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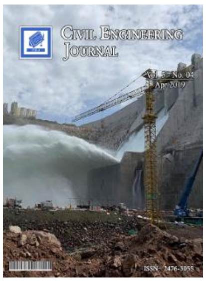

Investigating Factors of Safety Culture Assessment in Construction Industry Projects

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Abstract

Early signs of an organizational commitment to safety policies are manifested in the safety culture in that organization. Improving the safety culture of contractors can reduce occupational accidents in construction industry projects. Many scholars tend to research on this concept in order to achieve an approach to reducing occupational accidents. Numerous studies have attempted to identify the components affecting the safety culture using various methods and tools for measuring and assessing the safety culture; nevertheless, none of these studies measured the impact level of each of the evaluated factors on the safety culture. Hence, this study, assess the influence of each of these factors on the safe culture of contractors working in the construction industry. This study used a structural equation modeling approach to examine the safety culture assessment factors. Accordingly, ten factors affecting the safety culture were scrutinized to provide a conceptual model with ten predictable paths for evaluating the relationships between the variables. The data collected from thermal power plant construction projects were applied to test the hypothesized model experimentally using SEM-PLS method. According to the results of this study, it can be concluded that the factors of management commitment, appraisal of work hazards, supportive environment and communication among the factors influencing the safety culture of contractors in the studied projects had respectively the most impact on the safety culture of contractors operating in the thermal power industry, as well as the work pressure had the least impact on the safety culture..

Keywords: Construction; Power Plant Projects; Safety Culture; Health & safety; Structural Equation Modeling (SEM).

1. Introduction

About one-third of the work-related deaths occur due to industrial accidents. The cost of these incidents is estimated at around 5,000,000 million dollars annually in the world due to the loss of human resources, materials, equipment and time [1]. On the other hand, the construction is one of the most dangerous industries in the world [2–4]. For example, the incident rates, which represent the number of injuries and illnesses in the construction industry, were significantly higher than the national average among all industries in most countries [5]. Accidents in this industry occur due to various causes that can generally be categorized as accidents from hazardous situations or physics and those caused by unsafe behaviors or actions [6]. Accordingly, many research focused on the behavior of individuals as one of the main causes of accidents [7, 8]. It is believed that the establishment of a suitable safety culture in the organization and individuals is an important strategy for reducing occupational accidents [9]. In general, the organizations with strong

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safety culture and its continuous improvement perform better in preventing individual and organizational accidents [10].

Accordingly, many industries have shown their willingness to research on the safety culture as a factor in reducing the potential risks and incidents [11]. For this reason, various safety studies in recent years have been mostly focused on the safety culture and safety climate [12]. One of the most catastrophic disaster occurred in 1986 in Chernobyl, Ukraine. After this accident, many studies were conducted on discovering the causes of the incident and eventually led to the emergence of the concept of a safety culture [13]. Since then, various questions about big events have been raised regarding deficiencies in organizational structure and safety management systems, and so the importance of safety culture became more prominent [14].

Knowledge on the significance of safety culture in preventing the occupational accidents refers to numerous efforts to identify and assess the safety culture in the organizations, but there is still no overall definition of the safety culture in different organizations, because the safety culture is a multidimensional concept and has no clear structure. However, the common point is quite clear from the various definitions of safety culture so that the concept of culture is nothing but the values, beliefs, thoughts and behaviors of individuals about the safety [15].

Safety culture, which represent proactive indicators of safety performance, are highly linked to safety behaviors of workers. Leadership from contractors and other stakeholders all have significant impacts on safety culture [16]. Commonly defined elements within safety culture and safety climate include but are not limited to management commitment [17], co-workers caring and communication [18], and safety behavior [19]. A high attention within safety culture has been paid on workers, such as worker behavior [20], safety compliance [21]. Therefore multiple components have an impact on the safety culture of organizations and individuals. Numerous studies have attempted to identify the components affecting the safety culture using various methods and tools for measuring and assessing the safety culture; for example, the 9-item questionnaire by Cox et al. (2000) and the 9-item questionnaire Arghami (2016) for measuring the safety culture in thermal power plant construction projects [22]. Nevertheless, none of these studies measured the impact level of each of the evaluated factors on the safety culture. This study used the structural equation modeling (SEM) to evaluate the impact of factors affecting the safety culture on industrial projects and to assess the influence of each of these factors on the safe culture of contractors working in the construction industry.

