



Research Article

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## ***The Environmental Performance Evaluation of Ahwaz Pipe Manufacturing Company within the Environmental Management System***

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### **ABSTRACT**

ISO 14001 global standard is considered as the main reference measure for environmental management system evaluations and it is done for the establishment and the creation of the environmental coordinated management system in an organization and it enables the organization to reach the level of performance which is set by the organization itself and the organization can systematically control it. This standard entails requirements in order to develop and implement an environmental management system to be able to improve the organization's environmental performance and function. Since the establishment of such a system brings about many advantages for the organization the performance evaluation and the study of the weak and strong points for the organization's environmental management system performance improvement is one of the fundamental premises of the system. This study has been undertaken for the purpose of environmental management system performance evaluation and the survey of the effectiveness of the ISO 14001 standard in the Ahwaz Pipe manufacturing company. In the present study it was made use of FAHP method to design the organization's environmental performance evaluations in order for the standard to be upgraded in the organization. Then, the weighting and the ranking of the criteria has been done by the use of FAHP method and by taking advantage of Excel software and the performance score of the current situation of the criteria and the indices in the organization has been determined based on the Likert criterion and eventually for the standardization and the determination of the status quo the importance/performance analytical model (IPA) in relation to the determination of the company's performance status was used. And based on the obtained results it becomes clear that the implementation and operation criteria are of the maximum significance and importance, followed by, respectively, planning and survey and policy in the second to the fourth ranks and the company should try to do its best to focus greatly on the criterion of "environmental objectives and programs", the criterion of "staff members awareness of the EMS" and the criterion of urgency conditions management". Also, it is suggested that in order to improve the environmental performance the company should concentrate on the high-importance criteria having low performance value and the low-importance criteria with high performance qualities.

**Keywords:** ISO 14001 Standard, Environmental Performance, Evaluation, FAHP, IPA

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### **INTRODUCTION**

Nowadays, organizations are facing inescapable requirements for the confrontation with the environmental challenges and the proper environmental management has been turned into the organizations' success factor. Increased attention paid to the environment conservation through the establishment of the national/regional/international rules and regulations and the emerging sustainable development necessity has caused the organizations to take important steps and measures for acquiring an environmental management system. The

international ISO organization has offered ISO 14001 to internationally develop standardizations and to coordinate the global affairs and by doing so it has contributed a lot to the environmental approaches development. This standard has provided the organizations with the elements of an effective environmental management system (EMS) through the integration of which with the other management necessities and requirements assist the organizations in achieving the environmental and economic objectives [1]. From among the advantages of such a managerial system one can refer to the followings: the reduction of the unpleasant effects originating from the organization operations on the ecology, the increase in productivity and services and actions outputs, the increase in the energy effectiveness, energy savings, the utilization of the clean energies, the replacement of the renewable resources, the application of less-contaminating substances and material in the organizations [2]. Therefore, to heighten the systems' performances inside the organizations correct managerial solutions should be offered in order for the organizations to enjoy the systems advantages. After several years of the establishment of such systems in the organizations of our country we are continuously bearing witness to the ineffectiveness of such systems but even with the great benefits originating from the establishment of such systems in the organizations these systems maintenance is of a great value upon which the environmental performance of the organization rests. Ahwaz pipe-manufacturing company is a business entity committed to the followings:

The production and supply of different kinds of pipes required in the oil, petroleum, petrochemistry and water industries which are prepared according to the standards set by the customers, financing and implementing the pipeline projects, the establishment and deployment of the oil, gas, petroleum byproducts and water transmission lines in Iran and around the world, the creation of more value-added through the development of the supply chain and at the turn of the third Gregorian millennium the company's managers have chosen the objective of creating a better work environment in its agenda as a way to more effectively present the company to the world competitive market and they also wish to establish an Integral Management System (IMS) and this integral management system can become a reality by the implementation of quality management system ISO 9001, environmental management ISO 14001, safety management OHSAS 18001 and laboratory management systems ISO 17025 as well.

Since the proper environmental management of an organization depends on the environmental performance evaluation of the organization in order for the elemental management results such as activities, products and services which are interacting with the periphery of the organization to be fully comprehended and improved [3]. In the present study, we deal with the environmental performance evaluation of Ahwaz pipe manufacturing company within the environmental context to offer managerial strategies and solutions for enhancing and improving its performance and its ISO 14001 parameters will be investigated.

## **2. Literature Review**

### **2-1. Theories and Concepts**

#### **2-1-1. Environmental performance evaluations**

A process will be reported and acknowledged here which facilitates the management decision-making in respect to the environmental performance of the organization along with the selection of the indices, data collection and analysis, information evaluation and they are compared with the environmental criterion and through the regular review of the process it can be improved [4]. The appropriate environmental management is related to the environmental performance evaluation. The environmental performance includes the results obtained from the environmental aspects of an organization. The environmental aspects are the activities, products and services offered by an organization which can interact with the periphery of the organization. The environmental performance evaluation is a process which facilitates the decision-making process via considering the environmental performance of the organization [5].

