Identifying and Prioritizing Factors that Affect Technological Hazards in the Iranian Gas Refining Industry using Multi-criteria Decision-making Techniques (Case Study: South Pars Gas Complex)

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Abstract

Background/Objectives: All over the world, operational units in oil and gas refineries deal with hazardous chemicals and work with various equipment, such as isolated towers, storage tanks, pumps, compressors and pipelines, with high pressure and temperature. Thus, accidents, such as a toxic spill, fire or explosion, are possible. Preventing hazards and creating the appropriate infrastructure is a priority. Today, about 62 percent of the world’s major organizations have business continuity plans, but in Iran, they are still regarded as a luxury. Methods/Statistical Analysis: To develop this program, the first step is to learn the most important factor of technological hazards in vital industries, in terms of passive defense and then design strategies for eliminating or reducing it effectively. In this study, in the first phase, six major factors of technological hazards were identified. These factors examine using ideas from 20 experts in the refinery gas and gas industry; next, since many of these factors are connected, the Analytic Network Process (ANP) method was chosen to prioritize them. Findings: Results show that lack of adequate policies for developing refineries, using newly developed refineries with unfinished sections or components which cause increased risks of process, organizational processes that are inappropriate for the used technology, the inappropriate transfer of technology from developers to final operators of refineries, low level of technical knowledge related to the operation in indigenous contractors in terms of new technologies, lack of training programs tailored to the technological needs of the organization, the issue of sanctions which causes a lack of access to machine parts and consequently cause wear and hazard in the system, lack of accurate documentation and knowledge management to record the old technological problems of the organization, and therefore, lack of ability in preventing the repeat of same problems. Next, since many of these factors are connected, the Analytic Network Process (ANP) method was chosen to prioritize them. After a questionnaire was distributed to 20 experts, finally, low levels of HSE, the lack of adequate policies in development of refineries, and using newly developed refineries with unfinished sections or components were selected as the most important factor in creating technological hazards.

Keywords: Gas Industry, Technological Hazards, Techniques of Multi-Criteria Decision-Making Process Analysis Network

1. Introduction

Technology constitutes a very important and necessary part of human life today, and is an important factor in the production of goods and services. Technology influences the fabric of social life beyond the simple case of “converting inputs into outputs” and is converted to an environment which has a decisive impact on the attitudes,
values, ways of thinking, ways of living and actions of humans. Thus, managing technology is important.

The technologies used in the oil and gas industry are essentially a skill and require close interaction with technology holders. Due to competition and confidentiality of the information related to this industry, achieving technical knowledge is difficult. Therefore, transferring technology is the best method in this context. However, due to the lack of complete transfer of technology or human error, technology has hazards that can harm the health of consumers. Technological disasters are caused by human use of science and technology. The starting point is a failure or malfunction in a technological system. Some technological crises, however, occur as a result of human error. Usually in a technological crisis, one person is blamed, but in natural disasters, that is not always the case. Technological disasters include software failures, industrial accidents (the Chernobyl accident) and oil spills (the BP incident in the Gulf of Mexico). Because organizations can be affected by crises, managers and decision makers create measures for dealing with a possible crisis. If an unexpected event occurs and the organization has a strategy in place, the organization can continue to operate with minimal damage. The best action is business continuity management: “activities that an organization must do to sustain its activities after the occurrence of an unexpected accident”. Most activities should be performed before any event and preventing the creation of the necessary infrastructure, is a priority. Business continuity management, with various dimensions, occurs within an overall social, cultural, economic and technological structure. In the gas refinery industry, organizations often deal with hazardous chemicals and most of the operational units work with varied equipment such as isolated towers, storage tanks, pumps, compressors, pipelines that are under pressure, and temperature. Toxic spills, fires, or explosions are a danger.

