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ORIGINAL RESEARCH PAPER

The evaluation of the role of the safety management system in the safety culture of Iran Carbon Company using Geller model

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ABSTRACT

Developing a positive health and safety culture is important if high standards of health and safety are to be achieved and maintained. There is a limit to the health and safety performance an organization can achieve without addressing the contribution which human factors have to play in eliminating occupational accidents. The aim of this research is to evaluate the role of the safety management system in the safety culture of Iran Carbon Company using Geller model. This research is descriptive based on the data collection method. In addition, this is also correlational research as it investigates the relationship between the variables. The statistical population of this research is all employees of Carbon Company and 120 of them were selected as the sample volume. Data was analyzed in two parts of descriptive and inferential statistics. Moreover, Pearson correlation and linear regression tests were used by SPSS software to measure the relationship between the variables. The findings showed that the research hypotheses were confirmed (P<0.05).

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1. Background

According to the idea of the International Labor Office, the most important principle in the integrated development of safety principles and its reflection in the workplace (the principal prerequisite to reduce damages and accidents) is attention to the social and cultural aspects or liveware view (Gnoni and Saleh, 2017). In other words, cultural background influences the safety of the working operations. Therefore, concern about the safety culture is proposed today (Omidi et al., 2022). The expression of "safety culture" was developed after the Chornobyl disaster in 1986. It was a disaster that caused violations because of a weak safety culture, which disturbs operational processes, and finally that big disaster (O'Neill, 2020; Li et al., 2022; Diab, 2023). In Chornobyl, two explosions spread molten nuclear elements from the Chernobyl nuclear reactor and products into the atmosphere (Gharari et al., 2018). The International Safety Consultant group and a group of the International Atomic Energy Agency that was responsible to handle the Chernobyl disaster used the expression of "poor safety culture" to detect the causes of this disaster (Kim et al., 2018). International Safety Consultant group defined safety culture as "it is a set of attitudes and attributes in organizations and among their members which proves that the relevant issues to the safety of nuclear power plant have attracted the extent of attention that shows the degree of its importance" (Crow et al., 2017). This definition signifies two points: first, safety culture is about good attitudes toward safety, and it is about good safety management by organizations. Second, good safety culture means attributing the highest priority to safety (Cheung and Zhang. 2020). Safety culture is obtained in the organization in the light of a proper management system where the management is committed to safety affairs and issues. Actually, safety culture is a part of an organization's culture which is impressed by the attitude and behavior of people in health and safety performance (Van Nunen et al., 2018; Tabari et al., 2021).

In a work environment, employees can face numerous health risks, including Biological Hazards (Jalilzadeh Yengejeh et al., 2014; Kazemi Noredinvand et al., 2016; Nikpour et al., 2020;), Chemical Hazards (Kordestani et al., 2017; Gashtasbi et al., 2017; Masoumi and Yengejeh, 2020; Mehrdoost et al., 2021), Physical Hazards (Oakman et al., 2022; Abd Wahab et al., 2023) and ergonomic hazards (Bhagwat et al., 2022; Sekhavati and Yengejeh , 2022; Sun and Khayatnezhad, 2021, Wang et al., 2022). Integrated HSE management deals with various fields of safety, personal and social health, equipment, and the environment with a systematic, very regular, and intertwined approach and health and knowledge basis (Fataei et al., 2013; Ahamad et al., 2022; Jalilzadeh Yengejeh and Sekhavati 2023). An integrated HSE management system tries to make a healthy, desired, and enthusiastic environment far away from the accident, damage, harm, and waste in an integrated manner with convergence and synergistic arrangement of human force, facilities, and equipment (Gamar, 2019; Khajeh Hoseini et al., 2021). The health, safety, and environment management system (HSE-MS) has a roadmap and three-step evolution path which reduces the speed and number of the dangers in safety, health, and the environment by moving gradually in these steps (Fataei et al., 2012; Vincent and Teodoriu, 2022; Hoseini et al., 2022). In the first step, establishing the relevant technology to HSE includes improving the engineering, hardware, and software in addition to compliance with the health, safety, and environmental requirements (Mamashli et al., 2019).

