Int. J. Nonlinear Anal. Appl. 11 (2020) No. 1, 525-536
ISSN: 2008-6822 (electronic)
http://dx.doi.org/10.22075/ijnaa.2020.4371

Proposing a structural equation model for systematic management on incident costs

Hossein Rahmani[a], Mohammadreza Miri Lavasani*[,b], Mahnaz Mirza Ebrahim Tehrani[c], Farhad Hosseinzadeh Lotfi[d]

[a] *Phd student, Department of Environmental management, Islamic Azad University, Science and Research Branch, Tehran, Iran.*
[b] *Associate Professor, Department of Accounting, Central Tehran Branch, Islamic Azad University, Tehran, Iran.*
[c] *Assistant Professor, Department of Environmental management, Tehran North Branch, Islamic Azad University, Tehran, Iran.*
[d] *Professor, Department of statistics, Islamic Azad University, Science and Research Branch, Tehran, Iran.*

(Communicated by Madjid Eshaghi Gordji)

Abstract

Analyzing the events based on statistics and published information, numerous accidents of various types have occurred around the world with destructive and undesirable effects on the country's capital, and in some cases the effects have exceeded the country's borders and reached beyond the borders of the country. The purpose of the study is to manage the direct and indirect costs of accidents and improve the mechanism of accident management based on the critical costs of accidents across the country. This study is considered applied study in terms of purpose and is considered descriptive-survey in terms of methodology. The statistical population of the research includes experts in oil, gas, petrochemical, cement, steel, power plant, road construction and construction industries as well as university professors related to occupational health, industrial safety, HSE along with active professors in crisis and emergency management from which 384 people were randomly selected using the Morgan table. This research was conducted in the period of 1997 and 1998 determining the costs of work-related accidents. The research has been carried out in various upstream, oil, gas and petrochemical industries, steel and cement industries and other industrial and urban areas. The research instrument includes a researcher-made questionnaire. Data analysis was performed using SmartPLS structural equation software. All emergency actions (accident confrontation/initial accident costs), accident investigation costs, damage costs, work-related accident damages (personnel replacement costs), costs related to production of products/services, cost of marketing activities

*Corresponding Author: Mohammadreza Miri Lavasani

Received: April 2019 *Revised:* December 2019

(maintenance), reputation and work credit and resumption of work activities have the ability to measure occupational accidents.

Keywords: Designing structural equation models, Systematic cost management, Occupational accidents.
2010 MSC: 76T20

1. Introduction

Various events and incidents in health, safety and the environment (HSE) field have many adverse consequences and often have irreparable effects on human beings, capital, environment, the reputation and credibility of the industry. However, information about events in (HSE) field, especially incidents in safety field, its impact, as well as its considerable consequences around the world, especially in developing countries such as Iran are not available due to the lack of appropriate mechanisms and unsuitable systems of incidence registration and integrated, codified and systematic information systems in the field of incidence and all statistics regarding industry are not attributable in the framework of specific industry and the Ministry of Labor, Welfare and Social Affairs and the Ministry of Health, Treatment and Medical Education. On the other hand, in economic analysis and planning in the field of health, safety and environment, due to the lack of incidence reporting mechanism, a few reported incidents as a basis and lack of economic and financial studies in incident analysis and the lack of reference and database of statistical analyses, no financial and economic information is obtained and economic analyses are not used in the field of incidence. Given the statistics of medical referrals and research statistics on the actual statistics of accidents, and despite significant technical, managerial and executive efforts to prevent or reduce accidents and their consequences, the existing evidence remains worrisome. Because the very important dimension in the analysis of events is the financial dimension [1].

It seems that the factors identified in previous studies that examine the various dimensions and scope of incidence costs have a reciprocal and complex effect on each other that this mutual effect can be easily identified and identified and therefore cannot be analyzed and examined. By investigating the past studies on accident costs, there has been no study conducted that besides identifying the effective factors on accidents, detect hidden and intervening variables regarding the accident costs, and estimate the relationship between external and internal factors and hidden factors and analyze them finally. Therefore, as it was mentioned before; the aim of this study was to investigate and predict the effective factors on the costs of accidents, both direct and indirect, insurance and non-insurance in order to provide a model to identify the costs of each incidence and improve the mechanism of accident management and economic and financial studies of incidence are designed in the HSE management system in the industry [2].