In Iran, the oil and gas industry, the economic hub of the country’s energy sector, is not exempt. For example, some workers were killed in a fire and explosion at the Petrochemical Complex, located at South Pars in 2011, a gas leak and fire killed two people in 2012 at a refinery in Asaluyeh, and burn-through cooling gas killed one person and injured others in 2013. The first step in creating a business continuity plan was to identify and prioritize the factors that affect technological hazards; the study was designed with this aim.

Management technology, an interdisciplinary topic related to science, engineering and management, affects the function of many components, such as R and D, design, production, marketing, finance, personnel and information and includes strategic, operational, and organizational issues. Operational aspects deal with the daily activities of the organization and strategic aspects focus on longer-term issues. Organizations should pay attention to both dimensions. Studies have shown that most engineers and managers merely focus on the operational aspects and short-term results, and are oblivious to strategic issues. This shortsightedness is caused by the effects of actions today and ignoring the future. Technology management, with an emphasis on strategic objectives, helps eliminate system failures by helping managers improve productivity, increase effectiveness and strengthen the firm’s competitive position. Technology is a major factor in the production of wealth, which includes factors such as knowledge, intellectual capital, effective use of resources, conservation of natural resources, and other factors affecting the standard and quality of life. Technology management is a system that creates, acquires and deploys technology and includes liability, which puts these activities in order to serve humanity and to meet customer needs.

Although technology is the most important factor in the system creation of wealth, other factors are involved. For example, capital formation and investment play an important role in economic growth. Labor is another important factor. Social, political and environmental considerations also affect the process of producing wealth. The National Research Council of America defines technology management as “an interdisciplinary field that deals with the planning, development and implementation of technological capabilities to shape and accomplish the strategic and operational objectives of an organization”.

Technology management includes three dimensions: the national level, enterprise, and people. On the national or state level (macro level), technology management helps shape public policy. A general definition of the macro level is as follows:

Field of knowledge that deals with the determination and implementation of appropriate policies for the development and application of technology and the nature and aims to encourage innovation, economic growth and promoting the responsible use of technology to human welfare.
Technology management at the national level focuses on the role of public policy in promoting science and technology and discusses the overall impact of technology on society and in particular its role in sustainable economic development. Technology management at the national level covers issues such as the impact of technological developments on people, their educational needs, in terms of technology, the impact of technology on health and safety and environmental impacts of technology. Technology policies at the state level are the framework for the application of technological change, in the interest of society and its members. Technology policies at the firm level or organization (micro level) lead to the creation and consolidation of competitive enterprises. At the individual level, technology policies help to enhance the value of the individual in society.

2.1 Crisis Management (Definition)
Crisis management involves the coping mechanisms and resources for dealing with threats before, during and after the threat. Crisis management is variable; risk management assesses potential threats and finds a way to stop them. Crisis management functions during the crisis, that is, the start time of the accident, to begin recovery (rollback).

2.1.1 Crisis Management Goals
The following goals are the focus of crisis management: preparing for a crisis, responding quickly and appropriately to the crisis, creating clear and effective lines of communication during the crisis period and adopting rules acceptable to all to bring an end to the crisis.

2.1.2 Aspects of crisis management
The crisis management model is defined by the following three elements: methods for responding to a real crisis; measures, indicators or metrics for determining whether a crisis is one of the scenarios and based on that, what answer should be given to the crisis and how to achieve active response mechanisms; and communication.

2.1.3 Types of Crises
There are many varied and potential crises in the work environment, but they can be classified. This classification is important when a crisis calls for a crisis management strategy. Lerbinger introduced eight types of crises, including natural disasters, technological disasters, wars and conflicts, crime, corporate fraud, violence in the workplace, spreading rumors and terrorist attacks. Among these types, a closer look at the definition of a technological disaster is important:

Technological disasters are caused by human use of science and technology. The starting point is a failure or malfunction in a technological system. Some technological crises, however, occur as a result of human error. Usually in a technological crisis, one person is to blame, but in natural disasters, it is not always the case. Technological disasters include software failures, industrial accidents (Chernobyl accident) and the release of oil into the sea (BP companies in the Gulf of Mexico).

