IDENTIFICATION CAUSES OF OCCUPATIONAL ACCIDENTS IN EMPLOYEES' OF IRANIAN OIL INDUSTRIES

A CASE STUDY OF KARON COMPANY

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PURPOSE
THE goal of this research was to identify Occupational Accident causes in one of the main Oil Companies in Iran.

Design/Methodology/Approach: *The samples of this research were 211 respondents selected by a stratified random method from three companies in Ahvaz, Iran. The tools chosen for collecting data in this research were a structured questionnaire. The primary data for analysis were generated through a structured questionnaire. This questionnaire consisted of 137 questions, which cover all human and technological aspects of occupational accidents in this company.*

Findings: *The results of the study were three major factors identified through the use of Principal Component Method of Factor Analysis, which are responsible for the causes of occupational accidents to a large extent. The data were analyzed using the principal component method of factor analysis and the Varimax orthogonal rotation method, in Karon oil company. Three factors were extracted, in different categories such as Accident Involvement, Non-Accident Involvement, Technical, and Non-Technical. Mean, Standard Deviation, Eigenvalues, % of Variance, and % of Cumulative Variance have been computed for each factor.*

Research Limitations/Implications: *This study was conducted to determine the factors of Occupational Accidents in the companies, to identify the major variables related to the occurrence of accidents.*

Practical Implications: *In results and discussions, the implantation suggested for improving the safety plans found from the present research have been suggested, to avoid Human and Technological casualties through major or minor accidents or through different kinds of poisonous and hazardous elements at appropriate and required levels of safety measures which have become a major concern of this industry and for skilled and unskilled human security. These findings have been suggested to further reduce the agony of accidental hazards.*

Originality/Value*: The Paper presents original work in context to Iranian Oil Industries and offers very valuable and useful recommendations.*

Key Words: *Accident Involvement, Causes of Industrial Accidents, Occupational Accidents, Human Factors Accidents, Technological Factors Accidents.*

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Introduction

In the twenty-first century, the worst non-natural disasters in human suffering and death have been caused by wars, transport, and industrial activities. At first, industrial disasters mainly affected people engaged in specific occupations, but later, particularly with the rapid growth and expansion of the oil, chemical, petrochemical industry, and the use of nuclear power, these occurrences led to serious dangers even to the people outside work areas, and to the general environment. Chlorine and ammonia are the toxic chemicals most commonly used in major hazardous quantities, and both have a history of major accidents. The release of flammable or toxic materials in the atmosphere may also lead to fires (Stellman, 1998).

The cholera epidemic in Latin America and the chemical poisoning outbreak in Bhopal India (Bhopal, India 1985, had Environmental Hazard in Methylisocyanate, as Acute Lung Disease, which caused 2,000 deaths and 200,000 poisoned), to chronic effects (like Love Canal tragedy in USA). Environmental health impacts thus include the indirect effects of industrial disruption of the adequate food and housing, as well as the degradation of the global systems on which the health of the planet depends (Stellman, 1998).

Although agencies measure the severity of disaster by the number of people killed, it is becoming increasingly important also to look at the number *affected*. Across the world, *almost a thousand times more people are affected by disaster than are killed* and, for many of these people, survival after the disaster is becoming increasingly difficult, leaving them more vulnerable to future shocks. This point is relevant not only for natural disasters, but also for *human-made* disasters, especially in the case of chemical accidents whose effects on exposed people may become apparent after years or even decades (Stellman, 1998).

Unquestionably, on the global scale longevity has improved and people are healthier than they were centuries and even decades ago. On the other hand, industrialization has had adverse health consequences not only for workforces but for the general population as well. These effects have been caused either directly by exposure to industrial hazards and harmful agents or indirectly through environmental degradation locally and globally. **The significant fact is that accidents affect every country of the world, but it is the poorest countries where people most frequently lose their lives.**

The heavy industries are always prone to have major accidents. This accident proneness nature of heavy industries does not tend us to conclude that we should not have such industries.