In the second step, the establishment of the HSE management system includes integration, competence, evaluation, and management of risk (Skogdalen and Vinnem, 2011). The last step of the effective execution of the HSE system is improving and establishing the HSE culture which stabilizes and improves all its elements. This step includes the improvement of attitudes, behaviors, and increase of commitment, leadership, and accountability (Grimm et al., 2020). A workplace health and safety management system is a set of policies, procedures and plans that systematically manages health and safety at work and can help to minimize the risk of injury and illness from workplace operations.

The studies after the major industrial accidents confirm that a great part of events, accidents, and semi-accidents occur as the result of unsafe behaviors which were formed in the wrong safety management system and improper safety culture (Li et al., 2022). Occupational accidents and disasters in developing countries are 3 to 4 times as many as in developed countries (Umar and Egbu, 2020), which shows the fact that 95% of occupational accidents are related to the weak safety culture in organizations. Studies have shown that the main factor of most accidents is the unsafe behavior of humans (Tong et al., 2019). Thus, one of the definite tech nic to reduce accidents and control the unsafe behavior of employees is actualized by promoting the safety culture level (Maliha et al., 2021). The importance of this matter is intensified when we know the experiences of the used safety acts in developed and developing countries show that using engineering and technical methods is not sufficient alone to prevent and cope with unsafe conditions. Of course, it is essential to think about tact by completing the usable policy (Akram et al., 2022). Therefore, this work needs to focus on the relevant issues to the safety behavior which initiates the main changes in safety and can significantly and efficiently promote it (; Sekhavati and Jalilzadeh 2022; Brauer, 2022). Obtaining an acceptable level of safety in industrial activities and a developed safety culture requires the principal and fundamental acts, the most important of which is promoting the employees' awareness in the workplace (Hassanpour Kourandeh and Fataei, 2013; Schroeder et al., 2019). The role of the safety management system is extremely important because of reducing accidents

as the axis of progress and evolution in various fields (Mostofie et al., 2014; Marhavilas et al., 2022; Raazi Tabari et al., 2020). Safety management is designed to the real methods, roles, and performances relevant to safety protection in the workplace (Derakhshan-Nejad et al., 2020; World Health Organization, 2022). Safety management methods are the policies, strategies, procedures, and activities of organization management with an aim of employees' safety. These methods are the essential elements of effective safety management in the company and are designed based on the present laws in an organization (Mohammadfam et al., 2017; Fataei, 2020). The execution level of these methods in the organization is indicated by various programs of management and should be transparent for employees (Asif et al., 2013; Fazeli et al., 2019; Gazijahani et al., 2017; Hadi Bonab et al., 2020).

Geller's model is a static model and does not change in the time period. Dynamic models change in a unit of time.Therefore, evaluating the safety culture of these industries' employees seems necessary particularly because these variables have not been evaluated yet at the domestic research level by the safety management system.

In this study, the evaluation of the safety culture in Carbon Company of Iran has been done using Geller's model.

2. Materials and Methods

Since the objective of this research is to describe the examined phenomena, this is considered descriptive research according to the data collection method. On the other hand, since this research is conducted to discover the realities about things and the questionnaire is used to collect data.

In addition, this research studies the relationships between variables, so it is correlational research. Accordingly, this is applied research because the oil managers and employees can make the most of its results. The statistical population of this research is the employees of Iran Carbon Company, and 120 employees from the utilization and repair sector were selected as the sample volume. Mahdinia et al. (2016) designed a questionnaire to evaluate the safety behavior of the industries' employees. This questionnaire includes 23 questions in two fields of safety (12 questions), and safety participation (11 questions). Obeying safety shows the employees' behavior on a path to increase their personal health and safety. However, safety participation shows the employees' behavior in the path to increase the colleagues' health and safety and support the organizational goals.

The basis of Geller's model, which consists of three main dimensions (behavior, environment, person), and in other models, these three parameters are not placed together. The scoring method for the questions of this questionnaire is based on a five-point Likert spectrum as follows:

Never: 1, Rarely: 2, Sometimes: 3, Often: 4, Always: 5

Questions 2, 3, 4, 5, 11, and 12 are scored reversely.

In this research, the validity ratio and total content validity index of the questionnaire were obtained to evaluate the content validity. The reliability of the questionnaire was tested using the test-retest method, ICC index, and Cronbach's alpha coefficient. The total Cronbach's alpha coefficient of the safety behavior questionnaire in the studied population was obtained 0.902. In addition, Cronbach's alpha coefficient for the safety observation and safety participation was obtained 0.86 and 0.87, respectively.