On the other hand, the power plant construction projects have different characteristics comparing to regular construction projects, since they are large-scale projects, have a high degree of complexity, and include variety of construction activities. Therefore, these projects are highly prone to occurrences of events. Iran is ranked fifth in terms of global electricity generation, and as a developing country needs to increase its annual electricity production by about 5% [23]. Statistics show that over 80% of the electricity needed for Iran is supplied through gas, steam and combined cycle electric power plants [24]. On the other hand, the risky nature of building power projects, the increase in contracting companies in this area, the volume of projects, the complexity of work processes and the outsourcing of activities naturally highlight the need to pay attention to promoting safety and safety culture in these projects. Therefore, since the occurrence of events is different in industries and regions, this study examines the impact of factors influence on the safety culture in the construction of power plants projects (gas, steam and combined cycle) in Iran.

As previously mentioned, various studies measured safety culture in construction projects, however the impact of each of the factors on the safety culture has not been evaluated. Therefore, the innovation of this research is the use of structural equation modeling to assess the factors affecting the safety culture in the construction of thermal power plants in Iran. In addition, this method has not been used to assess the safety culture in the construction industry in Iran.

The results of this research will be able to assist contractors and decision-makers of power plant construction projects to have a conception of the most important factors and agents affecting the safety culture and prioritize them in the most optimal way to improve the safety culture and reduce the incident rates

2. Methods

With the aim of evaluating the culture embedded in the conducts of an organization, various methods are being applied which are both qualitative, say, collective and directed discussions, considerations and observations, going through the historically archived data, and individually focused case studies, or quantitative, say, surveys [25]. However, it seems that there is a relatively firm consensus among researchers that these methods, i.e., qualitative and quantitative, both can play a great role in the assessment and evaluation of the existing theories [26]. Nevertheless, when it comes to the time and cost aspects of doing a research, the quantitative methods, especially those like survey distribution and the like, which collect individual answers and remarks, are more reliable and manageable in terms of their practical capacities [26]. As a result, distributing survey and questionnaires are an important part of any evaluation and assessment made with regard to the safety culture, and, if fact, have been used extensively in various industries ranging from nuclear power, construction, chemical to manufacturing and transportation [27].

Mohammed (2002) presented a 10-factor framework for measuring and assessing the safety climate in construction projects [28]. The empirical study about assessment of safety culture on construction project conducted by Teo and

Feng (2009) demonstrates that the use of safety climate questionnaire could provide a reliable indication of the level of overall safety culture for construction projects [29]. Accordingly, Feng (2014) developed the 10 factors introduced by Mohammed (2002) and evaluated them for the safety culture in construction industry projects. The present study utilized the factors and questionnaire provided by Feng (2014) to assess the safety culture of contractors involved in the thermal power plant construction projects, including:

- Management Commitment (SCF1)
- Communication (SCF2)
- Safety Rules and Procedures (SCF3)
- Supportive Environment (SCF4)
- Supervisory Environment (SCF5)
- Workers' Involvement (SCF6)
- Personal Appreciation of Risk (SCF7)
- Appraisal of Physical Work Environment and Work Hazards (SCF8)
- Work Pressure (SCF9)
- Level of Competence and Training (SCF10)

Each of these factors has subclasses whose evaluation is done by a phrase as question that is answered with a five-point Likert scale. The questionnaire used in the research is presented in the Appendix I.

This study employed Structural Equation Modeling (SEM) to simultaneously assess these ten factors to measure the safety culture in construction projects. The SEM as a multivariate method allows to simultaneously examining the relationship between independent and dependent structures in a theoretical model.

there are certain benefits and merits in the application of SEM from among which one can refer to (i) its ability to deal with sophisticated associations among various variables in case that some of these variables can be considered as hypothetical or potential or without the scope of observation; (ii) it is capable of producing a synchronic or simultaneous assessment of all the coefficients involved in a model and, for this reason, capable of estimating the importance of the role of certain relationships within the framework of a complete model; and, (iii) the model sketched out hypothetically will be able to be put to test in a statistical manner in the synchronic or simultaneous scrutiny of the system of variables as a whole with the aim of identifying the degree of its consistency with the collected data [30, 31].