A tremendous investment in Oil Industry after 1970, and a rapid growth of this industry in developing countries caused the owners and managers of large companies to pay more attention to safety issues and maintain the growth of production, particularly with respect to the causes of increase in accidents vis-à-vis the rate of growth of production.

However, an understanding of the 'cause and effect' relation of the accident-causing factors is required before continuous improvement of safety processes can be undertaken.

Many governments have also been leaders in making safety analysis mandatory. Sweden, Finland, Japan, and Federal Republic of Germany have all reduced fatal occupational accidents by 60 to 70% during this time. Many other countries show similar progress.

The researcher aim was to study the human and technological characteristics related to the accident involvement and to identify technological and human factors responsible for the occurrence of accidents. Then to make the necessary suggestions and recommendations for the prevention of accidents.

Research Questions

In this research following questions have been studied.

1. Which technological factor causes industrial accidents in the Oil Industry in Iran?
2. Which human factor causes industrial accidents in the Oil Industry in Iran?

Literature Review

Asanga (1988), suggests that human reliability parameters are most varied, unpredictable, and some what puzzling in nature, such that research in human behavior under various stresses and environmental conditions presents a wide field of investigation and tend to involve the realms of human psychology and physiology. Sinha et al., (2010) document that there is considerable confusion in studies conducted regarding the constructs of psychological climate, organizational climate, and organizational culture, and reveal a need for researchers to use terminology that is consistent with their level of measurement, theory, and analysis.

According to the pure chance theory, every one of any given set of workers has an equal chance of being involved in an accident. It further implies that there is no single discernible pattern of events that leads to an accident. In this theory, all accidents are treated as corresponding to Heinrich's acts of God, and it is held that there exist no interventions to prevent them (Stellman, 1998).

Those who accept the energy transfer theory put forward the claim that a worker incurs injury or equipment suffered damage through a change of energy, and that for every change of energy there is a source, a path, and a receiver. This theory is useful for exterminating injury causation and evaluating energy hazards and either preventive, limiting or ameliorating with respect to the energy transfer (Stellman, 1998).

The "symptoms versus causes" theory is not as much a theory as an admonition to be heeded if accident causation is to be understood. Usually, when investigating accidents, we tend to fasten upon the obvious causes of the accident to the neglect of the root causes. Unsafe acts and unsafe conditions are the symptoms-the proximate causes-and not the root causes of the accident (Stellman, 1998).

Accident proneness theory maintains that within a given set of workers, there exists a subset of workers who are more liable to be involved in accidents. Researchers have been able to prove this theory conclusively because most of the research work has been poorly conducted and most of the findings are contradictory and inconclusive. This theory is not generally accepted. It is felt that if indeed this theory is supported by any empirical evidence at all, it probably accounts for only a very low proportion of accidents without any statistical significance (Stellman, 1998).

In theory, it is possible that a safety first campaign might by explanation and education affect every individual in the same manner. Everybody remains equally accident prone although less prone to have accidents. Again, everybody "learns by experience", and it is possible mathematically if not psychologically for everybody to learn alike (Stellman, 1998).

The worker who appears to be accident-prone and one job could have an excellent safety record on a different job. This is essentially the idea behind accident liability theory: an individual's risk of having an accident varies from situation to situation, as well as over time.

"Designing for everyone" puts special emphasis on an ergonomic approach that is based on the characteristics and capabilities of the worker, a concept often overlooked in practice. The ILO Encyclopedia are directly related to ergonomics, such as Heat and Cold, Noise, Vibration, Visual Display Units, and virtually all chapters in the sections, Accidents and Safety Management and Management and Policy (Stellman, 1998).

The overall rationale for training and education is to improve awareness of safety and health hazards, to expand knowledge of the causes of occupational illness and injury, and to promote the implementation of effective measures. The specific purpose and impetus for training will, however, vary for different target audiences.