Due to the passive nature of accident investigation and analysis techniques and their superficial view of most of them and the inefficiency of all economic study methods of existing accidents in the industry, the complexity of industrial environments, economic and social damage and due to the wide range of accidents with negligible consequences and significant industrial accidents such as the Chernobyl nuclear accident, the Bhopal India tragedy, the Piper Alpha oil accident, and hundreds of global and national consequences, and the direct and indirect costs of accidents, we need practical and structural models to investigate economic and financial dimensions of events. One of the important tools in this field is the models of calculating direct and indirect, insurance and non-insurance costs. We can examine the effective and contributing factors in increasing the costs of the accident using these tools and after modeling by different practical methods, we can develop studies

regarding other accidents and economic management of HSE activities. The purpose of modeling and presenting different patterns and models is to identify the intervening factors in increasing the accidents cost and ultimately the occurrence of accidents and their use in HSE management system costs and reduce the accidents costs and its consequences.
One of the important tools related to economic analysis and studies regarding the direct and indirect costs of accidents are structural equation modeling, which aims to provide different models of calculating and analyzing the factors of decreasing or increasing financial and economic dimensions of events. Although, different models have been proposed in this regard, each of these models refers only to some of the incident groups and does not specify the interactive and intensifying effects of costs. Also, many existing models do not refer to hidden connections and hidden dimensions in accidents. Therefore, it is necessary to conduct comprehensive studies in order to complete the existing theories and models in order to be able to resort to it with more certainty and assurance. As it was said, the main question of this research is "how is the structural equation modeling for systematic management of occupational accident costs?

2. Theoretical foundations and research background

Industrial accidents in industries, especially industries with high and medium level risks, are one of the most important problems in developed and developing countries. Despite many efforts to reduce the accidents rate, the statistics in the world are still catastrophic. Studies in several countries have attributed many unfavorable consequences to industry. Identifying the indicators of direct and indirect cost analysis of the accident and analyzing the complex relationships between the causes of the accident and the reasons before, during and after the accident in different stages of accident management and the mutual relationship between the financial indicators of accidents are important and fundamental issues in accident analysis and they can be used to reduce the costs of accidents. Approaches to accident issues and accident costs consider all relationships between indicators and rates of different activity management events as independent and assuming that all financial and economic indicators are independent and vivid, they study the cost of accidents. In terms of econometric methods, this is largely rejected, and the outcome of economic studies, in case of assuming the indices independent, is not reliable and used. Using a comprehensive approach that can first examine all financial indicators of the accident, including direct and indirect, overt and covert, insurance and non-insurance, and be used in econometrics and studies related to the financial and economic dimension of accidents [3].
The Canadian central conference, sponsored by the General Health Agency of Canada, in 2015, conducted a study "Costs of injuries and accidents in Canada", examined the various costs of injuries and accidents in Canada. The study's findings show that the cost of damage studied in 2015 increased by 35 % compared to 2004, and this is increased to 180 percent by 2035 [4]. Also, the hidden costs of accidents increase the various costs of accidents as 6 times more. Alizadeh et al. [5] showed that managers' inability in explaining how to develop and strengthen their safety management system is one of the causes of accidents. Then, they referred to the reduction of accidents, injuries and diseases, as well as the reduction of direct (overt) and indirect (covert) costs of accidents related to the design and implementation of a proper management system in safety field and examined the direct and indirect costs of accidents and its impact on the productivity and profitability of the organization and the method of their calculation. The results of this study indicate a high ratio of indirect costs to direct costs of accidents in all case studies and indicate the need for accident management in order to eliminate the factors increasing the financial and economic dimensions of accidents. Zhang et al. [6] in their research applied a systematic approach to the analysis of the interaction of the factors

involved in the occurrence of coal mine accidents (unsafe conditions of the rules and regulations, unsafe behavior of employees, unsafe conditions of tools and equipment and unsafe conditions of workplace). Arlinghaus et al. [7] showed in their study that occupational injuries are related to the multiple occupational and non-occupational risk factors via complex mechanisms that have not yet been accurately understood. They used structural equation modeling as a new approach to examining the risk of direct and indirect factors with the potential use of occupational injuries. The study data were collected from about 9,000 workers and the direct and indirect effects of working hours per week and normal sleep time on occupational injuries were modeled using structural equation method. The confounding and intermediate effects involved were also analyzed simultaneously. The final fitted model showed that the structural equation model is a suitable approach for examining dual results and indirect effects in complex samples and can explain a new and comprehensive model for predicting injuries.

