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 ISO 45001 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).

Thus, the utilization of a policy by the accreditation bodies for checking the quality of ISO 45001 audits conducted by Certifying Bodies (CBs) could identify the shortcomings of the audit process and help to increase their quality.

### **Aims of the present study**

The overall aim of this study was to investigate the status of systematic safety management in ISO 45001-certified companies, the effect of ISO 45001 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 ISO 45001 standard, and to explore the facilitators and barriers of maintenance and improvement of ISO 45001's effectiveness in the certified companies.

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

- Is ISO 45001 had an effect on the OIR in ISO 45001-certified companies compared with a group of companies that had not implemented ISO 45001? (Sub-Study I)

- How to develop a safety climate scale specific to Iranian manufacturing companies? (Sub-Study II)
  - Is ISO 45001 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 ISO 45001 in regard to the average OHS practices? (Sub- Study III)
  - What is the compliance level of OHSMS in the certified companies comparing with the ISO 45001 standard? (Sub-Study III)
  - What are the influencing factors, barriers, and facilitators of ISO 45001' effectiveness in the certified companies? (Sub-Study IV)
- Methods

### 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 ISO 45001 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 fourth sub-study used qualitative data and conducted in the certified companies. The written permissions have gotten from the companies to conduct this study.

### 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.

#### 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.

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).

#### 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 ISO 45001 standard (revision 2007) to collect data about ISO 45001 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 ISO 45001 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 ISO 45001.

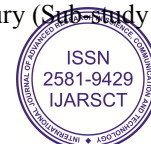
## II. RESULTS

Comparison of ISO 45001-certified and control companies in terms of occupational injury (Sub-study I)

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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 ( $t(9) = 5.74, P < 0.01$ ).

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 ( $p = 1.62, CI = 1.01-2.22, p < 0.001$ ) 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.

Factor structure of safety climate in ISO 45001-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. 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

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.

Safety climate differences between ISO 45001-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 ( $3.77 \pm 0.45, p < 0.01$ ) than other companies. A hierarchical regression revealed that the models were statistically significant. The ISO 45001 implementation and safety training were significant predictors.

Compliance level of ISO 45001-certified companies with the requirements of the ISO 45001 standard

The assessment of activity rates for the main elements of ISO 45001 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 ISO 45001 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 ISO 45001.

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.

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. 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. Further, employees performed their job activities using their traditional methods not as exactly based on the provided instructions.

#### **Factors influencing the effectiveness of ISO 45001 (Sub-study IV)**

The analysis of the data indicated eleven categories of factors influencing the effectiveness of ISO 45001. 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 ISO 45001 auditing.

#### **Factors inside the organization Management commitment**

The participants emphasized that the most important influencing factor on the effectiveness of ISO 45001 was senior management commitment to safety. They were satisfied with their senior managers' commitment to safety during the



implementation of the requirements of the ISO 45001 standard. However, the managers' commitment decreased after the implementation and led to the existence of a superficial OHSMS in the companies.

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 ISO 45001 and safety; lack of priority to OHS compare with production; insufficient OHS knowledge of managers and employees, and inadequate financial support of the system.

Lack of top managers' commitment to the requirements of ISO 45001 was an obstacle to the effectiveness of ISO 45001 in improving the OHS performance.

### **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 ISO 45001 practices did not communicate and consult with employees about OHS issues. The internal communication procedure did not consult with and involve employees in ISO 45001 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 ISO 45001. 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.

### **Employee involvement**

According to the participants, the employees of the companies were not actively involved in OHS/ISO 45001 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/ISO 45001 practices were not seen as routine activities by employees, because they were mainly performed by OHS officers.

The interviewees pointed out the main obstacles to employee participation in OHS/ISO 45001 practices. These factors included inadequate knowledge about OHS/ISO 45001, 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/ISO 45001, insufficient motivation, and scant job satisfaction.