Education focuses on theory or principles. Training gets into the specification of how to turn principles into effective action (Geller, 2001).

Mack (2005) says, the results revealed that management's commitment to safety is a major factor in the success of safety programs. Organizations with a strong safety climate have job-training programs, give executive authority to safety officials, have high-level managers on safety committees, and consider safety in job design. He feels that attempts to improve safety like new regulations or poster campaigns, without management commitment will probably not succeed. (Muchinsky, 1990)

Factors that affect which type of occupational health service are to be utilized include the potential risks of normal operations, the demographics of the workforce and management's interest in occupational health. Health service are dependent on the type of industry, the physical, chemical or biological hazards present, and the methods used to prevent exposure, as well as government and industry standards, regulations, and rulings. (Stellman, 1998)

A frequently used safety device is the safety sign. "Danger signals for work places-auditory danger signals, requires that any auditory alarm or warning be audible to all individuals in the work place, including those suffering from a hearing loss and/or wearing hearing protection devices (HPDs)" (Riggio, 1990).

Sanders and McCormick (1993), says that human factor researchers have, therefore, studied such variables as workers energy expenditure, strength, endurance, speed, accuracy of movements, and workload. Knowledge gained through this research has promoted the design of work places that maximize human performance, and minimize such outcomes as fatigue, stress, and the errors to which they contribute. He argued that it is often easier to design a safe workplace than it is to make workers behave safety, but workers must learn to use their work equipments, and in so, doing are likely to make errors and have accidents.

This study sought to minimize this problem by developing a composite measure of accident behavior. The accident consistency variable was the number of accidents incurred by an individual plus the number of years that the employee incurred at least one accident. Each of these measures has been used separately in past research (Hansen, 1988). It is proposed that this composite variable reflects the "consistency" of one's accident tendency by adding a measure of temporal frequency (number of years with an accident) to a measure of quantity (number of accidents).

This measure is the best criterion for a causal study because a major outcome concern is the prediction of accident potential for as long as possible. A worker who had a clean record except for four accidents in one year may simply have had an atypical year because of situational problems. That individual would be a relatively "poor bet" to consistently have accidents in the future. On the other hand, the employee who had one accident in each of 4 years could be demonstrating a personal propensity to have accidents at a low rate in the future. Both the short, and long-term implications of each worker's accident record are important, although a company would have better success in identifying and intervening with the later worker.

Researcher hope to avert some of the forthcoming tragedies caused by industrial accidents influencing the h*umanity* in general and *society* and *individual* in particular. The study here is proposed to identify the technological and human factors due to which accidents occur in oil industries.

Methodology

The population of this research consisting employees of the Karon oil company, in Ahvaz, Iran. For this purpose, first two groups accident victims were selected randomly to provide the particular causes of accidents in these companies. Researches, through interview and written in query, prepared a list of 177 technological and human causes of the accidents. A revision of this list by the researchers and a sample of some managers of the oil companies reduced the items of the list to 137. The revised list is questionnaire of this study. The sample consisted of 211 (56 victims and 155 non-victims) employees were selected by a stratified random method from the population of each of three companies.

This questionnaire was completed by 162 out of the 211 (about 76%) employees serving as the sample of study (Table No. 1).

Table No. 1: Chosen Sample and Frequency of Responded Applicants

	Intended	**Sample**	**Size**	**Final**	**Sample**	**Size**	
Region	Total	Victim	Non-victim	Non-victim	Victim	Absent	Total Joined
Korn oil Company	211	56	155	119	43	49	162