3. Method

The present study is applied-analytical and descriptive-cross-sectional and case study type. In this study, the criteria prepared to assess direct costs that their impact on other variables is considered as independent variables of research and indirect costs of accidents that are affected by the dimensions of the accident and the type of accident and direct costs of accidents and their changes are dependent on these criteria are known as research dependent variables. All independent and dependent variables and their types are described here. The statistical population of this study is limited to one group of experts - with two groups of university professors and senior managers related to the HSE fields. This group of experts includes experts in the oil, gas, petrochemical, cement, steel, power plant, and road and construction industries, numbering as 5,000, and university professors with a community of about 3,000, and experts in occupational health, industrial safety, HSE with about 2,000 people and finally professors active in crisis management and emergency conditions, among them 384 were randomly selected using Morgan's table. The data collection instrument in this study is a researcher-made questionnaire. The validity of the research questionnaire was confirmed by the construct validity method (of the results of PLS software) and the reliability of the questionnaire was confirmed by Cronbach's alpha test, the results of which are presented in the research findings section. Statistical analysis was performed using SmartPLS structural equation software.

4. Research findings

In the first stage, in a library study and the study of conventional and fixed models, which are considered as effective indicators in the cost of accidents around the world, and by holding 2 different Delphi panels between professors and experts in accident analysis field, effective indicators in accident costs were extracted according to the table below and were used as the basis of the study. Table 1 depicts the effective indicators and financial elements on the cost and economic dimension of accident costs (both direct and indirect). In the first stage, first, the macro models, frameworks, guidelines, software, standards and executive methods related to the calculation and economic analysis of events were identified. In the second stage, a detailed study and a list of initial criteria were determined.

Table 1: Table of indicators identified in the effective field studies in the cost of accidents (indirect and indirect)

1- Emergency action (facing the accident/initial costs of accident)			
Time spent for first aid	1-1	Securing the environment (fence and danger bar, etc.)	5-1
Equipment, tools and supplies related to first aid	2-1	Fire control and extinguishing	6-1
Transportation and sending the injured to medical centers	3-1	Reduction of production due to work stoppage (workers)	7-1
Taxi and ambulance costs	4-1	Lost time for people involved in emergency actions	8-1
2-The research and investigation of accident costs			
Time spent to analyze and investigate the accident	1-2	Discussion sessions about the accident with managers and clients	2-2
The time dedicated to complete the form and initial reports of the accident	2-2	The time loss of the people involved in the emergency action	7-2
The time spent to investigate the incident and completing additional reports	3-2	Discussion sessions on the accident with workers	8-2
The time spent to complete the relevant reports	4-2	The consultation right of the experts of the accident analysis headquarters	9-2
Reporting and analysis of the accident by qualified experts	5-2		
3-The accidents research costs			
The time spent to evaluate and estimate loss	1-3	Payment of compensation and required costs of damage value	9-3
service fees and legal follow-up expenses 2	2-3	Repair and maintenance time and improvement of production system	10-3
Time spent by staff to correspond and resolve legal issues	3-3	Cleaning time and collecting hazards from the environment	11-3
Imposing costs of dealing with the legal and procedure cases	4-3	Fees paid to the contractor and requirements for cleaning	12-3
Increase in insurance rate and increase next year's premium	5-3	Replacing lost parts, equipment and products	13-3

Losses of insurance companies in increasing damage and compensation	6-3	The cost paid for the treatment and medical equipment of the injured person	14-3
Payment of compensation and claimed expenses , the amount of compensation	7-3	Damage to the contracting party (obligation value)	15-3
Timing of coordination of repair and maintenance and improvement of production/service system	8-3		
4-The damage costs of work and accident (costs of replacing people)			
Salary transfer and transfer of alternative workers	1-4	Recruitment and employment costs (hiring and replacing new people)	4-4
Planning and replacement of other workers	2-4	Costs and salaries of the injured person (accident victim) in the absence of that person	5-4
Training period for the new workers replaced by	3-4	The cost of the replaced person with the injured person	6-4
5-The costs of production (product/services)			
Reduction of production due to interruption / reduction of process efficiency	1-5	Replacement of lost parts, equipment and products	4-5
Management of claim and damage complaint	2-5	The lost demands and offering for the product	5-5
Reduce the production and productivity of the injured worker after returning to work	3-5		
6-The cost of retrieving activities (retaining) the reputation and work fame			
Retrieve reputation of customers	1-6	Providing other resources to meet the demands of customers	3-6
The costs of advertising for planning	2-6		
7-Starating the work activities			
Assessment/ re-planning the work activities	1-7	Returning to common conditions of production and activity	4-7
Modify the product and activity of services	2-7	Change and modify any system defect	5-7
Equipment cleaning	3-7	Rent and purchase tools, equipment, device	6-7