Many of the organizations are in search of ways for understanding, reflecting and improving their environmental function and performance. This is facilitated via the efficient management of elements and components such as activities, products and services which can distinctively affect the environment [6].

**2-1-2. Introduction of the environmental performance evaluation comprehensive model:**

Based on the environmental performance evaluation comprehensive model, the environmental performance evaluation is a process which includes four stages:

The preparation of the environmental performance evaluation program (programming)

The implementation of the environmental performance

Validating the implementation of the environmental performance evaluation program

The review of the environmental performance evaluation program [4]

**1. Environmental performance evaluation program:**

At this stage, for the first step, the environmental performance evaluation scope is determined. In other words, in this step the boundaries of the surveyed organization are identified. Then, within the scope the activities, services and the elements interacting with the environment are identified. Next, the activities, products and the services environmental consequences are determined. For the second step, the environmental performance are formulated and then the environmental performance measures are identified.

**2. Implementation of the environmental performance evaluation program:**

After the preparation of the environmental indices, the environmental performance data which are in fact the environmental performance indices amounts are gathered from the resources such as the measurement history and the environmental survey, interviews and observations, annual reports, financial history, production, purchase, sales and accounting, then the environmental performance information is compared with the reference amounts such as amounts referred to in the environmental standards and rules and regulations, the amounts related to a definite index from the previous years, the targeted amounts in the environmental management programs and so forth and through this comparison the environmental performance can be improved and the deficiencies come to the surface.

**3. Validating the environmental performance evaluations:**

After the programming phase and the implementation of the environmental performance evaluations program it is necessary to validate the steps and the tasks performed in these two stages in order for the environmental performance evaluations improvement opportunities to show up. To validate the environmental performance programming, the distinct environmental aspects and the interested parties' perspectives are reviewed. Since the pooling of these two tasks provides us with the environmental performance indices their review also shows us if the appropriate indices have been chosen for the environmental performance evaluations.

**4. Environmental performance evaluation review:**

The objective of this stage is to improve the environmental performance evaluation. In fact, this stage steps and tasks substantiate the continuous improvement concept. To do so, the improvement opportunities identified within validating the environmental performance evaluation are taken into practical use and the first and the second stages of the environmental performance evaluation are reviewed [4].

**2-1-3. Environmental management system standard:**

This standard was established by the international standardization organization (ISO) in 1996 and the final edition was published in 2004. This standard is in fact a component of a series of standards which are called ISO 14000 series by the international standardization organization [7]. The ISO 14000 series of standards are the standards for the environment and ecology management which is based on systems and tools for the management, auditing, marking and the evaluation of the environmental performance of the organization and the products [8]. The environmental management standards are prepared with this aim of providing the organization with the elements of

an efficient environmental management system in order to be able to integrate with the other management requirements and assist the organizations in achieving the economic and environmental objectives.

This global standard has defined requirements for an environmental management system in order for the organization to be able to consider its marked legal requirements and the environmental consequences through developing and implementing its policies, trends and objectives. This standard tries to be useable for all of the organizations from any kinds and with whatever the size and it also manages to encompass the various geographical, cultural and social conditions. The general objective of this standard is to support the environment conservation plans and to prevent from pollution in such a manner that it can be in balance with the social and economical needs. The system's success depends on all of the staff commitment in each and every level of the organization specially the senior management [9].

#### **2-1-3-1. Advantages of utilizing ISO 14001 standard:**

- Establishment of the environmental management systems which will lead to a higher level of environment conservation
- Minimizing the non-tariff business barriers and the facilitation of the international business according to giving more weight to the environment in the organizations.
- Absorbing more customers and the increase in the market share in the international level
- Enhancement of the conservation rules and regulations observance
- Optimal use of the natural resources
- Facilitation of the international business
- Creation of more value-added for the organization

#### **2-1-3-2. Usability Domain:**

This standard defines some requirements for the environmental management system in order for the organization to be able to develop and improve its policy and objectives via considering the rules and regulations and the other requirements burdened by the organization and the information regarding the environmental market consequences. The use of this standard is for the identified environmental aspects which can be controlled by the organization and it could be expected that the organization would be able to influence them. This standard in itself is not indicative of any special environmental performance measure. Rather, this standard can be applied in any organization willing to implement the following cases:

- The creation, implementation, establishment and improvement of an environmental management system
- Insuring the system's compatibility with the set environmental trend.
- Justifying the compatibility with this standard through:
  1. Self-justification and self-report
  2. Requesting the compatibility confirmation by the organization interest groups such as customers, or
  3. Requesting the self-report confirmation by the parties outside the organization, or
  4. Applying for a document/testimony for the organization's environmental management system registration by an external organization.