The SEM method is classified into two categories: CB-SEM method based on covariance and PLS-SEM method based on partial least squares [32]. The PLS-SEM method was used in this study because of non-normal data that can be analyzed using the PLS method. In addition, the PLS method does not require a large number of samples, and can calculate hidden structures in a small statistical society as a linear combination of visible variables through their weight relationships [33]. The program used in this study was Smart PLS Version: 2.0.M3. The PLS method can be used to evaluate both the hidden (i.e., dependent) variables measured by the observed variables (i.e., indexes), and the relationship between the variables (i.e., the path coefficients of the hypotheses) [28].

The structural equation model has three major contents: hypothesis testing, structural confirmatory and modeling analysis [34]:

(1) Hypothesis testing: Hypothesis testing is the primary content of the structural equation model. The researchers make their own assumption model and by way of hypothesis testing validate the relevance of the relationship between the physical model and individual variable.

(2) Structural confirmatory: composed of a group of dimensions that cannot be directly observed and measured, but its existence is proved by statistical data obtained. This is also one of the main advantages of the structural equation model. The variables relationship is not simply variable inferences or discussion between variables relations, but also involves a latent cause and effect relationship and class issues. The inspection or verification of causality of structure in the scale depends on the nature and content of the variables clarified beforehand, understanding the hypothetical relationship between the variables, and then putting forward a series of specific hypothetical structural relationships to seek a statistical verification.

(3) Modeling analysis: to form the above explored hypothetical testing and structural confirmatory for a meaningful hypothetical model with a series of theoretical assumptions, and then through statistical procedures and fit to serve as a model verification.

2.1. Hypotheses and Model Structure

After introducing effective factors for assessing the safety culture, we will design a research model. In order to construct a theoretical model of research to analyze the relationships between factors and the safety culture, the following hypotheses were developed for analysis:

- H1 -The greater the level of management commitment toward safety, the more positive the safety culture
- H2 -The more effective the intra-organizational communication dealing with safety issues, the more positive the safety culture
- H3 -The better the perception of safety rules and procedures, the more positive the safety culture
- H4 -The higher the level of support given by coworkers, the more positive the safety culture
- H5 -The more safety aware and relationship oriented the supervisors, the more positive the safety culture.
- H6 -The higher the level of workers' involvement in safety matters, the more positive the safety culture
- H7 -The higher the level of workers' willingness to take risk, the less positive the safety culture
- H8 -The greater safety's integration in site layout planning to identify safety hazards, the more positive the safety culture
- H9 -The higher the perception of work pressure, the less positive the safety culture
- H10 -The greater one's experience and knowledge of safety issues, the more positive the safety culture

Based on the above hypotheses, the hypothesized model for the simultaneous relationships of factors affecting the safety culture is shown in Figure 1 In this model, the safety culture factors (SCF) were evaluated by SCF1 to SCF10 construct. These structures were measured by reflection indicators, which were the same question statements in the questionnaire.