Therefore, in order to determine the list of direct and indirect economic indicators and parameters in occupational accidents, first models, frameworks, guidelines and standards for reporting economic analysis and calculation of accident costs in three areas of health, safety and the environment, which are investigated in the macro knowledge section and the investigation of existing models in calculating and extracting cost of accidents were determined as economic indicators of accidents costs were determined and then, by examining the different models, the previous researches were investigated to select the best and most comprehensive model. Based on the extracted literature and studies, three suitable models and samples were selected and analyzed for selection and designing a checklists and questionnaires as follows. The three models studied were:

1. Model and software of calculating accident costs in OSHA organization
2. Model and software of calculating the comprehensive costs of accidents in England as HSE UK Incident Cost Calculator
3. The official model and website of Work Safe BC. Affiliated with the HSE Association of Canada

The final results of the Delphi fuzzy method showed that out of 51 initial indicators, 46 final indicators were confirmed and the fire control, expert advice feed of accident analysis staff, time of coordination of repair and improvement of production system/services, the cost of recruitment and employment (employment and contract) of another person and the return of work to normal and standard conditions was eliminated with the opinion of experts. The following are the findings of the SmartPLS software. First, the Kolmogorov-Smirnov test was used to evaluate the normality of the score distribution of the research variables. First, the mathematical formula for calculating the Kolmogorov-Smirnov test values is expressed:

$$\mathrm{Dn,m} = \mathrm{supx}|\hat{}\,\mathrm{F1,n(x)} -\hat{}\,\mathrm{F2,m(x)}| \tag{4.1}$$

The following are the findings of this test:

Table 2: Kolmogorov-Smirnov test for the normality of research variables

Indices	**P-value**	**Z Kolmogorov-Smirnov**	**SD**	**Mean**
Emergency action (dealing with accident/the initial costs of accident)	0.001	2.077	0.46	3.93
The costs of accident research	0.028	1.458	0.57	3.56
The costs of compensation for damage	0.2445	1.024	0.53	3.7
The costs of damage of work and accident (alternative costs of people)	0.001	1.045	0.58	3.41
The costs of product/services production	0.015	1.562	0.62	3.34
The costs of retrieving activities (retain) reputation and work fame	0.001	2.667	0.6	4.07
Re-starting work activities	0.002	1.844	0.62	3.52

Given that the significance level of Kolmogorov-Smirnov test in the above table is less than 0.05 for the research variables, it is concluded that the distribution of the above variables has a significant difference with normal distribution. Therefore, we conclude that the distribution of research variables was not normal.

4.1. Analysis of the analysis model using PLS software

The computational formula for the relationship between the variables is obtained from the following mathematical formula:

$$p_{ij} = \alpha_j + \beta_j OA_i + u_{ij}, j = 1 \dots k \tag{4.2}$$

The Latin term OA variable is the short form of occupational accidents. The following are the findings of PLS software:

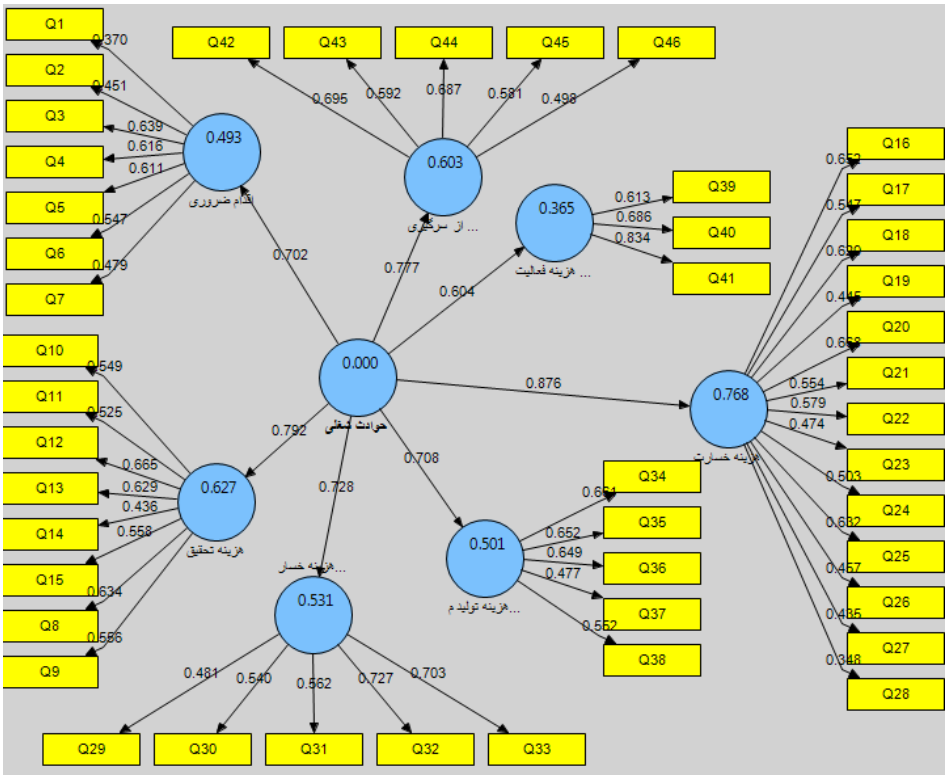

Figure 1: The intensity values of the relationship between the research variables in the final model as the significance level of the above relations

