

An Empirical Study of Safety Performance Assessment

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ABSTRACT

Safety performance is the overall performance of the organization safety management system in the operational system of safety. In the present study, the components of safety performance included visible management leadership, employee participation, training, inspection, implementation tools, and maintenance. The objectives of this study were to assess safety performance, and to analyze difference in safety performance components in the metal products industry in Iran. The target population included managers and non-managers and the random sampling method is used. A total of 714 respondents participated in present study. The method applied in present study was a questionnaires quantitative type based on a Lickert scale and the data collected were analyzed statistically. The one-way ANOVA was applied to assess significant differences in safety performance components in the metal products industry. The results indicated that safety performance was not strong based on the mean for average score of 2.61 which was less than 3 compared to the possible maximum of 5. The one-way ANOVA analysis showed that there was a significant difference among safety performance components where respondents regards maintenance as a stronger component while employee participation as the weakest. The result of study also revealed that to improve safety performance in the metal products industry, all components should be improved.

KEYWORDS: *Safety Performance, Visible Management Leadership, Employee Participation, Training, Inspection, Implementation Tools*

INTRODUCTION

Though modern life has brought more comfort for the societies, it has also caused accidents in human life [1]. Simultaneously growth and development of industries in the world, and despite of safety strategies have been implemented in workplaces, occupational accidents have increased. Occurrence of terrible occupational accidents points to the importance of issue [2]. The technological dependence has increased in various industries, and as a result occupational accidents become further and more people involved.

There are many industries in the world that depend on human safety performance to avoid occupational accidents. Examination of

occupational accidents reveals that human and organizational safety performance plays a major role in the root reason of such events [3]. To secure long-term positive changes in safety performance it is essential to change both human attitudes and behaviors [4]. Human and organizational factors have key impacts on safety performance. No one can state what might have happened without strong safety performance. It seems that strong safety performance is significant in industries render an absence of occupational accidents [5].

Accidents are the second highest cause of fatalities in Iran, which make it necessary to analyze them exactly, and taking corrective actions to prevent recurrence [6]. To alleviate occupational accidents, some harsh laws have been approved [7]. All requirements to follow safety regulations should be considered in

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workplaces but there is no obligation to [8]. The numbers of occupational injuries have steadily increased in the manufacturing industries during recent years and among them, the metal products industry is confronted with the highest [9]. As a high risk industry, there is a need to investigate factors that affect the occurrence of these accidents to be able to protect all employees. Weak safety performance, unsafe acts and unsafe conditions in the workplaces, not following safety regulations, are causes of the occupational injuries in Iranian industries [9, 10].

Most of the occupational injuries are consequences of unsafe acts that refer to employees' attitude, behavior, and imprudence [9]. Safety performance has an important role in reducing occupational accidents in Iran's industries [11]. Furthermore, the current safety situation in the metal products industry shows that there is room for safety improvement by the management to implement the safety procedures [12]. However, no studies have been conducted on safety performance in the metal products industry in Iran.

Safety performance refers to the overall performance of the organizations' safety management [13]. Safety performance has been defined as protecting the physically and mentally well-being of people that employer must provide in the workplace for all of the employees [14]. Also, safety performance has been defined as evaluative behaviors or actions that individuals exhibit in almost all jobs to promote the safety of employees [15]. Safety performance is a multidimensional concept [16], and its components are as follows:

(i) Visible management leadership: It refers to the motivating force for an effective safety program of the employees [17]. Management leadership style should be visionary, flexible, innovative, and responsive. Through such management style, organizations will be able to respond quicker to changes in order to be competitive. Leadership is one of the important predictors of good safety performance [18]. Organizations that achieve optimal safety performance have effective safety performance leadership. These organizations invoke visionary leadership from the top down, which aligns and applies performance leadership throughout organization [19].

(ii) Employee participation: It refers to the extent to which employees are actively involved in safety activities on a daily basis. Employee involvement connects all members of an organization to safety as a core value [20]. Employee participation provides the means, through which employees identify hazards, recommend and monitor abatement, and otherwise participate in their own safety program [17]. Employee involvement is probably the most important indication of a strong safety foundation in industry [21]. Employee involvement is desirable in achieving better safety and safety performance at work [22].

(iii) Training: It is providing employees the opportunity to learn new skills and knowledge. Training is necessary for employees to perform their jobs effectively and safely, and it must cover the safety responsibilities of all employees who work in the company [17]. Training is emphasized and encompasses both safety and skill training to ensure that people are able to competently meet their safety responsibilities [23]. Due to the industrial hazards and the wide variety of activities and jobs being performed in industrial companies a wide range of training is needed. Safety training is one of the dimensions on the safety performance and retraining allows existing employees to keep their safety knowledge up to date [24]. Organizations that achieve optimal safety performance have effective safety training programs [19].