The entire requirements cited in this standard are aimed for consideration in any environmental management system. The application field for this standard depends on the factors such as organization's environmental policy, the nature of its activities, products and services and where the activities are taking place and the statuses of the activities [9].

#### **2-1-4. The ISO 14000 requirements:**

This standard imposes some requirements for an environmental management system to enable the organization to develop and improve objectives and attitudes through considering the regulations, other requirements accepted to be burdened by the organization and the reference information, distinct environmental consequences. Its usability has been identified in the field of environmental aspects controlled by the organization and it could be expected that the organization can influence these aspects. The usability extent depends on the factors such as organization's environmental attitudes, the organization's activities, products and services nature and the focus and status of the activities.

##### **2-1-4-1. General requirements:**

The environmental management system implementation as determined by this standard is to achieve the environmental performance improvement, therefore this standard is based on this theory that the organization should periodically review and assess its environmental management system in order to identify its chances of improvement and the quality of the standard utilization. The amount, extent and the time span for the constant improvement can be caused by considering the economical and other organization's environmental conditions aspects.

This standard requires an organization to:

- Create an appropriate environmental attitude
- Identify the environmental aspects resulting from the current or past or programmed activities, products and services in order for the distinct environmental consequences to be determined.
- Identify the applicable regulations and the other requirements shouldered by the organization.
- Identify the priorities and determine the macro-objectives and the environmental objectives.
- Create a structure and a program(s) for the formulation of the environmental policy and achieving the macro-criterion objectives.
- Facilitate the planning, controlling, assessment, adjusting and preventive, artificial and review measures to make sure that both the policy is followed and the environmental management system is continuously established and appropriately followed.
- Have the compatibility with changing conditions.

##### **2-1-4-2. Environmental policy:**

The senior management should define the organization's environmental policy corresponding to its environmental management system scope and make sure that this policy:

- Is conformant to the nature, extent and the environmental consequences of its activities, products and services
- Includes commitment to constant improvement and prevention from pollution.
- Includes commitment to the pursuance of the rules and the other requirements accepted by the organization and relates to its environmental aspects.
- Offers a framework for the determination and review of the macro- and micro-environmental objectives.

- Be implemented and kept in a codified and embodied manner
- Be announced to the entire organization's staff members and all of the individuals working on its behalf.
- Be accessible by the general public

#### **2-1-4-3. Planning:**

##### **2-1-4-3-1.Environmental aspects:**

The organization should create, implement and keep administrative method(s) for the following affairs:

- The identification of its environmental aspects of the activities, products and services within the determined environmental management system scope which can be controlled and influenced by the organization, or can be reviewed or renewed by considering the future plans or developments or the activities, products and services
- The determination of the aspects which have or can have distinct environmental consequences.

The organization should compile this information and keep them up-to-date and also the organization should insure that it is creating and implementing and establishing the standard through the consideration of the distinct environmental management system aspects.

##### **2-1-4-3-2.Regulations and the other requirements:**

The organization should create, implement and institute a method(s) for the followings:

- The identification, achievement of the actable rules and the other requirements which are agreed upon by the organization in relation to its environmental aspects
- The determination of the application quality of these requirements in its environmental aspects
- The organization should insure that the actable regulations and the other accepted requirements have been considered in the creation, implementation and the establishment of its environmental management system.

##### **2-1-4-3-3. Micro- and macro-objectives and the Plan (s)**

The organization should create, implement and institute the compiled macro- and micro- environmental objectives in whichever the level or section of the organization deemed related. The macro- and micro-objectives should be to the maximum extent possible measurable and they should be conformant to the environmental policy including the commitment to the pollution prevention, the observation of the actable rules and the other accepted requirements and the continuous improvement. The organization should consider the rules and the other accepted requirements and the distinct environmental aspects when creating and reviewing its macro- and micro-objectives. Also, the technology options and the financial, operational, commercial requirements and the interest groups ideas have to be taken into consideration. The organization should create, implement and establish program (s) for getting to the macro- and micro-objectives. This program (s) should include the following items:

- The determination of the responsibilities for the achievement of the macro- and micro-objectives in whichever level or section of the organization deemed as related.
- The manner in which getting to the objectives is scheduled.