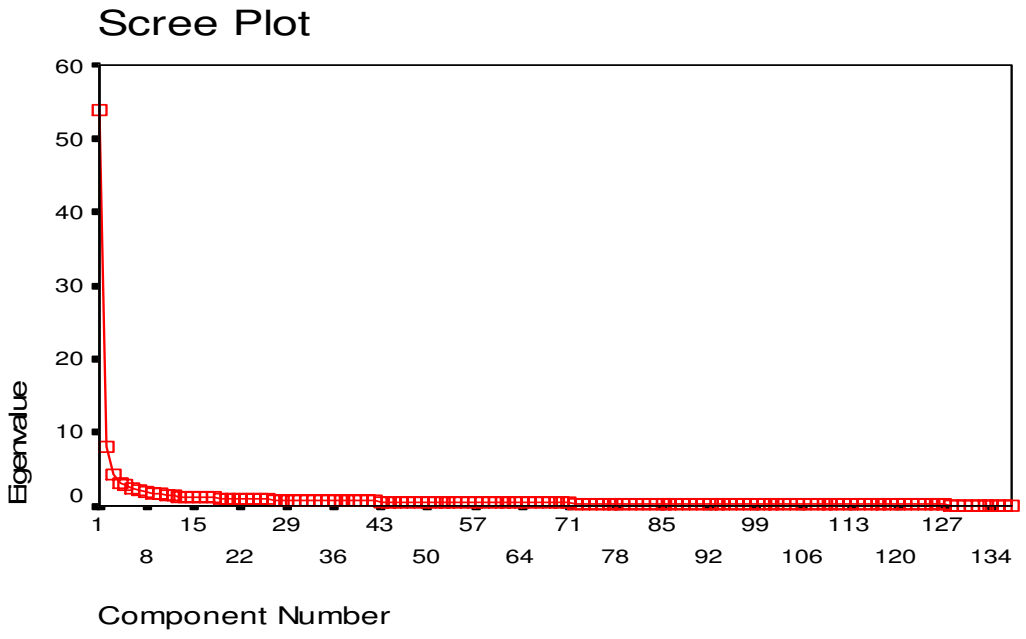
Table No. 2: Discriptive Statistics of Total Sample in NISOC

	Range	**Minimum**	**Maximum**	**Mean**	**Std. Dev.**
Age	35	25	60	10.6	16.39
Education	30	3	18	11.1	4.06
Experience	38	3	41	22.9	10.67

The data collected were analyzed by applying the principal components method of factor analysis, using varimax type of orthogonal rotation methods. To assure the appropriateness of the data collected for factor analysis, tests of KMO and Bartlett were used. KMO index was 0.974 and Bartlett's test yielded a $\chi^2 = 66778.88$. Both indices are completely satisfactory.

Findings

To deforming the number of factors to be extracted Cattell's Scree test was used. The scree test is shown in Figure 1.



On the basis of the scree plot, three factors were extracted. The cut-off point of 0.45 was adopted to determine the number of items in each of the three factors. These factors along with their eigen values,

percents of variance explained, cumulative percents of explained variance, number of items in each factor, mean, and standard deviations of the three factors are shown in Table No. 3.

Table No. 3: Mean, Standard Deviation, Eigen value, % of Variance, and Cumulative % of Variance of the Three Factors

Factor No.	mean χ	Standard Deviation	Eigen value	% of Var.	Cuml. % of Var.	Number of Items
1	29.4	16.39	30.13	21.99	21.99	71
2	11.05	4.06	22.27	16.25	38.24	40
3	19.98	10.67	13.65	9.96	48.21	16

According to Table No. 3, the values of the above indices for the three factors are as follows:

Factor One, (x =29.4, S.D.=16.39, Eigen value=30.13, % of Var.=21.99, Cuml.% of var.= 21.99 and 71 items), **Factor two** (x =11.05, S.D. = 4.06, Eigen value = 22.27, % of Var.=16.25, Cuml. % of var. = 38.24 and 40 items), **Factor three** (x = 19.98, S.D.=10.67, Eigen value = 13.65, % f Var. = 9.96, Cuml. % of var. = 48.21 and 16 items). The numbers of items included in the three factors are as follows: factors 1, 71 items, factor 2, 40 items, and factor 3, 16 items.