Technological crises can be classified as sudden crises and smoldering crises. Sudden crises require crisis management, and usually management cannot be blamed for crisis. In smoldering crises, downtime is due to the neglect of control and turns into a crisis and in such a crisis the organization is the culprit.

2.2 Specific Emergency Scenarios and How to Respond
This part of the project preparation explains how the crisis management team can react to different events. For each adverse event, a series of expected events, the introduction of a scenario, then the practices, and general principles governing the appropriate response are specified in the form of a list. The list specifies the necessary first step after the events of each scenario. Of course the actual time of issuing and carrying out the orders will also be inserted in the menu list.

This section analyzes the crisis management model, which closely models risk analysis. In order to maintain effective preparedness for emergencies, the risks related to machinery and equipment operations must be identified. The principles governing crisis management measures in this plan and for the proposed scenarios, in order of preference are as follows:
- Save the fleeing people, save lives, and bring them to a safe place.
- Protect the environment.
- Protect the integrity of the equipment, and, as far as possible, avoid stopping production.
- Protect the environment around the site.
- Manage such mishaps; the consequences are minimal and its negative effects.
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2.2.1 Spills and Gas Emissions Scenario

This scenario is characterized by the size, pressure and amount of gas released into the atmosphere and the type, such as cloud formation, density and the pressure of the gas. The consequences of this scenario can be an explosion, fire, or severe poisoning of personnel. The protection principles for this scenario are as follows: (1) Avoid creating sparks. (2) Identify the sources of gas emissions and isolate the other parts. (3) If it is possible, to de-gas density. (4) If it is possible, forward the gas emissions elsewhere. (5) When approaching a place, always move upwind. (6) Be careful packaging facilities, where possible; heavy gas is collected. (7) Prevent other people from entering the premises.

2.2.2 Fire Scenario

This scenario is characterized by the type of fire source, which may be gas or condensate, fires in pools, exhaust valves and pipes, an electrical fire, chemical, or gas emissions. In any case, the fire might spread to other places create toxic smokes leading to severe poisoning or asphyxiation, and might also lead to equipment failure caused by high temperature. The protection principles in this model are as follows: (1) Isolate the source of the fire. (2) Protect the neighboring facilities, to cool them. (3) Use foam for hydrocarbon fires. (4) If the fire is in the inner courtyard, close it to prevent air circulation and ventilation. (5) Once fire is distinguished; clear the area from all effects of fire. (6) Note that methanol is a colorless fire, and cannot be seen.

2.2.3 Blast Scenario

This scenario introduces two types of explosions: a mechanical explosion in closed containers and pipelines. Hydrocarbon explosions spark from hydrocarbon gas. The consequences of this scenario can be an explosion, fire, or equipment failure. The protection principles in this scenario are as follows: (1) Isolate each type of debris from the blast. (2) Carefully monitor vital equipment. (3) Act quickly to prevent subsequent accidents. (4) Be careful another explosion does not occur. (5) Discover the cause of the explosion.

3. Research Methodology

The objective was to innovate, extract and prioritize the factors that create technological hazards. Since a local variable was not found for the South Pars Gas Complex, we use the Delphi method and a set of eight senior managers. The Delphi technique is based on the opinion of experts in the scientific realm about predicting the future. Thus, unlike survey research methods, the validity of the Delphi method does not depend on the number of participants in the study, which depends on the scientific validity of the participating experts. Participants in a Delphi study include 5 to 20 people. The minimum number of participants depends on the research methods used. In this way, the board is made up of a panel of experts, in which communication between members goes through the board director or supervisor. Internal communication between participants is done anonymously and opinions, estimates, and intentions, cannot be attributed to their providers. This information is published without identifying the sources. With three-phase indicators, the experts examined the six factors identified as contributing factors to technological hazards.

| Table 1. Factors that affect technological hazards |
|---------------------------------------------------|
| Low levels of HSE                  |
| Organizational processes           |
| Lack of training programs          |
| Lack of training programs          |
| Sanctions; parts cannot be replaced for the machines, and thus wear out and create a risk in machines |
| The lack of accurate documentation and knowledge management, for documenting old technological problems to avoid duplication |

Network analysis techniques were used to prioritize these factors, some of which are interdependent. The Analytic Network Process (ANP) includes four main steps:

In Step 1, the model is constructed. It must be stated clearly and decomposed into a logical system, such as a network. The structure can be achieved, with the opinions of decision makers through brainstorming or other appropriate methods.