### **Integration**

Participants raised the lack of integration of ISO 45001 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/ISO 45001 practices as the duties of safety managers. The ISO 45001 practices were assumed as extra tasks compared with their routine work activities. There was a common viewpoint that the practices of the ISO 45001 were separate from their traditional (routine) activities in the companies even some years after the certification.

They mentioned the point that the OHS/ISO 45001 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.

### **Safety culture**

The participants reported that the safety culture of an ISO 45001-adopting company influences the effectiveness of ISO 45001. Lack of practical efforts to improve the level of safety culture was an obstacle to the effectiveness of ISO 45001 and could lead to the existence of a paper-only system. They described how the companies can enhance the culture of safety.

The interviewees pointed out that the efforts conducted by an ISO 45001-adopting company can increase the level of safety culture and help to achieve a satisfactory safety performance.

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/ISO 45001 tasks safely. It can also impact the effectiveness of ISO 45001.

### **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 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 ISO 45001-adopting companies and for checking the quality of safety products such as personal protective equipment can help the ISO 45001-adopting companies to better maintain the system.

### **OHS authorities' support**

Most of the respondents expressed that the OHS authorities' support for the ISO 45001-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.

### **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 ISO 45001-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.

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 ISO 45001 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 ISO 45001-adopting companies to certify or extend the certification period. Moreover, only later did the certified companies learn the manner in which the ISO 45001 auditors had conducted their audits. (Participant 10)

Iranian organizations usually implement the requirements of the ISO 45001 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.

### **External incentives**

According to the participants, the existence of incentive programs for the ISO 45001- 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 ISO 45001 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.

The participants also pointed out other internal and external factors that can be considered as obstacles to the effectiveness of ISO 45001. 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.

### **Experiment**

This study was aimed at evaluating the effectiveness of safety management system (SMS) in a Automation company. A 5-point Likert questionnaire ranging from “strongly disagree to strongly agree” questions was used to evaluate workers’ perception of the implication of safety management system in the organization. The ISO 45001 internal audit checklist was also used to measure the level of compliance with the requirements of the SMS. Secondary data was obtained from document and safety report of the case study. The data was collated and subjected to descriptive statistics, t-test and row and column contingency (R & C) table to evaluate the relationship between safety performance and compliance. For compliance to SMS: General requirements, 91%; Health and Safety Policy, 95%; Planning, 93%, Implementation and Operation, 98%; Audit, 98%; and Management Review, 93%. The overall average level of compliance was 95%. 100 respondents participated in the questionnaire, 64 males and 36 females; 68 technical personnel and 32 nontechnical respondents. Descriptive analysis of employees’ perception resulted in: Safety satisfaction and feedback, 4.113; Training and competence, 4.182; Safety reporting and investigation, 4.212; Work Duties/Pressure, 3.989; Management commitment, 4.098; Safety communication, 4.171; and Emergency response and planning, 4.126. t-test indicated that there was no significant difference in perception between males and females, and the perception of technical and non-technical employees with  $p > 0.05$ . R & C contingency table was used to evaluate the relationship between safety performance and safety compliance. The result showed that there was a significant difference between safety compliance and safety performance since  $X^2_{calc} < X^2_{tab}$ . Therefore, safety management system will continuously improve safety performance. Hence, the effectiveness of safety management system cannot be overemphasized. The practice of health and safety has evolved over time, as a matter of common sense in several industries. However, this study opines that the implementation of safety management system requirements is instrumental to a sustainable continuous improvement in safety performance. The study, therefore, encourages organization to consider the safety management system certification.

### **Method of Data Collection**

The method adopted for carrying out this work is the use of a questionnaire and checklist for primary data collection. The questionnaire consists of open-close-ended questions which were self-administered. The questions are answered with a 5-point Likert scale, ranging from strongly disagree to strongly agree. The checklist also containing 85 questions, grouped into the elements of the safety management system, was used to check the company’s compliance to the relevant safety management system requirements through inspections, review of documents, and interviews where necessary. Such information from documents and health and safety reports of the organization formed the secondary data.