The factors were labeled after a careful scrutiny in the items comprising, each of the three factors. Thus, the three factors were labeled, respectively, as follows: 1. "**Improper Execution of Organizational Processes**", 2. "**Inadequacy of Technological Aspects"**, 3. "**Incorrect Implementation of Management Methods**".

The reliability coeffients of the three factors are shown in Table No. 4.

Table No. 4: The Reliability Table

Statistical Index Kind	Factors	Correlation Between	Reliability Spearman Brown	Gutt man Split-Half	Alpha Cronbach
Total Sample	F1(71)	0.9218	0.9593	0.9579	0.9862
	F2(40)	0.828	0.9059	0.9045	0.97
	F3(16)	0.7678	0.8686	0.8681	0.9445
Ancident	F1(67)	0.9247	0.9609	0.9595	0.9858
Involved	F2(42)	0.8157	0.8985	0.897	0.9703
Sample	F3(23)	0.8047	0.892	0.8914	0.9566
Non-Accident	F1(73)	0.9223	0.9594	0.9594	0.9865
Involved	F2(34)	0.842	0.9142	0.9131	0.967
Sample	F3(9)	0.7796	0.8773	0.8709	0.904

The remaining items in each of the three factors along with their loading factors, mean, and standard deviation for the sample of 162 are shown that the items with loading factors less than 0.45 have been deleted for each of the three factors.

Resulets and Discussion

The goal of this research was to identify the factors causing industrial accidents in Oil Industry of Iran. To reach this goal principal components factor analysis was used. Three factors were extracted which

were called: "**Improper Execution of Organizational Processes**", "**Incorrect Implementation of Management Methods"** and "**Inadequacy of Technological Aspects".** Two of the factors, that is, "**Improper Execution of Organizational Processes**" and "**Incorrect Implementation of Management Methods"** are human factors, which are in harmony with the findings of other researchers such as Hansen (1989), and Stellman (1998). The identified factors show that a major part of industrial accidents are due to the problems and difficulties of employees in the organizations. The third factors, that is, "**Inadequacy of Technological Aspects"** is due to technical variables.

Comprehending why technological variables cause accidents is not very difficult; non-standard tools, machines and equipments, shortage of safety and protective tools and equipments, or non-observance of safety measures are the probable causes of accident occurrences. But, comprehending how human variables cause accidents can be explained by several general reasons.

One explanation for the effects of human variables on occurrence of industrial accidents is the different problems with which the manpower may be involved. These problems will occupy the minds of the employees, and facilitate the occurrence of accidents.

This mind-boggling will cause absent-mindedness and mental distraction, as well as lack of concentration on the job that affect the performance of the work. The result will probably increase their accident involvements. The problems and difficulties of manpower in organizations come from two major sources.

A. The first source is related to the personal and individual characteristics and psychological or physical movements of the employees. This means that the employees of an organization may not have the potential, the ability, the personal characteristics such as rhythm and harmony of the eyes and the hand/foot, or enough flexibility of the limbs involved in doing a job, etc. If this is true, engagement of manpower in accidents will be anticipated. Manpower also needs the necessary knowledge, experience and skill for doing jobs. Shortage of this characteristic probably will increase the cause of accidents' involvement for manpower, and will increase accidents' occurrence. B. The second source will be the problems in the work area, or out of the work area, in addition to the family problems. Problems such as, job dissatisfaction, feeling of injustice and discrimination, arguments with supervisors, colleagues and employees, which are mind-boggling and will make them prone to accidents.

Negative attitudes to safety and absence of motives to observe safety regulations will also cause the involvement of the manpower in accidents. If there is a risk of negative attitude in the organization and the manpower shows inclination toward a risky behavior, and if, there is not enough motivation for safe behavior in accordance with safety rules and regulations, the occurrence of accidents in the organization will be certain.

As it is seen, many different factors may cause the engagement of the manpower in occupational accidents. So, an organization's executives and safety managers should consider these factors and plan to prevent such accidents in the organization and provide a safe environment without danger or risk.