In Step 2, the test matrix and the vector of priorities are compared: the ANP and the Analytic Hierarchy Process (AHP) elements of decision-making in any combination are compared in pairs, in proportion to their importance and control measures and are also compared in pairs, in proportion to their role and participation in achieving the objective. In addition, paired comparisons should be used...
if connections exist between the elements of a component and a specific vector can be obtained, for each element, which indicates its impact on other elements. The values of relative importance, determined by a scale of 1 to 9, where 1 indicates equal importance between the two elements and a score of 9 shows the extreme importance of the element in that specific topic (matrix row) compared with other elements (matrix column).

A reciprocal value is assigned to the inverse comparison, as \( a_{ij} = \frac{1}{a_{ji}} \) where \( a_{ij} \) (or \( a_{ji} \)) indicates the importance of the \( i \)th (or \( j \)th) element, compared with the \( j \)th (or \( i \)th) element. The paired comparisons, in the ANP, are performed in the context of a matrix, such as AHP and a local priority vector can be obtained by estimating the relative importance of each element (or components), which is evaluated with the following equation:

\[
A \cdot w = \lambda_{\text{max}} \cdot w
\]

Where \( A \) is the matrix of the paired comparisons, \( w \) is an eigenvector, and \( \lambda_{\text{max}} \) is the largest Eigen value of \( A \). Saati proposed algorithms for approximating \( w \). The following three steps are used to combine the priorities.

1. Sum the amounts of each column of the paired matrix.
2. Divide each element of the corresponding column to the sum of the column. The matrix is known as the normalized matrix of the paired comparisons. (3) Sum the elements of each paired rows of the matrix and divide the total on all \( n \) elements of rows. The numbers are estimates of the relative priority of each element, compared with relevant high-level metrics.

Priority vectors must be calculated for the paired-comparisons matrix.

In Step 3, the super matrix formation, the super-matrix is similar to the process of the Markov chain. To obtain the final priorities in a system influenced by interdependency, local priority vectors are entered in the columns of the matrix as appropriate. This matrix is known as a super-matrix. As a result, a super-matrix is actually a partitioned matrix, where each part states the relationship between the two groups (components or categories) in a system. Suppose the components of a decision-making system are \( C_1, K = 1,2,\ldots,n \) and each \( K \) element includes \( m_k \) elements that are expressed as \( e_{k1}, e_{k2},\ldots,e_{km_k} \). The local priority vectors are classified, in the second step, and placed in the appropriate matrix, based on the impact a component has on itself or others. A standard image of a super-matrix is shown in the following Figure.

![Figure 1. The standard image of a super-matrix.](image)

For example, the super-matrix of a chain with three levels is as follows:

\[
W_k = \begin{bmatrix}
0 & 0 & 0 \\
0 & w_{21} & 0 \\
0 & 0 & w_{32}
\end{bmatrix}
\]

Where \( w_{21} \) is the effect of the ideals on the criteria, \( w_{32} \) is the matrix effect of the measures on each alternative, \( I \) is the identity matrix and 0 is related to elements that are not affected.

Step 4: Choose the best option: if the super-matrix formed in Step 3 covers the entire network, the priority weights of the alternatives can be determined in the alternatives column in the normalized super-matrix. However, if a super-matrix contains only components that have internal communications, additional calculations must be performed to acquire all options first. The item that has the most priority must be the first choice.