### **Workers’ Perception to the Implication of SMS Questionnaire**

The questionnaire used consists of 35 open-close ended questions adapted from Safety Climate Assessment Questionnaire, developed by Flin, Mearns and Burns from University of Aberdeen. It is divided into two sections: A and B. Section A includes demographic information such as age, department, length of years in service, and gender. Section B consists of 35 questions which are used to identify the perception or opinion of workers or employees on the company’s health and safety management system. Section B is further divided into 7 sections which focuses on specific area of general safety climate in the industry, they include: safety satisfaction and feedback, training and competence, safety reporting and investigation, work pressure, management commitment, safety communication, and emergency preparedness and response.

### **Method of Data Analysis**

The data collected from the checklist and survey was compiled and assigned codes. The coding made data representation and analysis convenient. The data was then analyzed using the Statistical Package for the Social Scientists (SPSS) version 25. Descriptive methods were used to simplify and characterize the data. Further statistical analysis includes t-test, Row and Column Contingency Table. Significance was set at a two-tail with an alpha level of 0.05.

**Determination of Compliance Level to Safety Management System Requirements**

Based on the findings at Figure 1, it showed that the level of compliance to the requirements of the safety management system was high, ranging between 91% - 98%. From the chart, it showed that the company has 91% compliance to the general requirements, 95% to Health and Safety Policy, 93% to Planning, 98% to Implementation and Operation, 98% to Audit or Checking, and 93% to Management Review. The overall average compliance of the organization as shown in the graph was 95%.

According to Hasse et al.: “an excellent compliance to the implementation of the SMS requirements in any organization generally translates to effective management of risk, improving the leading indicators like training, management visit, inspections, maintenance, action items, investigations, audit, safety meeting, near-miss reporting, and risk assessment” . The general requirements of the SMS include setting up the management system itself and how the requirements are to be fulfilled.

Figure 4. Showing the level of safety management system

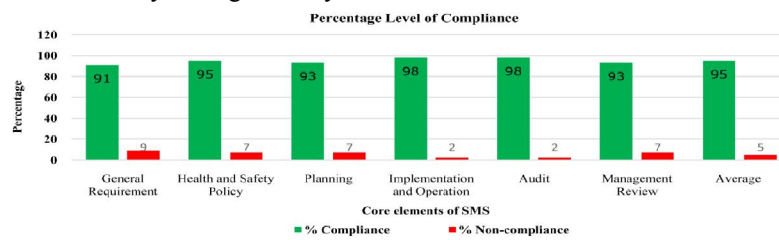


Figure 5. Showing distribution of respondents to the questionnaire

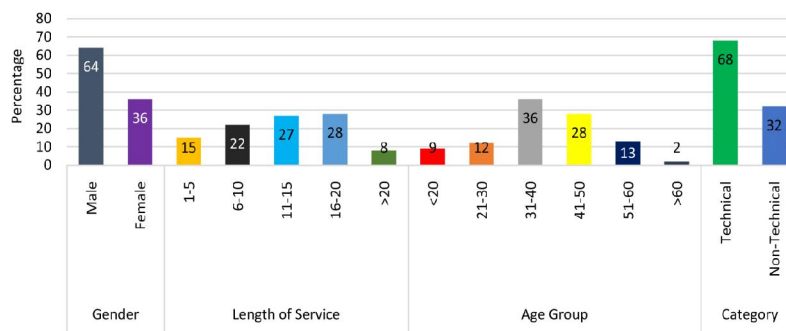


Table 1. t-test analysis for genders.