Other values of the research model can be seen in Table 3.

The effect intensity indicates the intensity of the relationship between the variables which is in the range of 0 and 1. The closer this value is to 1, the stronger the relationship between the variables. The T values , which are the result of dividing the effect intensity by the standard error, indicate the significance of the relationship of the variables. T values between -1.96 and 1.96 indicate that there is no significant effect between latent variables. The T values between 1.96 and 2.576 indicate a significant effect with more than 95% confidence among the latent variables. T values equivalent or greater than 2.576 indicate a significant effect with more than 99% confidence among the relevant latent variables.

4.2. Measurement model test

To test the measurement model in this study, Cronbach's alpha and composite reliability were used to evaluate the reliability of the measurement model and convergent validity and divergent validity test were used to evaluate the validity of the measurement model. The results are as follows:

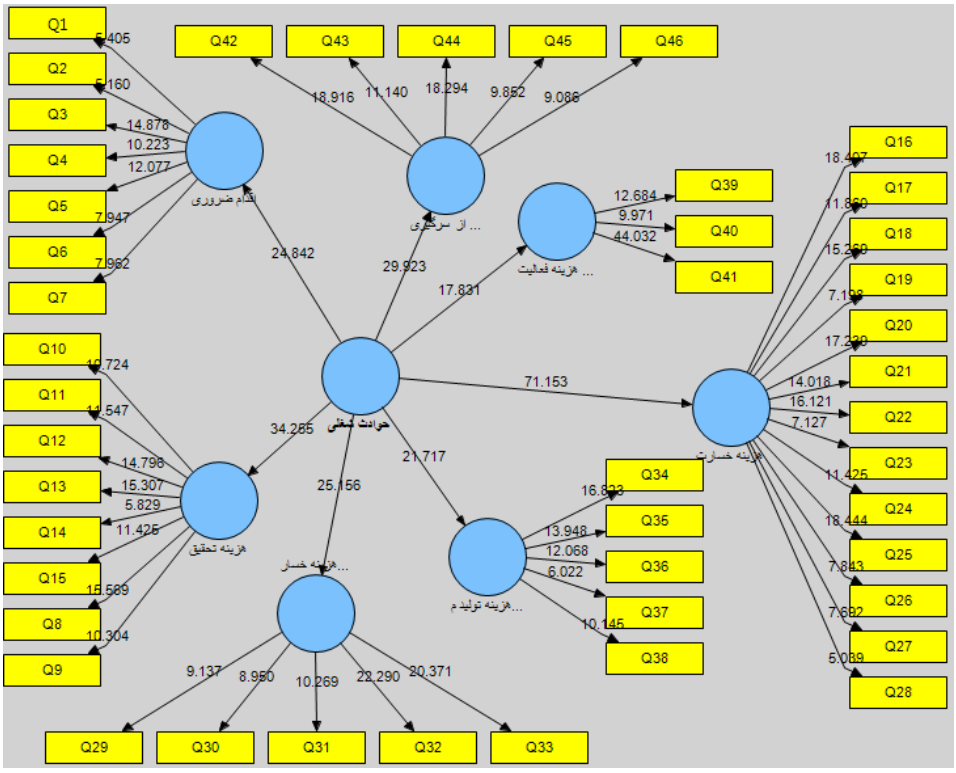

Figure 2: T values of the relationships between the researches variables in the final model

For the Cronbach's alpha index, since the majority of the values are close to 0.7, this index of research variables is confirmed. It should be noted that the value of Cronbach's alpha below 0.5 is not acceptable and above 0.5 to 0.7 is relatively acceptable. Given that the composite reliability of the research variables is higher than 0.7; therefore, it can be said that all research variables have a suitable and acceptable condition in terms of composite reliability. For a divergent validity index, given that the majority of values are close to 0.5; the convergent validity is relatively acceptable for all research variables.