### 4. Research Findings

Normalized decision matrices, using the Saati method of weight vectors, related to the dependency between factors that affect technological hazards are shown in the following tables. An important point about the pair-comparison matrices is the catch rate. According to Saati, the originator of the AHP and the ANP, for that judgment to be stable, the rate of adaptation of the matrix must be less than or equal to 0.01. Therefore, if the rate is greater
than 0.1, in the paired-comparisons matrix, the experts must repeat their opinions to stabilize the matrix, and then the geometric mean of the elements of the matrix must be calculated. A paired-comparison questionnaire was distributed among eight of the organization's managers. There was an inconsistency rate of the whole matrix is less than 0.1. The results of the model in terms of the non-weighted super matrix and the exponentiation super-matrix are shown in the following tables. The results for calculating the weight of the decision-making criteria and

### Table 2. Normalized paired comparison group decision matrix of factors that affect technological hazards

| Purpose: To prioritize the factors that affect technological hazards | Lack of a safety culture | Organizational processes inconsistent with the technologies | Inappropriate technology transfer | Lack of appropriate training | Sanctions problem | Lack of accurate documentation and knowledge management |
|---|---|---|---|---|---|---|
| Lack of a safety culture | 1 | 1.15 | 0.50 | 0.66 | 1.50 | 1.86 |
| 0.87 | 1 | 1.42 | 0.91 | 1.13 | 1.35 |
| 2.01 | 0.70 | 1 | 0.53 | 0.98 | 1.14 |
| 1.52 | 1.10 | 1.90 | 1 | 1.51 | 2.94 |
| 0.67 | 1.10 | 1.02 | 0.66 | 1 | 1.54 |
| 0.54 | 0.74 | 0.88 | 0.34 | 0.65 | 1 |
| 0.0303 | | | | | | |

### Table 3. Normalized comparison of group decision matrix of factors that affect technological hazards, based on the influence of the lack of a safety culture

| Objective: The impact on the lack of a safety culture | Organizational processes inconsistent with the technologies | Inappropriate technology transfer | Lack of appropriate training | Sanctions problem | Lack of accurate documentation and knowledge management |
|---|---|---|---|---|---|
| 1 | 1.06 | 0.89 | 2.92 | 2.78 |
| 0.95 | 1 | 1.86 | 1.33 | 2.93 |
| 1.13 | 0.54 | 1 | 2.58 | 3.28 |
| 0.34 | 0.75 | 0.39 | 1 | 2.18 |
| 0.36 | 0.75 | 0.31 | 0.46 | 1 |
| 0.0180 | | | | | |

### Table 4. Normalized comparison of group decision matrix of factors that affect technological hazards, based on the influence of organizational processes inconsistent with the technologies

| Objective: The impact of technology on organizational processes is inappropriate | Organizational processes inconsistent with the technologies | Inappropriate technology transfer | Lack of appropriate training | Sanctions problem | Lack of accurate documentation and knowledge management |
|---|---|---|---|---|---|
| 1 | 1.29 | 1.29 | 2.67 | 3.11 |
| 0.78 | 1 | 1.61 | 1.16 | 1.94 |
| 0.78 | 0.62 | 1 | 1.52 | 3.04 |
| 0.37 | 0.86 | 0.66 | 1 | 1.98 |
| 0.32 | 0.86 | 0.33 | 0.51 | 1 |
| 0.0108 | | | | | |
### Table 5. Normalized comparison of group decision matrix of factors that affect technological hazards, based on influence on inappropriate technology transfer

| Objective: The influence of improper technology transfer | Inappropriate technology transfer | Lack of appropriate training | Lack of accurate documentation and knowledge management | Consistency rate |
|----------------------------------------------------------|----------------------------------|------------------------------|-------------------------------------------------------|------------------|
| Lack of a safety culture                                 | 1.07                             | 1.40                         | 2.74                                                  | 1.86             |
| Organizational processes inconsistent with the technologies | 1                                | 0.91                         | 2.46                                                  | 2.00             |
| Lack of appropriate training programs                    | 0.71                             | 1                            | 1.34                                                  | 1.20             |
| Lack of appropriate training programs                    | 0.36                             | 0.75                         | 1                                                      | 1.28             |
| Despite sanctions problem                                | 0.54                             | 0.78                         | 0.78                                                  | 1                |
| The lack of accurate documentation and knowledge management | 0.0199                           |                               |                                                        |                  |