Safety Variables	Levene test for equality of variances	t	Sig (2-tailed)
Safety Satisfaction and Feedback	0.004	-1.349	0.179
Training and Competence	0.001	-1.376	0.071
Safety Reporting and investigation	0.001	0.038	0.044
Work Duties/Pressure	0.059	0.315	0.753
Management Commitment	0.032	0.088	0.114
Safety Communication	0.001	-1.010	0.587
Emergency Response and Planning	0.174	-0.485	0.700

perception on the areas of safety climate in the organisation. Empirical evidence showed that there were no significant differences for the areas of safety climate between the two genders, except for safety reporting and investigation, where  $t = -1.349$ ;  $p > 0.05$  (safety satisfaction and feedback),  $t = -1.376$ ;  $p > 0.05$  (training and competence),  $t = 0.315$ ;  $p > 0.05$  (Work pressure),  $t = -1.010$ ;  $p > 0.05$  (safe- ty communication),  $t = -0.485$ ;  $p > 0.05$  (emergency preparedness and response), and  $t = 0.088$ ;  $p > 0.05$  (management commitment). Thus, null hypo- thesis was accepted. The results suggested that the two gender groups interpret the variables in the same way. Nevertheless, the results revealed significant differences between male ( $M = 4.1182$ ) and female ( $M = 3.9924$ ) workers on safety reporting and investigation, where  $t = 0.038$ ;  $p < 0.05$ , thus, alternative hypothesis was accepted. It was seen that male workers perceived significantly stronger safety reporting than female workers.

Table 2. t-test analysis for categories of workers (technical and non-technical).

Safety Variables	Levene test for equality of variances	t	Sig (2-tailed)
Safety Satisfaction and Feedback	0.040	-0.949	0.145
Training and Competence	0.011	-0.180	0.405
Safety Reporting and Investigation	0.013	-0.146	0.066
Work Duties/Pressure	0.507	-0.515	0.054
Management Commitment	0.232	0.231	0.206
Safety Communication	0.001	0.720	0.060
Emergency Response and Planning	0.340	-0.492	0.124

Table 3. Row and column contingency table.

Safety Performance	Level of Compliance to SMS Requirements						TOTAL
	General Requirement	Health and Safety Policy	Planning	Implementation and Operation	Checking	Management Review	
Satisfactory	0.91	0.95	0.93	0.98	0.98	0.93	5.68
Unsatisfactory	0.09	0.05	0.07	0.02	0.02	0.07	0.32

From the secondary data retrieved from the company’s HSE report, it was discovered that the company had recorded no fatalities, 7 Lost Time Injury (LTI), 9 Medical Treatment Cases (MTC), 17 First Aid Cases (FAC), 830 Near-miss reported, 104,167 reported unsafe acts and unsafe conditions, 1052 health and safety walkabouts, 582 Safe System of Work audits, 152 Senior Management Team (SMT) site engagement, and about 48,066,469 cumulative man-hours in 20 months. From these reports, we could also infer that the high number of reported unsafe acts and conditions, SMT engagement, audits, HSE walkabout and about 48 million man-hours in relation to the number of incidents also correspond to the results of the various analysis and test of hypothesis between compliance to safety management system and safety performance.

More so, this was also in line with the work done by Lee et al., on the effect of occupational health and safety management system on work-related accident rate and differences of occupational health and safety management system awareness between managers in south Korea’s construction industry. They indicated that, the accident rate, among top 100 largest construction companies, is much lower for the SMS certified companies than that for the noncertified companies. The average accident rate is lowered by 67% when safety management system certified companies were compared with noncertified construction companies. This reduction is likely due to the implementation of safety management system, because the influencing factor of the company size has been mitigated [8]. This view was also supported by Mengolini and Debarberis that: “high safety performance correlates with elements including strong safety management commitment, interaction between workers and supervisors, and open communications on safety”. Many benefits are associated with the development and implementation of a safety management system. Most importantly, an effective safety management system can help prevent injuries and property loss, reduce costs, and support due diligence. Developing a proactive approach to health and safety through a health and safety management system and its essential elements results in long-term financial and cultural benefits.”