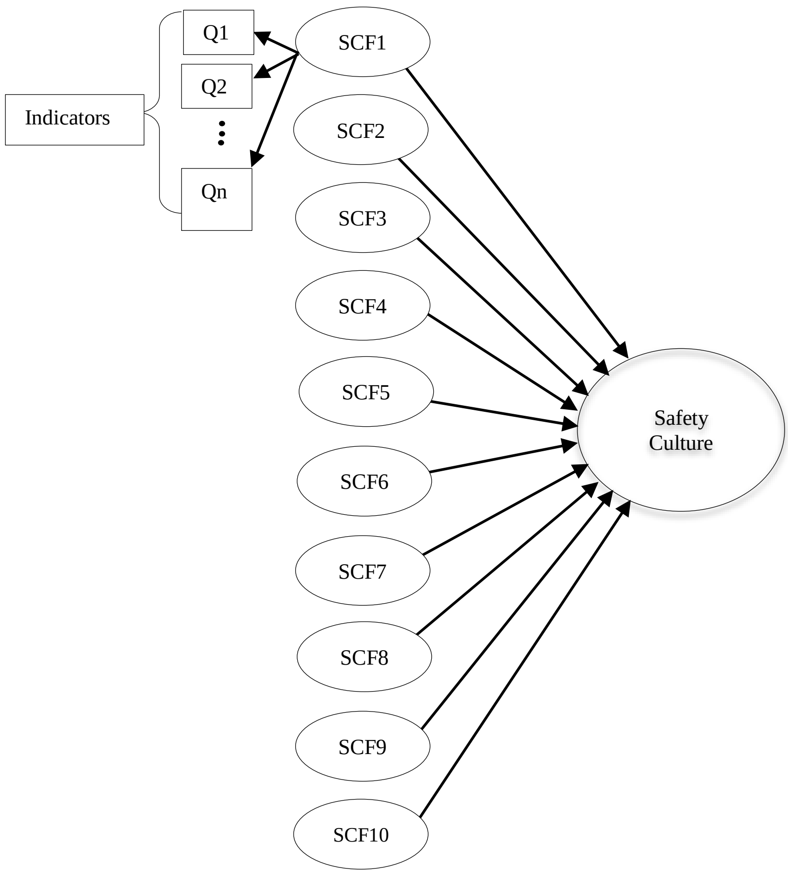

Figure 1. The hypothesized model of research

2.2. Statistical Population

The statistical society used for the analysis of the data of the present research includes the contractor companies employed for the construction of gas, steam, and combined cycle power plants. With regard to the complexity of the power plant related projects, in Iran, usually the task of constructing such power plants is assigned to a manager contractor (MC). The MC then divides the principal parts of the activities involved in the task of constructing the power plant and assigns a specialized contractor, with particular area of expertise for each, to the task of executing one of these divided parts. For instance, the projects of the power plants took as the case studies of the present research included civil works contractors, ACC cooling tower structure building tasks, Heller cooling tower construction, the erection of cooling facilities, the installment of Steam Turbine Generator (STG), the installment of the support steam system and boiler, the installment of heat recovery steam generator (HRSG), the installment of gas turbine generator (GTG) and its supplementary devices, the execution of the balance of plant (BOP), the execution of water treatment plant (WTP), and the operation tasks all of whom working under the supervision and guidance of the manager contractor of the project.

For collecting the data required to carry out the present study, connections were made with the manager contractors of 28 power plant construction projects from among whom 19 power plant related project managers participated in this study and by their assistance and participation, the information was collected from 78 contractor companies employed in areas with expertise in the task of the construction of power plant related projects. In Table 1, the number of the contractors participating in this study along with the area of activity of each of them is stated.

Table 1. Distribution of contractors

Type of contractors activity	Frequency	Percentage
Civil works	11	14.1
Structure of ACC cooling tower	8	10.3
Structure of Heller cooling tower	5	6.4
Erection of cooling facilities	6	7.7
Installment of STG	7	9.0
Erection support steam system	8	10.3
Erection of boiler	8	10.3
Execution of BOP	8	10.3
Execution of WTP	9	11.5
Operation	8	10.3
Total	78	

3. Data Analysis and Result

Using the data collected through the questionnaire, the hypotheses of the research and the hypothesized model were evaluated empirically by SEM method. The SEM method assessment consists of two main parts:

A) Evaluation of the measurement model: indicates the relationship between hidden variables and their indexes and exhibits whether the hidden variables were measured with accuracy, these criteria are:

Confirmatory factor analysis (CFA) should be 0.4 [35]. Cronbach's alpha (CA) and composite reliability (CR) should be more than 0.7 [36]. Average extracted variance (AVE) should be at least 0.5 [37].

CFA criteria are presented in Table 2, the results show that the CFA for all questions to assess the safety culture indexes is between 0.5 and 0.9, which is greater than 0.4, indicating that these criteria are suitable for measuring indexes.