### Table 6. Normalized comparison of group decision matrix of factors that affect technological hazards, based on the influence of the lack of appropriate training programs

| Objective: The impact on the lack of appropriate training programs | Inappropriate technology transfer | Lack of appropriate training | Lack of accurate documentation and knowledge management | Consistency rate |
|------------------------------------------------------------------|----------------------------------|------------------------------|-------------------------------------------------------|------------------|
| Lack of a safety culture                                         | 0.96                             | 0.83                         | 1.61                                                  | 2.01             |
| Organizational processes inconsistent with the technologies       | 1.04                             | 0.74                         | 1.11                                                  | 2.34             |
| Inappropriate technology transfer                                 | 1.21                             | 1                            | 1.33                                                  | 2.10             |
| Despite sanctions problem                                        | 0.62                             | 0.75                         | 1                                                      | 1.65             |
| The lack of accurate documentation and knowledge management       | 0.50                             | 0.48                         | 0.61                                                  | 1                |
| Inconsistency rate                                                | 0.0357                           |                               |                                                        |                  |

### Table 7. Normalized comparison of group decision matrix of factors that influence technological hazards, based on influence of the sanctions issue factor

| Objective: The effectiveness of the sanctions issue | Inappropriate technology transfer | Lack of appropriate training | Sanctions problem | Lack of accurate documentation and knowledge management | Consistency rate |
|----------------------------------------------------|----------------------------------|-------------------------------|-------------------|-------------------------------------------------------|------------------|
| Lack of a safety culture                           | 1.11                             | 0.91                          | 0.90              | 1.07                                                  | 0.90             |
| Organizational processes inconsistent with the technologies | 0.90                             | 1                             | 1.00              | 0.80                                                  | 2.23             |
| Inappropriate technology transfer                   | 1.10                             | 1.00                          | 1                 | 1.23                                                  | 1.27             |
| Lack of appropriate training                        | 1.11                             | 1.25                          | 0.81              | 1                                                      | 1.18             |
| The lack of accurate documentation and knowledge management | 0.93                             | 1.25                          | 0.78              | 0.85                                                  | 1                |
| Inconsistency rate                                  | 0.0164                           |                               |                  |                                                        |                  |
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There was an inconsistency rate of the whole matrix is less than 0.1. The results of the model in terms of the non-weighted super matrix and the exponentiation super-matrix are shown in the following tables. The results for calculating the weight of the decision-making criteria and technological factors that affect risk are shown in Table 9. After exponentiation the above matrix, the following results are obtained for weighting of the criteria and the technological factors that affect risk.

### Table 8. Normalized comparison of group decision matrix of factors that influence technological hazards, based on the influence of the lack of accurate documentation and knowledge management

| Lack of a safety culture | Organizational processes inconsistent with the technologies | Inappropriate technology transfer | Lack of appropriate training programs | sanctions issue | Objective: The impact of the lack of detailed documentation and knowledge management |
|--------------------------|----------------------------------------------------------|----------------------------------|--------------------------------------|----------------|------------------------------------------------------------------------------|
|                          |                                                          |                                  |                                      |                | Lack of a safety culture |
|                          |                                                          |                                  |                                      |                | Organizational processes inconsistent with the technologies |
|                          |                                                          |                                  |                                      |                | Inappropriate technology transfer |
|                          |                                                          |                                  |                                      |                | Lack of appropriate training programs |
|                          |                                                          |                                  |                                      |                | Despite the boycott issue |