Geller model has 3 factors:

A- Human: knowledge, skill, abilities, motivation, and personality

B- Behavior: compliance, following, guidance, identification, communication, and active attention

C- Environment: equipment, instruments, physical arrangement, execution methods, standards

The basis of Geller's culture model is the continuous monitoring of the three mentioned aspects in the model. These three aspects are dynamic and can influence each other. On this basis, people decide to work safely, think safely, and finally express safe behaviors and change in their work conditions.

2. Results

The obtained results for the age condition of participants show that 5.8% out of the total sample volume are younger than 30 years, 53.3% are 30-40 years old, 34.2% are 41-50 years old, and 6.7% of participants are older than 50 years (Table 1).

Table 1. Frequency distribution of participants based on age

	Frequency	Percentage	The cumulative percentage
Younger than 30	7	5.8	5.8
30-40	64	53.3	59.2
41-50	41	34.2	93.3
Older than 50	8	6.7	100.0
Total	120	100.0	100.0

The obtained results about the academic condition of the participants show that 7.5% of participants out of the total sample volume have a diploma, 5% had an associated degree, 42.5% had a bachelor's degree, 40% of them had a master's degree, and 5% of them had Ph.D.

The obtained results from the work experience of participants show that 6.7% out of the total sample volume had work experience less than 5%, 26.7% had 5-10 years of work experience, 27.5% had 11-15 years of work experience, 39.2% had more than 15 years of work experience (Table 3).

Table 2. The descriptive statistics of participants based on the academic condition

	Frequency	Percentage	The cumulative percentage
diploma	9	7.5	7.5
associated degree	6	5.0	12.5
bachelor's degree	51	42.5	55.0
master's degree	48	40.0	95.0
Ph.D.	6	5.0	100.0
Total	120	100.0	

Table 3. The mean work experience of the research participants

	frequency	percentage	The cumulative percentage
Less than 5 years	8	6.7	6.7
5-10	32	26.7	33.3
11-15	33	27.5	60.8
More than 15	47	39.2	100.0
Total	120	100.0	

Table 4. Results of Kolmogorov-Smirnov test

	Kolmogorov-Smirnova		
	Statistic	Df	Sig.
Acts of safety management system	2.650	216	0.063
Acceptance of safety culture	3.029	216	0.069
safety participation	2.486	216	0.139

The normality of variables should be examined first to analyze the data and select the type of relevant test. If the variables are normal, we are permitted to use both parametric and non-parametric tests. However, if the variables are not normal, we are only permitted to use non-parametric tests. Kolmogorov-Smirnov test (K-S) is used to test the normality of variables.

H0: the relevant variable has a normal distribution.

H1: the relevant variable does not have a normal distribution.

According to the results of the Kolmogorov-Smirnov test (K-S) test (higher error of Kolmogorov-Smirnov statistics than 0.05), the data of this research is normal (Table 4).

Table 5. Correlation test between the acts of safety management system in acceptance of safety culture (first hypothesis)

		Acts of Safety Management System	Acceptance of Safety Culture
acts of safety management system	Pearson Correlation	1	0.009
	Sig. (2-tailed)		0.918
	N	120	120
acceptance of safety culture	Pearson Correlation	0.009	1
	Sig. (2-tailed)	0.918	
	N	120	120

1-There is a significant relationship between the acts of the safety management system and acceptance of safety culture.

To test this hypothesis, the significance test of Pearson's r has been used. The obtained results from this test show that the variables of the acts of the safety management system and acceptance of safety culture have a relationship with r=0.918 at sig. level of 0.009. It can be analyzed that there is a positive and significant relationship between these two variables (Table 5).

The correlation between the dependent and independent variables is 0.019. The determination coefficient was obtained 0.012, and this value shows that 0.012 of the changes in acceptance of safety culture are related to the acts of the safety management system (Table 6).

According to the mentioned table, the calculated sig. level for this statistic was 0.018 and shows the significance of a regression. Therefore, we conclude that the used model is a good estimation for the variable of "acceptance of safety culture".

The inserted variable in the regression equation is the main core of the regression analysis which is shown in Table 7. In this regard, it can be claimed that promoting 1 unit of the independent variable, i.e. acts of the safety management system, will promote the acceptance of safety culture up to 2.008 (Fig 1) (Table 8).