Table 2. CFA for questions to assess the safety culture indexes

Factor	SCF1				
Question	Q1	Q2	Q3	Q4	Q5
CFA	0.75	0.68	0.81	0.72	0.7
Factor	SCF2				
Question	Q6	Q7	Q8	Q9	Q10
CFA	0.77	0.76	0.8	0.79	0.69
Factor	SCF3				
Question	Q11	Q12	Q13	Q14	Q15
CFA	0.73	0.89	0.87	0.78	0.79
Factor	SCF4				

Question	Q16	Q17	Q18	Q19	Q20
CFA	0.69	0.59	0.82	0.68	0.78
Factor			SCF5		
Question	Q21	Q22	Q23	Q24	
CFA	0.75	0.87	0.79	0.83	
Factor			SCF6		
Question	Q25	Q26	Q27	Q28	
CFA	0.59	0.78	0.68	0.74	
Factor			SCF7		
Question	Q29	Q30	Q31	Q32	Q33
CFA	0.88	0.79	0.61	0.57	0.69
Question	Q34	Q35	Q36		
CFA	0.76	0.71	0.83		
Factor			SCF8		
Question	Q37	Q38	Q39	Q40	Q41
CFA	0.79	0.65	0.59	0.73	0.81
Question	Q42	Q43			
CFA	0.89	0.72			
Factor			SCF9		
Question	Q44	Q45	Q46	Q47	Q48
CFA	0.88	0.76	0.65	0.58	0.73
Factor			SCF10		
Question	Q49	Q50	Q51	Q52	Q53
CFA	0.58	0.82	0.78	0.61	0.75

The results of Smart PLS software output for CA, CR, and AVE criteria are presented in Table 3, which shows acceptable validity and reliability of the measurement model indexes.

Table 3. Evaluation results of the measurement model

Construct/ Index	Cronbach's alpha (CA)	Average extracted variance (AVE)	composite reliability (CR)
SC1	0.88	0.73	0.94
SC2	0.80	0.77	0.84
SC3	0.75	0.68	0.80
SC4	0.71	0.67	0.78
SC5	0.83	0.72	0.87
SC6	0.90	0.60	0.93
SC8	0.79	0.76	0.83
SC9	0.77	0.75	0.82
SC10	0.78	0.62	0.75

B) Hypothetical model assessment (Path coefficients): After evaluating the measurement model, the structural model is evaluated and the hypothesis of the research is tested. The first criterion for assessing the structural model is the significance t coefficient that is evaluated in Smart PLS with the Bootstrapping technique, and this coefficient should be greater than 1.96 to confirm the hypothesis at 95% confidence interval [35]. According to suggestion of Hire (2011), the number of bootstrap was considered to be 5000 in this study [36], and the number of samples was 78 in the software. The t-values for each of the model hypotheses are presented in Table 3. According to the results, it found that all hypotheses have a significant relationship with a high 95% confidence interval and are confirmed.

Another criterion for assessing the hypothetical model is R2, which represents the level of influence of the independent (or exogenous) variables on the dependent variable (endogenous). The higher the R2 value, the better the fit. Three values of poor (0.19), moderate (0.33) and strong (0.67) have been introduced to evaluate R2 [38]. In this research, the safety culture was a dependent variable that is under the influence of the ten factors of SCF1 to SCF10. The R2 value for the dependent variable of the safety culture was equal to 0.61, confirming the appropriateness of the structural model fit according to the earlier mentioned values.

Finally, the values of route coefficients that are extracted from the Smart PLS software can be used to assess the level of influence of the ten factors on the safety culture. The higher the route coefficient indicates the stronger the impact of a variable on the other. Figure 2 shows the route coefficients of the software output for the model. Table 4 is summarized the route of the hypotheses, the route coefficients, and T-value coefficient of the software output.