### III. DISCUSSION

Comparison of ISO 45001-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 ISO 45001 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.

A possible explanation for this might be that the companies did not properly implement and maintain the requirements of ISO 45001 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 ISO 45001 for managing OHS to improve safety performance.

Considering the effect of ISO 45001-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 safety culture of an ISO 45001-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).

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. 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 ISO 45001 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.

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 mechanically 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 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 ISO 45001 standard to develop a high-quality OHSMS, and the situations suggest the existence of a paper system in the 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.

Lack of knowledge by the workers who were interviewed regarding the ISO 45001 and the lack of their participation in ISO 45001 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.

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).

### **Barriers and facilitators of ISO 45001 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 ISO 45001 in the adopting companies. Lack of senior management commitment to safety was the main barrier for the effectiveness of ISO 45001. Vredenburg (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.

The inadequate participation of employees in the OHS and OHSAS practices discovered as another hindrance for the effectiveness of ISO 45001. 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).

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/ISO 45001 practices.

An ISO 45001-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 ISO 45001. 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.

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). Other companies that plan to adopt with the ISO 45001 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 ISO 45001. 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 lack of the OHS authorities' support and the lack of enforcement for OHS regulations were identified as other external barriers to the effectiveness of ISO 45001. 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.

The main purpose of the OHS enforcement activities conducted by OHS authorities should make sure that the requirements of the ISO 45001 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 ISO 45001.

### **Implications of the present study**

The present study might be a small step to understand the current situation of ISO 45001 and its effectiveness in the ISO 45001-certified companies in Iran. This study is a pioneering research about the effect of ISO 45001 on safety performance in Iran. Results of the sub-studies I, II, and III demonstrated that the implementation of ISO 45001 in an organization cannot automatically improve safety performance.

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. The ISO 45001-certified companies and the companies, which intended to implement the requirements of the ISO 45001 standard, must make a good infrastructure by considering the internal influencing factors to develop an effective OHSMS.

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 ISO 45001-certified companies compared with a group of control companies.

The application of these indicators facilitates the judgment regarding the effect of ISO 45001 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.

### **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 ISO 45001-certified companies from manufacturing companies in Iran.

This study includes only three ISO 45001-certified manufacturing companies in the West Azerbaijan province due to the limited number of ISO 45001-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.

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.

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.

### **Concluding remarks**

The present study was set out to explore the status and the effectiveness of ISO 45001 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 ISO 45001 standard (documentation) and certification by a CB is not a difficult task.

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).

The present study indicated that the implementation of the requirements of the ISO 45001 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 ISO 45001 for the management of OHS by a certified company impact the effectiveness of OHSMS.

Because there is a scarce number of studies about the effectiveness of ISO 45001 in adopting companies, more research is needed to be conducted in this field. The studies might investigate the effects of ISO 45001 certification on the used or other lagging or leading safety performance indicators.

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.



#### IV. CONCLUSION

This study has shown that there is a relationship between safety management system implementation and safety performance by testing for dependency between the two variables in the automation company. The R & C table analyses indicated that there is a significant difference between compliance with the safety management system and the company's safety performance. The result obtained from employees' perceptions and secondary data retrieved from the company's HSE reports also supported these results. Therefore, it is concluded that safety management system is key to improving the safety performance of a company, and safety management system is hence, effective in the organization. There is a need for ongoing commitment and determination from all parties concerned for the improved safety performance in the organization to be sustained.

The present study indicated that the implementation of the requirements of the ISO 45001 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 ISO 45001 for the management of OHS by a certified company impact the effectiveness of OHSMS. The implementation of ISO 45001 facilitates the improvement of safety performance by making a good infrastructure to systematically managing of OHS. Therefore, the ISO 45001- 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 ISO 45001 in adopting companies, more research is needed to be conducted in this field. The studies might investigate the effects of ISO 45001 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 ISO 45001 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 ISO 45001. 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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