Table 6. The related regression to the first hypothesis

Model	Correlation coefficient	Determination coefficient	The adjusted determination coefficient	Standard error estimation
1	0.019a	0.012	0.008	5.50922

Table 7. Investigating the changes prediction for the acceptance of safety culture (first hypothesis)

	Model	Sum of squares	Df	Mean squares	F	Sig. level
1	Regression	.320	1	0.320	2.011	0.018a
	Residual	3581.472	118	30.351		
	Total	3581.792	119			

Table 8. The relevant regression coefficient to the first hypothesis

	Model	Regression non-standard coefficient		Regression standard coefficient	T	Sig. level
		B	Standard error	Beta		
1	(Constant)	50.006	5.237		9.548	0.000
	Acts of safety management system	2.008	0.080	0.019	0.103	0.018

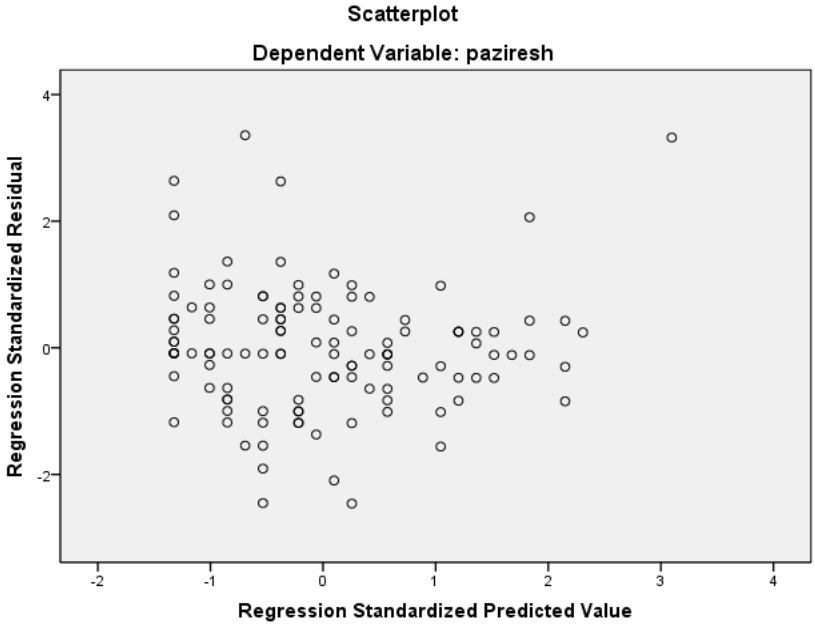

Fig 1. Regression of the acceptance of safety culture for the first hypothesis

2-There is a significant relationship between the acts of the safety management system and safety participation.
To test this hypothesis, the significance test of Pearson's r has been used. The obtained results from this test show that the variables of the acts of the safety management system and safety participation have a relationship with r=0.614 at sig. level of 0.014. It can be analyzed that there is a positive and significant relationship between these two variables (Table 9).
The correlation between the independent and dependent variables is 0.114. The determination coefficient was obtained 0.013, and this value shows that 0.013 of changes in safety participation are related to the acts of the safety management system (Table 10).
According to the mentioned table, the calculated sig. level for this statistic was 0.014 and shows the significance of a regression. Therefore, we conclude that the used model is a good estimation for the variable of "safety participation"
The inserted variable in the regression equation is the main core of the regression analysis which is shown in Table 11. In this regard, it can be claimed that promoting 1 unit of the independent variable, i.e. acts of the safety management system, will promote safety participation up to 2.008 (Table 12) (Fig 2).

Table 9. Correlation test between the acts of safety management system in acceptance of safety culture (first hypothesis)

		Acts of safety management system	Safety participation
Acts of safety management system	Pearson Correlation	1	0.014
	Sig. (2-tailed)		0.614
	N	120	120
Safety participation	Pearson Correlation	0.014	1
	Sig. (2-tailed)	0.614	
	N	120	120

Table 10. Correlation test between the acts of safety management system in acceptance of safety culture (first hypothesis)

Model	Correlation coefficient	Determination coefficient	The adjusted determination coefficient	Standard error estimation
2	0.114a	0.013	0.005	3.50325

Table 11. Correlation test between the acts of safety management system in acceptance of safety culture (first hypothesis)

	Model	Sum of squares	Df	Mean squares	F	Sig. level
1	Regression	19.116	1	19.116	2.558	0.014a
	Residual	1448.184	118	12.273		
	Total	1467.300	119			