(iv) Inspection: It refers to evaluating physical conditions and acts of people. To identify new failures in hazard controls, an effective safety program will include regular safety inspections [17]. A program of targeted inspections is essential to ensure compliance with safety legal requirements and standards in companies. A safety inspection program can be viewed as fact-finding with emphasis on locating potential hazards that can adversely affect safety of organization employees. Line management is responsible to perform inspections. More frequent safety inspections of the workplace could carry out by line managers on a weekly, monthly, or quarterly basis to further enhance safety performance [25]. There are additional important benefits from inspections, such as they provide an opportunity for sharing experiences [26].

(v) Implementation tools: It refers to

those recourses, functions, and expertise that facilitate effective safety implementation [17]. Managers are required to show visible support for safety by ensuring implementation tools or adequate resources for employee safety, such as a qualified safety manager responsible for supporting employee safety, adequate safety personal protective equipment, funds for appropriate equipment maintenance and safety improvements [27].

(vi) Maintenance: It refers to set of actions that must be conducted in a way to ensures that machineries and equipment are released to operation in a safe condition. An effective safety program will provide for facility and equipment maintenance [17]. Maintenance people need to keep equipment operating safely. Accountability for equipment maintenance lies both with those responsible for maintaining the equipment and those who use it [28]. The practical maintenance programs must cover all sorts of important machinery and equipment with regular tests [26]. The amount of maintenance affects the technical risk of the system and the number of hazardous events. As the system ages, more maintenance may be required [29].

The objective of this study was to evaluate the safety performance, and to analyze the difference in safety performance components in the metal products industry in Iran.

MATERIALS AND METHODS

According to Social Security Organization [30], industries in Iran in terms of variety of productions are classified into six clusters as follows: i. Manufacture of food, beverages and tobacco, ii. Manufacture of textile, wearing apparel and footwear, iii. Manufacture of wood, cork, furniture, paper, printing and publishing, leather and related products, iv. Manufacture of chemicals, rubber and coal-derived products, v. Basic metal industries, metal products, electric and non-electric machinery, and vi. Other manufacturing industries. Furthermore, industrial companies of Iran in terms of human resources' quantity are classified into two groups as follows [31]: i. The first group is industrial companies with less than 10 employees. ii. The second group is industrial companies with 10 employees and above. The last census conducted in 2004 has shown that among the industrial companies of the second

group in Iran, 7.77% companies were in the metal products industry. Also, among the industrial companies of the second group in Guilan Province 5.85% companies were in the metal products industry. This represents 2.61% of the total companies in the metal products industry in the whole of Iran [32].

A total of 14 companies with more than 10 employees in the metal products industry in Guilan Province of Iran participated in the questionnaire surveys. This industry was chosen because of the higher occupational injury rate amongst the industries in Iran (approximately 35 injuries per 1,000 workers). The population under study included managers and non-managers and to define it a random sampling method is used. A total of 842 questionnaires were sent out for the survey and 714 completed questionnaires were returned, representing an overall response rate of 84.80%.

The quantitative and descriptive methodology was used to collect and statistically to analyze data. Data collection was concluded questionnaire surveys, using a five point Likert scales. The questionnaires were designed to receive the respondents' opinions of the existing safety performance in the metal products industry in Iran (Guilan Province) through its six components. The safety performance questionnaire in this study was based on the NASA Occupational Safety and Health Survey (1998) [33] standard questionnaire which was modified for the purpose of this study. The questionnaire was aimed at assessing safety performance and its components. They are as follows: visible management leadership, employee participation, training, inspection, implementation tools, and maintenance. Each component consisted of 6 items. Therefore, the questionnaire includes 36 items. The internal consistency reliability coefficient (Cronbach's alpha) was used to test and determine the reliability of the survey instrument in present study.

The data collection for the quantitative method was based on hypothesis on the differences in safety performance components in the metal products industry in Iran (Guilan Province). Thus, to study differences in safety performance components in the metal products industry, a One-way ANOVA analysis was used. The total score of safety performance components based on the employees' opinions

was analyzed and used to test the hypothesis of present study. A significant level of 0.5 (P -value) was used to determine differences between the variables. The smaller p -value shows higher estimation certainty and vice versa for a higher P -value.