Table 8. Normalized comparison of group decision matrix of factors that influence technological hazards, based on the influence of the lack of accurate documentation and knowledge management

| Lack of adequate training | Lack of a safety culture | Sanctions issue | The lack of accurate documentation and knowledge management | Inappropriate technology transfer | Organizational processes inconsistent with the technologies | Technological hazards |
|---------------------------|--------------------------|-----------------|------------------------------------------------------------|---------------------------------|-----------------------------------------------------------|---------------------|
| 0                         | 0.250728                 | 0.209358        | 0.191758                                                  | 0.201759                        | 0.21696                                                   | 0.246485            |
| Lack of a safety culture  | 0.232032                 | 0               | 0.195663                                                  | 0.185392                        | 0.285397                                                  | 0.309136            |
| Sanctions issue           | 0.178428                 | 0.134338        | 0                                                          | 0.23646                         | 0.13173                                                   | 0.154598            |
| The lack of accurate documentation and knowledge management | 0.10958 | 0.07805 | 0.154688 | 0 | 0.148462 | 0.089569 |
| Inappropriate technology transfer | 0.259446 | 0.269409 | 0.218203 | 0.220817 | 0 | 0.229738 | 0.163308 |
| Organizational processes inconsistent with the technologies | 0.220513 | 0.267475 | 0.222088 | 0.165573 | 0.232652 | 0 | 0.174725 |
| Technological hazards     | 0                         | 0               | 0                                                          | 0                                | 0                                                          | 0                   |

Table 9. Results of the software unweight super-matrix
Limit Super-matrix

|                          | Lack of appropriate training | Lack of a safety culture | Sanctions Issue | The lack of accurate documentation and knowledge management | Inappropriate technology transfer | Organizational processes inconsistent with the technologies | Technological hazards |
|--------------------------|------------------------------|--------------------------|-----------------|-------------------------------------------------------------|---------------------------------|----------------------------------------------------------|----------------------|
| Lack of appropriate training | 0.178427                    | 0.178427                 | 0.178427        | 0.178427                                                    | 0.178427                        | 0.178427                                              | 0.178427             |
| Lack of safety Culture sanctions Issue | 0.200515                    | 0.200515                 | 0.200515        | 0.200515                                                    | 0.200515                        | 0.200515                                              | 0.200515             |
| The lack of accurate documentation and knowledge management | 0.137431                    | 0.137431                 | 0.137431        | 0.137431                                                    | 0.137431                        | 0.137431                                              | 0.137431             |
| Inappropriate technology transfer | 0.102147                    | 0.102147                 | 0.102147        | 0.102147                                                    | 0.102147                        | 0.102147                                              | 0.102147             |
| Organizational processes inconsistent with the technologies | 0.195568                    | 0.195568                 | 0.195568        | 0.195568                                                    | 0.195568                        | 0.195568                                              | 0.195568             |
| Technological hazards | 0                          | 0                          | 0                | 0                                                          | 0                              | 0                                                      | 0                    |

Based on these findings, the weight factors affecting technological hazards in the South Pars Gas Complex are described in Table 10.

Table 10. The final weight of the factors that affect technological hazards for the south pars gas complex

| Alternatives                                              | Total   | Normal  | Ideal   | Ranking |
|-----------------------------------------------------------|---------|---------|---------|---------|
| Lack of appropriate training                              | 0.1784  | 0.1784  | 0.8898  | 4       |
| Lack of a safety culture                                  | 0.2005  | 0.2005  | 1.0000  | 1       |
| Sanctions                                                 | 0.1374  | 0.1374  | 0.6854  | 5       |
| The lack of accurate documentation and knowledge management | 0.1021  | 0.1021  | 0.5094  | 6       |
| Inappropriate technology transfer                          | 0.1956  | 0.1956  | 0.9753  | 2       |
| Organizational processes inconsistent with the technologies | 0.1859  | 0.1859  | 0.9272  | 3       |

technological factors that affect risk are shown in Table 9. After exponentiation the above matrix, the following results are obtained for weighting of the criteria and the technological factors that affect risk.