• Divergent (Discriminative) validity: This index measures the ability of a model to differentiate the observable variables of the latent model from other observations in the model. Cross Loading is used to measure divergent validity. The acceptable value for this indicator is that the factor loading of each observable variable on its own latent variable must be at least 0.1 greater than the factor loading of the same observable variable on other latent variables. The results of the divergent validity table in the research model showed that all observable variables had higher factor loading than other latent variables and were acceptable. The results of divergent or discriminant validity are shown in the table below.

4.2.1. Structural model test

1. T-values significance: Values above 1.96 indicate the correlation between the constructs and thus confirm the research hypotheses at the 95% confidence level, the values of which are shown in Figure 4-6.

2. R^2 criterion: This criterion is used to connect the measurement section and the structural section of the structural equation modeling and shows the effect of an exogenous variable on an endogenous variable. Given that the R^2 value of the emergency action variable (0.493), research costs (0.627), damage costs (0.531), product production costs (0.501), damage costs (0.768), costs of marketing

Table 3: Testing research hypotheses

The relationship between concepts and indices in the model	Impact intensity	T value	Significance level	Result
The emergency action factor (dealing with an accident / initial costs of accidents) is one of the economic indicators (direct and indirect costs) of occupational accidents.	0.702	24.842	P<0.01	Supported
The cost of research and investigation of accidents as one of the economic indicators (direct and indirect costs) of occupational accidents.	0.792	34.285	P<0.01	Supported
The costs related to damages and compensation is as one of the economic indicators (direct and indirect costs) of occupational accidents.	0.876	71.153	P<0.01	Supported
The costs of damage of work and accident (costs of replacing individuals) are used as one of the economic indicators (direct and indirect costs) of occupational accidents.	0.728	25.156	P<0.01	Supported
The costs related to the production of products / services as one of the economic indicators (direct and indirect costs) of occupational accidents.	0.708	21.717	P<0.01	Supported
The cost of retrieval (retaining) of reputation and work credit is one of the economic indicators (direct and indirect costs) of occupational accidents.	0.604	17.831	P<0.01	Supported
The resumption of work activities is one of the economic indicators (direct and indirect costs) of occupational accidents.	0.777	29.923	P<0.01	Supported

activities (0.365) and resumption of business activities (0.603) are almost average; therefore, it can be said that the structural fit of the model using R^2 is average.

3. Q^2 criterion: This criterion was introduced by Stone Geiser and determines the predictive power of the model; that is, the models that have an acceptable structural fit should be able to predict the characteristics of the model's endogenous structures. The values 0.02, 0.15, and 0.25 indicate poor,

Table 4: Cronbach's alpha of research variables

Variable	Composite reliability Delvin-) Goldstein	Convergent validity	Cronbach's alpha	Variable status
Re-starting work activities	0.75	0.378	0.585	Accepted
Emergency action (dealing with accident/initial accident costs)	0.735	0.29	0.583	Accepted
Occupational accidents	0.876	0.226	0.852	Accepted
Research costs of accidents	0.794	0.329	0.704	Accepted
The costs of product/service production	0.738	0.363	0.563	Accepted
The costs of damage and compensation	0.838	0.291	0.79	Accepted
Damage costs of work and accident (costs of replace people)	0.743	0.372	0.577	Accepted
The costs of retrieving activities (retaining) reputation and work fame	0.757	0.514	0.523	Accepted

moderate, and strong predictability, respectively. Given that the Q^2 value for all dependent variables is higher than 0.25; therefore, it can be said that the structural model has a high predictive power and is acceptable.

4.2.2. Evaluate the overall model fit

1- GOF criterion: This criterion is related to the general section of structural equation models. This means that by this criterion, the researcher can also control the fit of the general part after examining the fit of the measurement section and the structural part of the general research model. 0.01, 0.25, and 0.35 values indicate weak, moderate, and strong overall fit, respectively. The GOF value in the present research model is as follows:

$$GOF = \sqrt{communality} \times \overline{R^2} \tag{4.3}$$

Given that the GOF value is 0.413;
Therefore, it can be said that the overall fit of the model is suitable and acceptable.