Safety recommendations on the basis of research findings.

The goal of this research is to identify causes of industrial accidents in oil industries, and to suggest proper measures and recommendations for the prevention of accidents. For this reason, variables of each one of the three obtained major factors require careful study to arrive at solutions. Some important recommendations concerning each of the three factors are given below:

I. Improper Execution of Organizational Processes

By studying the variables of the factor **"Improper Execution of Organizational Processes**", different improving recommendations are as follows:

1. Friendly relationship of supervisors and managers with their personnel.

2. Providing enough actual work training for different personnel in different jobs and duties.
3. Relieving personnel from fear threats and existence of stress problems in work areas.
4. Matching of jobs' physical characteristics with employees' characteristics.
5. Providing safety culture in the work place.
6. Providing job satisfaction and motivation for employees from different aspects of treatment by their work.
7. Offering equal opportunities to the personnel (Providing justice and fair supervisors and managers).
8. Providing suitable human models for the personnel to follow work safety regulations.
9. Solving personnel problems in relation with their family problems.
10. Reducing long-time overtimes.
11. Providing suggestion channels to receive employees' suggestions.
12. Preventing work fatigue.

II. Inadequacy of Technological Aspects

1. Attendant of safety and fire extinguishing officials in accidents' places on time.
2. Offering suitable skill and safety trainings corresponding to the work conditions.
3. Encouraging employees to use safety /protective facilities.
4. Providing suitable needed facilities to extinguish fire.
5. Providing standard parts, tools, equipments, machines, and safety cloths.
6. Regular service and maintenance, control and inspection of machines, tools, and equipment by responsible people on work.
7. Replacing worn transferring pipes of gas and gasoline.
8. Providing medical facilities on site of work/operation with high accident risks.
9. Standardizing roads used for related work of oil industries.
10. Providing suitable standard distance and space between machines and equipments.
11. Execution of high-risk tasks without haste on irrational speed.

III. Incorrect Implementation of Management Methods

1. Solving problems of the personnel dwellings and financial problems.
2. Removal of discrimination and unbiased assessment in the organization, such as giving advantages, financial benefits, raises, etc.
3. Use of participative management.
4. Providing a suitable system of reward and punishment.
5. More consideration and care of managers and supervisors for their personnel problems, suggestions, and talents of employees and taking proper steps toward them.

References

Asanga, P.M. (1988). Availability and safety study of an oil refinery: The availability and safety behavior since commissioning in 1980 of the KADUNA refinery is study in depth, particular attention being given to the importance and effects of human factors (Nigeria). University of Brantford.

Geller, E.S. (2001). The psychology of safety handbook. Boca Raton, FL: Lewis Publishers.

Hansen, C.P. (1988). Personality characteristics of the accident involved employee, *Journal of Business and Psychology*, *2*(4), 346-365.

Hansen, C.P. (1989). A causal model of the relationship among accidents, biodatam, personality, and cognitive factors, *Journal of Applied Psychology*, *74*(1), 81-90.

Mack, J.A. (2005). The law of bullying: Off the playground and into the workplace. *Bench & Bar of Minnesota, 62*(8), 20-24

Muchinsky, P.M. (1990). Psychology applied to work. An introduction to industrial and organizational psychology. Pacific Grove, CA.: Brooks/Cole Publishing.

Riggo, R.E., (1990). Introduction industrial/organizational psychology. Illinois: Scott, Foreman and Company.

Sinha, S., Singh, A.K., Gupta, N., Rajul, D. (2010). Impact of work culture on motivation level of employees in selected public sector companies in india. *Delhi Business Review*, *11*(1), 43-54.

Stellman, J.M., (1998). Encyclopedia of health and safety (4th Edition). Geneva: International Labour Organization.

Sanders, M.S., and McCormick, E.J. (1993). Human factors in engineering and design (7th ed.). New York, NY: McGraw Hill.