5. Discussion and Conclusion

Strong intangible factors, such as organizational culture, values, and employee beliefs, affect the success of an organization and its ability to deal with a crisis. Organizational culture is evident in the belief system expressed through language, signs, and symbols. Rituals that reflect behavior are the result of a belief system; therefore, the type of belief system can have a big effect on the behavior of members. Preparations and infrastructure create a culture in which everyone, at the time of an unexpected event, tries to fill the gaps caused by the crisis and make it possible to continue the activity. However, this is achievable only through the institutionalization of the culture crisis and a stabilized business. The organizational culture affects all aspects of the organization, including goal setting, strategy,
individual behavior, creativity and innovation, employee involvement, job satisfaction and the like. Research has shown that successful and sustainable organizations have a strong corporate culture when they face a crisis. The momentum and motivation to maintain an organization during a crisis should be institutionalized in the form of business continuity in individuals’ beliefs.

Each organization has its own culture, which shows the attitude of the staff and their orientation and organization, the environment, and unexpected factors. Therefore, creating models of organizational culture, which can be easily organized, the formation of a stable environment, and unexpected events that give life and sustain it, are essential. Until now, there have been many definitions of organizational culture. In fact, no definition in general is acceptable. Richard Morris defined organizational culture, values, and shared perceptions, which are maintained by members of the organization.

A survey was conducted among the 22 largest construction companies. Researchers found that 82 percent of the companies did not have any information about business continuity management and 92 percent, when faced with an unexpected event, tried to come up with solutions to reduce damages right at the moments of that crisis (and not before). The researchers concluded that there was no written plan in order to reduce losses due to the crisis, which may affect their brand. In this study, the authors suggested that the government should force these companies, which constituted a large part of the oil and gas industry, to submit plans to anticipate crises and management strategies by pushing the idea of continuing the business of these companies, the use of financial incentives and tax breaks. Savage, referring to the September 11 attacks, and the problems caused by this event, stated that a Business Continuity Plan (BCP) is necessary for enterprises. His proposed BCP included the following steps: (1) Assess the risk analysis and business impact. (2) Document the activities necessary to prepare the organization to deal with unexpected events (e.g., recovery strategies for affected areas). (3) Identify and authorize activities related to the coping process, during unanticipated events. (4) Test the processes. (5) Train staff. (6) Run the processes for coping with risk, and update them regularly.

### 6. References

1. Wu W-W, Yu B, Wu C. How China’s equipment manufacturing firms achieve successful independent innovation: the double helix mode of technological capability and technology management. Chinese Management Studies. 2012; 6(1):160–83.
2. Vednere G. Crossing the IT hurdle: a practical approach to implementing records management technology. Records Management Journal. 2009; 19(2):98–106.
3. Chehreh GK, Raissi G. Reviews and formulate an appropriate model, the technology transfer organization and management software, Rotsel German Company, for use in small Industries Steel in Iran third Annual Congress. Iranian Metallurgical Engineering Society. 1999; 512–23.
4. Syed-Ikhsan S, Rowland F. Knowledge management in a public organization: a study on the relationship between organizational elements and the performance of knowledge transfer. Journal of Knowledge Management. 2004; 8(2):95–111.
5. Lerbinger O. The crisis manager: facing risk and responsibility. Mahwah, NJ: Erlbaum; 1997.
6. Goldberg M. Sustainable utility business continuity planning: a primer, an overview and a proven culture-based approach. The Electricity Journal. 2008; 21(10):67–74.
7. Kordnaj A, Moshabaki A. Explaining the design and interactive strategy, corporate culture and environment, industrial organizations. Quarterly Journal. 2002; 6(1).
8. Sharifzadeh F, Mehdi K. Management culture of the organization. Tehran: Publication Ghomes; 1998.
9. Morris MR. Effective organizational culture is key to a company long terms success. Industrial Management. 1992 Mar; 34(2).
10. Low S, Liu J, Sio S. Business continuity management in large construction. Journal of Disaster Prevention and Management. 2010; 19(2):219–32.
11. Savage M. Business continuity planning. Work Study. 2002; 51(5):254–61.