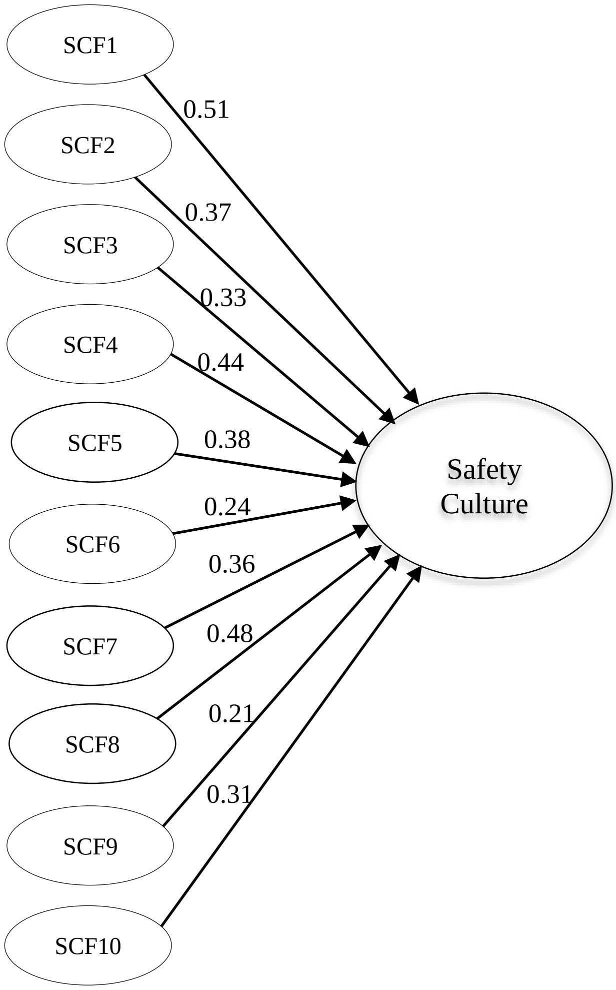

Figure 2. The paths coefficients of research model

Table 4. The fitting results of the hypothesized model paths

Hypothesis	Hypothesis path	t-value	Path coefficient	Hypothesis state
H1	Management Commitment → +SC*	3.14	0.51	Accept
H2	Communication → +SC	2.31	0.37	Accept
H3	Safety rules and procedures → +SC	2.17	0.33	Accept
H4	Supportive environment → +SC	2.47	0.44	Accept
H5	Supervisory environment → +SC	2.38	0.38	Accept
H6	Workers' involvement → +SC	2.02	0.24	Accept
H7	Personal appreciation of risk → -SC	2.26	-0.36	Accept
H8	Appraisal of work hazards → +SC	2.78	0.48	Accept
H9	Work pressure → -SC	1.98	-0.21	Accept
H10	Competence → +SC	2.17	0.31	Accept

4. Discussion

Based on the presented research model and the results of Table 4, we can extract the following items:

The hypothesis 1 was verified according to t-value of 3.14 with 95% confidence interval. Considering its high path coefficient (0.51), it can be concluded that the management commitment to safety issues has a great impact on the safety culture of contractors. This finding correlates with the results of Zhou et al. (2008), who indicated that management commitment is paramount importance for the development of safety culture as well as the allocation of resources to safety [39]. The hypothesis 2 was confirmed with t-value = 2.31 and shows that improving intra-organizational communication in contracting companies has a positive impact on the safety culture of contractors. This is consistent with the studies of Shin et al. (2013) who stated that communication is very important to create safer construction environments and to prevent possible accidents [40]. In addition, Hofmann and Stetzer (1998) claimed that accidents can be reduced in a safe communication climate. In other words, workers in a group of active communication on accidents are less likely to encounter accidents than those in a group who do not actively share the information regarding accidents [41].

Both hypotheses 1 and 2 emphasize intra-organizational safety and compliance with the findings of Edmondson (1996) who found that handling errors in a negative way engendered a negative climate that in turn influenced the willingness of both management and employees to communicate freely and discuss mistakes and problems. Therefore, one can conclude that both commitment and communication are prerequisites to creating and sustaining a positive safety culture in construction site environments [42].

Results show that the hypotheses 3 was verified, this is consistent with Shin's research, which states procedures and rules are prominent sub factor of safety culture. The hypothesis 4 was verified according to t-value of 2.47 with 95% confidence interval. Considering its high path coefficient (0.44), it can be concluded that a construct of employee caring seems to be an important safety culture construct related to moment-to-moment safety behaviors. Nevertheless, there is a robust model of employee-focused caring in the safety literature. For over two decades, Geller (2000, 2001) has been advocating an Actively Caring factor as an essential part of safety culture [43, 44]. The results for hypotheses 3, 4, and 5 (respectively, safety rules and procedures, supportive environment, and supervision) indicate that these three factors, which are categorized under the safety system, affect the safety culture. The supportive environment seems to have a relatively greater significance than the environmental supervision because a building worker affects constantly coworkers and is affected largely by the safe working environment. These findings indicate that the workers in safe working environments are more likely to have better working relationships with managers, supervisors and coworkers.