Table 12. The relevant regression coefficient to the second hypothesis

	Model	Regression non-standard coefficient		Regression standard coefficient	T	Sig. level
		B	Standard error	Beta		
1	(Constant)	29.513	3.330		8.862	0.000
	Acts of safety management system	0.063	0.051	0.114	1.248	0.014

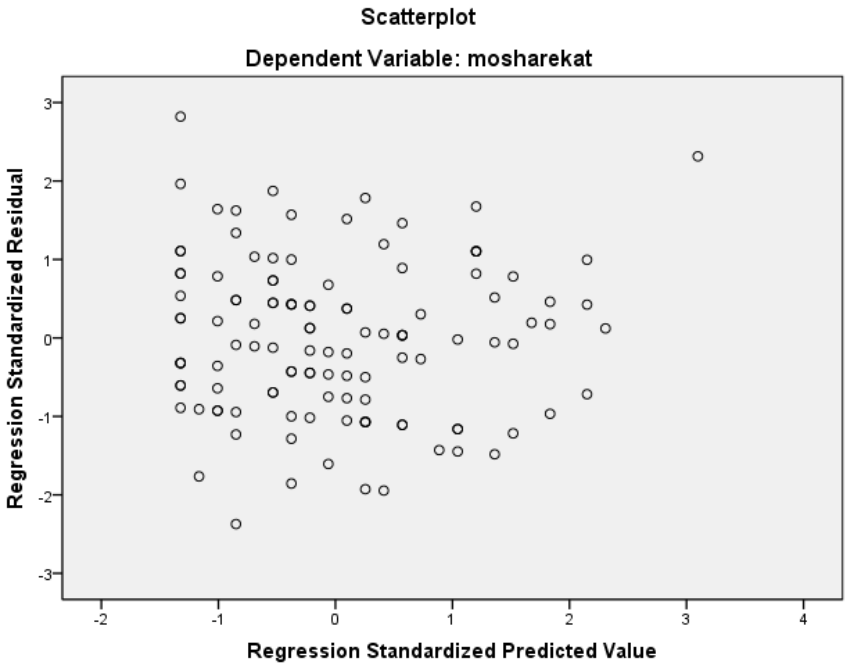

Fig 2. Regression of safety participation

4. Discussion

The objective of this research was to evaluate the role of the safety management system in the safety culture of Iran Carbon Company using Geller model. Therefore, 2 questions and 2 hypotheses were proposed in which the relationship between the acts of safety management system with the acceptance of safety culture, and the relationship between the acts of safety management system with safety participation was investigated. Thus, first, the checklist and questionnaire were indicated after the surveying. The behavior questionnaire of Mahdinia et al. (2016) was used to investigate the acceptance of safety culture and safety participation. The results of this research indicate that the ease of safety management has a significant relationship with the adoption of safety culture, and compared to a similar study regarding the effect of behavior-based safety interventions in reducing unsafe practices in an automobile company, they have come to the conclusion that the development of safety-based orientation on the behavior, one of the unsafe behaviors and as a result, reducing the rate of accidents in the country's industries.

Data was analyzed in two parts of descriptive and inferential statistics. The descriptive findings showed that the research data in the descriptive analysis part expresses the frequency of age, educational level, and work experience of the studied sample, and its results are as follows:

The obtained results about the age condition of participants showed that 5.8% out of the total sample volume are younger than 30 years, 53.3% of participants are in the age range of 30-40, 34.2% are in the age range of 41-50 years, and 6.7% are 50 years old. The obtained results about the educational level of participants show that 7.5% out of the total research sample volume have a diploma, 5% have an associated degree, 42.5% have a bachelor's degree, 40% have a master's degree, and 5% of participants have Ph.D. The obtained results from the work experience of participants show that 6.7% out of the total research sample volume have less than 5 years of work experience, 26.7% have 5-10 years of work experience, 27.5% have 11-15 years of work experience, and 39.2% of participants have more than 15 years of work experience.

5. Conclusion

Results of this research show that acts of a safety management system have a significant relationship with the acceptance of a safety culture. The obtained results from the findings of this research are aligned with the theoretical bases and findings of the literature. Moreover, the results of this research showed that acts of safety management system have a significant relationship with safety participation. The results showed that promoting health, safety, and the environment have improved in 2001-2003 when the HSE system was executed.

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