To assess the safety performance based on employees' opinions, performance scores of safety performance components were calculated. Performance scores of safety performance and its components were specified by calculating the mean of participants' responses to each item. The mean score on each of the safety performance components shows respondents' overall opinion of them. A mean score below 3 on each of the components shows that respondents hold a negative opinion of safety performance in regard to related component. It means that in their opinion those components are not strong. In contrast, a mean score 3 and above on each of the components shows that respondents hold a positive opinion of safety performance in regard to related component. It means that in their opinion those components are strong. The mean score on all safety performance components shows respondents' overall opinion of safety performance. Also, a mean score below 3 on all of the components shows that respondents hold a negative opinion of safety performance. It means that in their opinion safety performance is not strong. In contrast, a mean score 3 and above on all of the components shows that respondents hold a

positive opinion of safety performance. It means that in their opinion safety performance is strong.

RESULTS

Thirty completed questionnaire surveys from the pilot group were used to compute the Cronbach's alpha coefficient for a standard questionnaire on safety performance. The result shows that Cronbach's alpha coefficient was 0.87 in the safety performance questionnaires. Since the questionnaire reliability was 0.87 in Cronbach's alpha, the instrument can be considered very reliable.

In the present study, safety performance is analyzed based on the respondent's opinion by scoring each component.

Table 1 shows the result of description for average score of safety performance and all its components. The results show that the mean for average score of safety performance, visible management leadership, employee participation, training, inspection, implementation tools and maintenance was 2.61 ± 0.64 , 2.64 ± 0.83 , 2.50 ± 0.78 , 2.53 ± 0.79 , 2.66 ± 0.91 , 2.57 ± 0.78 and 2.75 ± 0.81 respectively, compared to the possible maximum score of 5. Since the mean score on all of them was less than 3, it indicates that, safety performance and all its components were not strong in the metal products industry in Iran (Guilan Province).

Table 1. Average Score of Safety Performance Components

Safety Performance (Components)	Mean	S.D
Safety Performance	2.61	0.64
Visible Management Leadership	2.64	0.83
Employee Participation	2.50	0.78
Training	2.53	0.79
Inspection	2.66	0.91
Implementation Tools	2.57	0.78
Maintenance	2.75	0.81

The results in Table 2 show that 57.60%, 65.78%, 63.43%, 57.88%, 61.73%, and 55.97% of respondents respectively, gave low ratings on items of the visible management leadership, employee

participation, training, inspection, implementation tools, and maintenance compared to whom gave high ratings.

Table 2. Percentage of Items Score of Safety Performance Components

Safety Performance Components	Low Ratings (%)	High Ratings (%)
Visible Management Leadership	57.60	42.40
Employee Participation	65.78	34.22
Training	63.43	36.57
Inspection	57.88	42.12
Implementation Tools	61.73	38.27
Maintenance	55.97	44.03

Moreover, there was a direct question in safety performance survey to find the respondents' overall opinion about safety performance. Respondents' answer to this item shows their opinion directly regarding safety performance.

The result shows that 73.70% of respondents gave low ratings on direct item of safety performance survey compared to 26.30% who gave high ratings. Those respondents stated that safety performance was not strong in the metal products industry in Iran (Guilan Province).

In the present study the results obtained are analyzed for any difference in safety performance components in the metal products industry in Iran. The hypothesis is: There is a difference in safety performance components in the metal products industry in Iran (Guilan province).

Table 3 shows the result of variance analysis for the difference in safety performance components. Since the Sig (P-value) is less than 0.01, there is a statistically difference in safety performance components at the 95% confidence level.

Table 3. Variance Analysis of Difference in Safety Performance Components

Differences	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1128.760	5	225.752	9.376	.000
Within Groups	103001.298	4278	24.077		
Total	104130.059	4283			

Table 4 shows the result of comparison of safety performance components using the Duncan Post Hoc Test. This analysis shows that there is a difference between maintenance compared with other components at the 95% confidence level. Other differences can also be seen between inspection compared with other components except visible management leadership, between visible management leadership compared with other components except inspection and implementation tools, between implementation tools compared with other components except visible management leadership and training, between training compared with other

components except implementation tools employee participation, and between employee participation compared with other components except training and implementation tools at the 95% confidence level. There are no differences among the means in either group, or any member of either group was different from a member of the other group [34]. Moreover, the results show that maintenance was stronger than other safety performance components, while employee participation was the weakest safety performance component in the metal products industry in Iran (Guilan Province).