The model confirms the hypotheses of 6, 7 and 8 (effective level of workers' involvement, promoting the level of workers' willingness to take risk and assessing work-related hazards). As to hypothesis 6, Safety involvement refers to the participatio n of all employees and associate d parties in safety work, which would enhance the implementation of safety culture. Mohamed (2002), Fang et al. (2006) identified involvement as part of safety culture factor structure by intensive literature review and factor analysis respectively [28, 45]. This element was also supported by the work of Dedobbe-leer and Beland (1998) [46]. Given the path coefficient of 0.48 for the hypothesis 8, one can conclude that understanding and evaluating the hazards by individuals and employees have a strong positive relationship with employee safety culture. This finding correlates with the results of Mohammed (1999), who indicated that the ability to detect and evaluate potential hazards plays an important role in the safety performance and safety culture of an organization and this issue improves with safety training and the level of management effort in the field of safety [47]. According to this, With a low level of safety knowledge, an inexperienced worker may not have the ability to detect a surrounding hazard, may not recognize the risk, may not know the way to get rid of the hazard, or may lack the right skill to execute the correct response, which may be associated with failures of detecting hazards, recognizing hazards, perceiving responses.

The hypothesis 9 has a path coefficient of -0.19, which suggests that high work load have little effect on employee safety culture, which is close to the results of research by Mohammed (2002) who stated that work load has insignificant impact on safety culture of the employees [28].

According to t-value of 2.17, the hypothesis 10 shows a significant relationship between organizational competence and safety culture, and the greater the competence of an organization and its employees, the better the safety culture of the organization. This is consistent with the studies of Laukkanen (1999) who reported that experienced and efficient workers and personnel have fewer signs of stress and are less vulnerable compared to inexperienced people [48]. Also when employee safety competency decreases, safety culture can be affected and risk awareness and understanding is decreased, that may lead to further increase in the disabling injury frequency rate.

5. Conclusion

In the present study, we tried to evaluate the factors affecting the assessment of safety culture in the construction projects. For this purpose, an approach based on structural equation modeling was used to examine the safety culture evaluation factors. Accordingly, ten effective parameters in the safety culture were scrutinized to provide a conceptual model with ten presumed paths for evaluating the relationships between the variables. The data collected from thermal power plant construction projects were applied to test the hypothesized model experimentally using SEM-PLS method. According to the results of this study, it can be concluded that the factors of management commitment, appraisal of work hazards, supportive environment and communication among the factors influencing the safety culture of contractors in the studied projects had respectively the most impact on the safety culture of contractors operating in the thermal power industry, as well as the work pressure had the least impact on the safety culture.

6. Limitation

The first limitation is related to the generalizability of research findings. As previously mentioned, the safety culture is different in various regions and industries. The findings of this research are based on information from power generation projects in Iran and should be interpreted in this area. Another limitation in this research is small sample size due to the low number of power plants and the low contractor response rate. It is worth noting that the PLS method was used to solve this problem, which is the most appropriate method for analyzing structural equations for data with small sample size.

7. Acknowledgements

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8. Conflicts of Interest

The authors declare no conflict of interest.

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Appendix I: Questionnaire

Please indicate to what extent you agree or disagree with each of the following statements based on the safety practices in this project by ticking your responses using the following scale:

Strongly Disagree (1); Disagree (2); Neutral (3); Agree (4); Strongly Agree (5).