5. Discussion, conclusion and research recommendations

The purpose of this study was to design a structural equation model to systematically manage the costs of occupational accidents. In the initial phase, the number of identified initial indices was evaluated by fuzzy Delphi method and 46 indices were divided into 7 categories. The findings of

Table 5: Divergent validity based on cross loading

	Emergency action	**Research costs**	**Damage cost**	**Work damage**	**Product production**	**Recovering activity**	**Restarting activity**
Question 1	0.37						
Question 2	0.451						
Question 3	0.639						
Question 4	0.616						
Question 5	0.611						
Question 6	0.547						
Question 7	0.479						
Question 8		0.634					
Question 9		0.556					
Question 10		0.549					
Question 11		0.525					
Question 12		0.665					
Question 13		0.629					
Question 14		0.436					
Question 15		0.558					
Question 16			0.652				
Question 17			0.517				
Question 18			0.62				
Question 19			0.445				
Question 20			0.628				
Question 21			0.554				
Question 22			0.579				
Question 23			0.474				
Question 24			0.503				
Question 25			0.632				
Question 26			0.467				
Question 27			0435				
Question 28			0348				
Question 29				0.481			
Question 30				0.54			
Question 31				0.562			
Question 32				0.727			
Question 33				0.703			
Question 34					0.621		

Question 35	0.652		
Question 36	0.649		
Question 37	0.477		
Question 38	0.552		
Question 39		0.613	
Question 40		0.686	
Question 41		0.834	
Question 42			0.695
Question 43			0.592
Question 44			0.687
Question 45			0.581
Question 46			0.498

the quantitative section showed that all seven factors of emergency action (dealing with accident/ initial costs of accidents), costs of accidents investigation costs related to damage and compensation, costs of work and accidents (costs for replacing people), costs related to the production of products / services, the cost of retrieving (maintaining) reputation and work credit activities, and resuming work activities with the ability to measure occupational accidents. According to the factor loading for the identified factors, it can be seen that the highest ability is the component of costs related to damages and compensation with the factor loading of 0.876. Other factors include the cost of research accidents, resuming work activities, the costs of work-related accidents (replacement costs), the cost of producing a product/service, and emergency action (dealing with an accident/Initial costs of accidents) and finally the cost of restoring (retaining) reputation and work credit activities were ranked with a factor loading of 0.792, 0.777, 0.728, 0.708, 0.702 and 0.604 .

Alizadeh et al. [5] in their study showed that the ratio of indirect costs to direct costs of accidents in all above case studies is high and this indicates the need for accident management in order to eliminate the factors that increase the financial and economic dimensions of accidents. In Seo [8] research , it was shown that the perceived safety climate by individuals are the best explicative factor and the reason for unsafe behavior among the effective factors and this affects the unsafe behaviors, and this result is consistent with the findings of the present study. This research has been accompanied by. Arlinghaus et al. [7] showed in their study that the occupational injury issue is related to the multiple occupational and non-occupational risk factors through complex mechanisms that have not yet been truly understood. They used structural equation modeling as a new approach to examine the risk of direct and indirect factors with the potential use of occupational injuries. Study data were collected from about 9,000 workers and the direct and indirect effects of working hours per week and normal sleep duration on the job injuries were modeled using structural equations modeling. The confounding and mediating effects involved were also analyzed simultaneously. The final fitted model showed that the structural equation model is a suitable approach for examining dual results and indirect effects in complex samples and can explain a new and comprehensive model for predicting injuries. Zhang et al. [6] in their research classified the factors involved in the accidents of coal mine. The study applied a systematic approach to the analysis of the interaction of the factors involved in

the occurrence of coal mine accidents (unsafe conditions of the rules and regulations, unsafe behavior of employees, unsafe conditions of tools and equipment and unsafe conditions of workplace) and with the components of costs of damage and compensation, costs related to the production of products / services and the costs of research and investigation of accidents are consistent with the findings of this research.