Table 4. Duncan Post Hoc Test (Tests of Between-Subjects Effect) Safety Performance Components

Safety Performance Components	Subset for alpha = 0.05			
	1	2	3	4
Employee Participation	14.9804			
Training	15.1891			
Implementation Tools	15.4090	15.4090		
Visible Management Leadership		15.8361	15.8361	
Inspection			15.9664	
Maintenance				16.5028
Sig.	.120	.100	.616	1.000

DISCUSSION

The objective of this study was to evaluate the safety performance, and to analyze the difference in safety performance components in the metal products industry in Iran. The review of literature showed that occupational accidents have increased in Iran. Since weak safety performance is one of the vital causes of the occupational accidents in Iranian industries [11], strengthen safety performance and its components could reduce occupational injuries. Good perception of items relating safety performance components could strengthen existing weaknesses. Few studies have been done about safety performance in some industries of Iran for example Gas Industry [35], Basic Metal Industries [36], Construction Industry [37], Services Industry, Auto Industry [39], no studies have been conducted on safety performance in the metal products industry. To study the situation of safety performance in this industry, the NASA modified survey is used. The components of safety performance were visible management leadership, employee participation, training, inspection, implementation tools, and maintenance. In this study, safety performance is analyzed based on the respondent's opinion by scoring each component.

Table 1 shows based on the mean for average score, safety performance and all its components were not strong in the metal products industry in Iran (Guilan Province). The results in Table 2 show that a majority of respondents gave low ratings on the items of safety performance components compared to whom gave high ratings. Also, a majority of respondents gave low ratings on the direct question in safety performance survey compared to whom gave high ratings. This result shows the respondents' overall opinion about safety performance, emphasizing it was

not strong. It must be mentioned that the findings of this study are not in line with another [37] that reported a majority of respondents had almost high perception about safety performance. Furthermore, the findings of this study are in disagreement Nasiripour et al. [39] in which almost all performance indicators of HSE were at a middle level.

The results of Table 3 and Table 4 indicated that, there was a statistically difference in safety performance components. The results show that maintenance was stronger than other components, while employee participation was the weakest component. According to Almasi et al. [8] safety performance in different industries resulted from different predictor variables. In their opinion the factors regarding health and safety are respectively managerial factors, informational factors, personnel factors, physical factors, and chemical factors.

As a summary, respondents assumed that to strengthen safety performance components the following points must be considered such as:

-The annual performance plan should contain requirements to achieve safety program goals. The specific safety objectives should be developed. Top management should involve safety committee to review the effectiveness of the safety program. Employees must be known with the basic safety policies and objectives. Safety meetings, including all levels of the employees should be regularly held. Adequate safety staffing should exist to carry out effective safety programs.

-Effective communication among employees about safety issues must be considered by top management. Safety rules, regulations, and procedures must be recorded and kept up-to-date. Employees should be aware of their rights to contact Labor

Organization with safety issues without fear of reprisal. Employees must be involved in safety inspections planning, and made aware of safety inspection results. Any mishaps that may occur should receive complete investigation.

-The training program should be updated to enhance employee safety awareness. The training should cover all necessary topics, operations, and hazards identified for employees' job. Safety training courses must be conducted by educated persons. The employees' recertification requirements must be documented and tracked. The formal orientation program to recognize hazards, violation of standards, and facility safety practices must be provided to all new employees. The employees must be encouraged to assist in developing training requirements.

-Employees input into facility inspections should be encouraged. Safety inspections should be performed and the results be documented. Safety inspection results must be reviewed and compared with near misses and hazard reports. Safety inspectors should have the necessary expertise and experience in related area and adequate knowledge about units under inspection. The periodical inspection programs should be done according to the stated schedules orderly.

- Supervisory responsibility for safety matters should be clearly defined. Managers must recognize and support employees' defined safety responsibilities. Job safety accountability must be clearly defined. Information necessary should be available to carry out employee's responsibilities for the safety program. The budget for safety should be adequate to meet the needs. Safety department in this facility should meet the safety needs of the daily operations.

- Each piece of equipment must be adequately maintained and safe to operate. Each piece of equipment should be provided with adequate operating procedures including safety hazard information. Maintenance of equipment should be conducted according to stated timetable. Maintenance process should be done by experts. Management must equip machineries and equipment with up-to-date technologies.

CONCLUSION

The statistical analyses demonstrated the evaluation of the safety performance in the metal products industry in Iran (Guilan Province). The findings showed that based on the employees' opinion, safety performance and its all components were not strong. The data analysis of the comparison between safety performance components showed there is a statistically difference among them, while evaluated maintenance as the strongest component and employee participation as the weakest component. It is interpreted to mean that managers aim to implement maintenance regular programs as a strategy to control safety affairs within companies, without attempt to employee effective participation in safety issues in their workplaces. Therefore, the low level of safety performance components was due to low level safety performance in the target population group.

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