Statements	Scale				
1- Management Commitment					
Top management considers safety to be more important than productivity	1	2	3	4	5
Management acts only after accidents have occurred	1	2	3	4	5
Management praises site employees for working safely	1	2	3	4	5
Management penalizes site employees for working unsafely	1	2	3	4	5
2- Communication and Feedback					
Management clearly communicates safety issues to all levels within the organizations	1	2	3	4	5
Management operates an open-door policy on safety issues	1	2	3	4	5
Management encourages feedback from site employees on safety issues	1	2	3	4	5
Management listens to and acts upon feedback from site employees	1	2	3	4	5
Management communicates lessons from accidents to improve safety performance	1	2	3	4	5
3- Supervisory Environment					
Site management and supervisors see themselves as safety role models for all workers	1	2	3	4	5
Supervisor/safety officer usually engages in regular safety talks.	1	2	3	4	5
Supervisors endeavour to ensure that individuals are not working by themselves under risky or hazardous conditions.	1	2	3	4	5
Supervisor/safety officer is a good resource for solving safety problems.	1	2	3	4	5
Supervisors have positive safety behaviour.	1	2	3	4	5
4- Supportive Environment					
As a group, workers maintain good working relationships.	1	2	3	4	5
Co-workers always offer help when needed to perform the job safely.	1	2	3	4	5
Workers always remind each other on how to work safely.	1	2	3	4	5
The communication between workers and supervisors is effective (no language barriers)	1	2	3	4	5
The communication between workers and their co-workers is effective	1	2	3	4	5
5- Work Pressure					
Workers always work under a great deal of tension, and not given enough time to get the job done safely.	1	2	3	4	5
Under tight schedule, management tolerates minor unsafe behaviours performed by workers	1	2	3	4	5
The wages of workers are not determined solely by the amount of work completed by them	1	2	3	4	5
Productivity targets are in conflict with some safety measures.	1	2	3	4	5
6- Personal Appreciation of Risk					
Everyone on site is clear about his/her responsibilities for safety.	1	2	3	4	5
Everyone on site is aware that safety is the top priority in his/her mind while working	1	2	3	4	5
Workers are willing to report the unsafe and unhealthy conditions on site.	1	2	3	4	5
Workers have the right to refuse to work in unsafe and unhealthy conditions.	1	2	3	4	5
7- Training and Competence level					
There is adequate safety training to site management team, such as supervisors and project management team members.	1	2	3	4	5
There is adequate safety certification & training for the operators in the project.	1	2	3	4	5
Enough safety training is conducted for personnel receiving and handling hazardous chemicals.	1	2	3	4	5
Enough in-house safety training and orientations for workers (including sub-contractors) on site.	1	2	3	4	5
The designated persons of the permit-to-work systems have the appropriate certificates and experience.	1	2	3	4	5
Workers are familiar (>1 year experience in similar type of work) with the type of work that they are doing in this project.	1	2	3	4	5
Personnel are required to attend refresher and upgrading course on a regular basis to maintain and enhance their safety knowledge and awareness	1	2	3	4	5

8- Safety Rules and Procedures					
Your project has a project-specific Health & Safety (H&S) plan	1	2	3	4	5
The set of safety rules and regulations is reviewed or updated periodically (minimum once per year).	1	2	3	4	5
The set of safety rules and regulations is understood by site supervisors.	1	2	3	4	5
The set of safety rules and regulations is understood by workers.	1	2	3	4	5
Permit-To-Work (PTW) systems are established and implemented.	1	2	3	4	5
Emergency and initial response procedures were developed.	1	2	3	4	5
There are procedures to ensure that the sub-contractors meet the site safety requirements.	1	2	3	4	5
There is a system to record and monitor worker’s behavior and/or attitude.	1	2	3	4	5
9- Workers’ Involvement					
Workers play an active role in identifying site hazards.	1	2	3	4	5
Workers report accidents, incidents, and potentially hazardous situations.	1	2	3	4	5
Workers are consulted when safety plan is compiled.	1	2	3	4	5
Workers are involved with Health and Safety (H&S) inspections.	1	2	3	4	5
10- Appraisal of Work Hazards					
There is an established and implemented hazard analysis or risk assessment Programmed /plan.	1	2	3	4	5
Potential risks and consequences are identified prior to execution.	1	2	3	4	5
Control measures for risks identified are adequate.	1	2	3	4	5
The inspection systems for the following items in the project were adequate.	1	2	3	4	5