Gholamnia et al. [9] in their study showed that the average lost days working days were 49.57 days and the hidden causes of safety training, risk control and risk assessment as latent variables of reducing the lost working days are effective. It was consistent with the components of costs related to damage and compensation and emergency action (dealing with accidents / initial costs of accidents). Among the variables of emergency action (dealing with accident / initial cost of the accident), the index of transporting and sending the injured to medical centers with a factor loading of 0.639 has the highest ability to measure this variable, so the human resources managers of the organizations related to this field should inform the personnel for the necessary measures in case of unexpected events. The cost index for taxis and ambulances is in second rank with the factor loading of 0.616, which makes it necessary to consider the financial issues for emergencies. For the cost of research and investigation of accidents, the reporting and analysis of the accident index by qualified experts with the factor loading of 0.665 is in the first rank. First, we should hold the coursers to increase the skill to provide report and analyze the causes of accidents so that in case of occurrence, the best and most practical report can be prepared during the shortest time and the necessary planning can be done to eliminate the problem. The time index for analyzing and investigating the accident with the factor loading of 0.634 is in the second rank. The need to increase skills in this index can be considered in the time interval. Because only training does not make a person an expert in this field and does not increase his skills. For the cost of damage, the time index dedicated for estimating the damage with the factor loading of 0.652 is highly capable to measure this variable. By holding in-service training, especially with experts in this field, we can reinforce the newly trained and practically experienced people and increase their skills at a lower cost. The cost index paid to the contractor and the requirements for cleaning with the factor loading of 0.632 is in the second rank. The need to identify contractors with appropriate and fair administrative and financial procedures can help the organization in such cases at a lower cost and more efficiently, and to prevent financial misuse. Among the indicators of labor and accident damage costs variable (replacement costs of individuals), the cost and salary index of the injured person (injured) as not present with the factor loading of 0.727 is in the first rank. To increase morale of loyalty of the staff to the organization, in such cases, the organization can act in the best way and other employees, seeing the support level of the organization of the injured, can be encouraged to continue working in the organization and be loyal to the organization. The salary cost index of the replaced person with the injured person with the factor loading of 0.703 is in the second rank. Human resource managers should motivate all people in the organization by creating succession system at all organizational levels, and on the other hand, in the event of such problems, at the lowest cost, find a suitable alternative for the individual in order not to stop the current affairs of the organization. For the variable of costs related to production (product/service), the management index of claims and damage with the factor loading of 0.652 is in the first rank. By creating clear and specific legal bases for these affairs, and explaining and justifying all organizational personnel, we can minimize ways to create and increase complaints in this area. In the second rank is the index of reduced production and productivity of the injured worker after returning to work with the factor loading of 0.649, so it is recommended that the return period is minimized and we can increase skill and productivity and this increases morale for personnel of organization by creating suitable rehabilitation programs appropriate to the damage imposed on organizational personnel. On the other hand, the organization does not face any difficulties or

slow process in performing the assigned tasks. Among the variables of retrieval activities (retaining) reputation and work credit, the index of providing other resources to meet the needs of customers with the factor loading of 0.834 is in the first rank. With continuous monitoring of groups providing organizational resources, the necessary measures should be taken to increase the quality on the one hand and to reduce the organizational costs on the other hand. The index of costs of advertising for planning with the factor loading of 0.686 is in second rank. By creating cyberspace ground to reduce the costs of advertising and information with the least time and cost to all real and potential customers can help optimize the organization in the long run. Finally, for the variable of resumption of work activities, the evaluation / re-planning index of work activity with the factor loading of 0.695 is in the first rank. In the second rank, there is the site cleaning index, waste disposal, equipment transfer, etc., so it is suggested that by measuring the quality of equipment layout and the need to reduce the risk of equipment layout, it is possible to reduce and eliminate the possibility of such risks and problems.

References

[1] Rohollahi, Ahmad Ali (2014). Investigate the relationship between different dimensions of safety climate and safety performance in aviation industry. Iran's occupational health. 2015; 12 (3): 96-107.
[2] Aaltonen MVP. (2016). A Consequence and Cost Analysis of Occupational Accidents in the Furniture Industry. Doctoral dissertation. People and Work 6. Finnish Institute of Occupational Health, Helsinki.
[3] Antti-Poika M. and Laitinen H. (2004) "Accident Prevention". Taskinen H. (Editor). Good Occupational Health Practice: A Guide to Planning and Follow-up of Occupational Health Services. Ministry of Social Affairs and Health, Finnish Institute of Occupational Health, Helsinki, Finland.
[4] European Commission (2015) Socio-economics of the cost of accident at work and work-related ill health. http://ec.europa.eu/social/publications. Accessed March 9, 2013.
[5] Alizadeh, Shamsuddin; Mirzaei, Reza and Ahmadlou, Mehdi (2008). Calculate the direct and indirect costs of work-related accidents. Social, Economic, Scientific and Cultural Monthly of Labor and Society; October, 2008, No. 100, pp. 96-101.
[6] Zhang, Y., Shao, W., Zhang, M., Li, H., Yin, S., Xu, Y. (2016). Analysis 320 coal mine accidents using structural equation modeling with unsafe conditions of the rules and regulations as exogenous variables. Accident; Analysis and Prevention, 14 Apr 2016, 92: 189-201.
[7] Arlinghaus, Anna & Lombardi, David & Willetts, Joanna & Folkard, Simon & Christiani, David. (2012). A Structural Equation Modeling Approach to Fatigue-related Risk Factors for Occupational Injury. American Journal of Epidemiology. 176.pp. 597-607.
[8] Seo, D.Ch. (2005). An explicative model of unsafe work behavior. Safety Science. 43 (3): 187-211.
[9] Health and Safety Authority (1999). Workplace Health and Safety Management. Ireland: Health and Safety Authority Publications.