##### **2-1-4-3-4. Administration and operation**

###### **A. Resources, tasks, responsibility and options:**

Management should insure that it has the necessary resources for the creation, implementation and the establishment and the improvement of the environmental management system. These resources include the human resources, the specialized skills, technology, infrastructure and the financial resources. The tasks, responsibilities and the latitudes should be determined, codified and announced for the effective environmental management to be facilitated. The organization's senior management should appoint known management representative (s) who has the task, responsibilities and latitudes for the following jobs regardless of the other responsibilities:

- Making sure that the environmental management system has been administrated and instituted based on the standard's requirements.
- Reporting to the senior management regarding the environmental management system performance along with improvement recommendations for the purpose of reviewing.

#### **B. Qualifications, instruction and knowledge:**

The organization should insure that all of its workers and the individuals working on the behalf of the organization and their activities potentially results in distinct environmental consequence (s) are qualified from the education, instruction or experience point of view. The organization should keep the individuals' related historical information. The organization should identify its educational needs related to its environmental management system. Also, the organization should create, implement and establish administrative method (s) for informing the staff members and the individuals working on its behalf from the following cases:

- The importance of conformation to the policy attitudes and the administrative methods and the environmental management system requirements
- The distinct environmental aspects and the relationship between the potential and possible consequences and the organization's activities and the environmental interests resulting from the individuals' improved performances.
- Tasks and responsibilities in achieving the conformation to the environmental management system requirements
- The potential consequences and responsibilities in achieving the conformation to the environmental management system requirements
- The potential consequences resulting from deviation from the determined administrative methods

#### **C. Communications:**

The organization should create, implement and establish a method (s) for the following items according to its environmental dimensions and its environmental management system:

- The communication between various intra-organization levels and sections
- Receiving, compiling and responding to the ideas delivered by the outer organization interest groups

The organization should make decisions regarding the announcements outside the organization about its environmental aspects and the decision-makings should be compiled. In case there is a decision to announce and communicate the organization should create and administrate a method (s) for the communications outside the organization.

#### **D. Documentation:**

The environmental management system documentation should include the following items:

- The environmental policy, macro- and micro-objectives
- The environmental management scope explication
- The environmental management system main elements explication and their mutual relationships and reference to the related documents
- The documents and the historical data required in this standard
- The documents and the historical data determined by the organization in order to make sure of the planning, implementation and controlling processes efficiencies which are in relation to the distinct environmental aspects of the organization.

#### **E. Document controlling:**

The required documentations in the environmental management system and this standard should be controlled. The historical data are a special case of the documentations and they should be controlled according to the previous requirements. The organization should create, implement and institute a method (s) for the following cases:

- Confirming the documents' qualities before issuing
- Reviewing and upgrading the documents if required and reconfirmation of the documents
- Making sure that the status quo and the changes in the documents are determined
- Making sure that the respective copy of the actable documents can be accessible in the utilization areas
- Making sure that the document has remained legible and it is easily identifiable
- Making sure that the documents originating from the outer-organization sources which have been determined for the planning and operational needs of the environmental management system by the organization are identified and their distribution is under control.
- Preventing from inadvertent use of the obsolete documents and identifying these obsolete documents in case they are kept for any purpose.

#### **F. Operation control:**

The organization should identify and determine the operations related to its distinct environmental aspects which are in relation with the environmental policy, its micro- and macro-objectives and it should make sure that these objectives are achieved under the following determined conditions:

- The creation, implementation, establishment of the administrative compiled methods for controlling the statuses the lack of which will result in the deviation from environmental and micro- and macro-objectives policies.
- Operational measures determination for the administrative method (s)
- The creation, implementation and establishment of the administrative methods related to the distinct and identifiable environmental aspects for the products and services used by the organization and announcing the actable administrative methods and the requirements related to the suppliers and contractors

#### **G. Readiness and reaction in emergency situations:**

The organization should create, implement and institute a method (s) for the identification and the quality of reacting to the emergency situations and potential events which can be followed by environmental phenomena. The



organization should be prepared to appropriately react to the emergency situations or possible threats for the prevention of or reduction of the environmental consequences damages resulting. The organization should periodically review and revise, if required, the administrative methods for preparing and reacting to the emergency situations especially after the events have taken place or post-emergency situations. Also, the organization should periodically, or whenever it is deemed possible, test these administrative methods.

#### **2-1-4-4. Measurement and monitoring:**

The organization should create, implement and institute administrative method (s) for monitoring and measuring its operations' key features which can exert a distinct environmental influence. This method(s) should include information compiling for the performance monitoring, operational control related to and compatible with the environmental micro- and macro-objectives. The organization should insure that the measurement and monitoring equipment' calibration or authentication is applied and instituted. The organization should keep historical information related to this operation.

##### **1. Regulations and the other requirements:**

- The organization should create, implement and institute administrative method (s) along with commitment to the observation of the regulations for the periodical assessment of sticking to the actable regulations. The organization should keep the periodical evaluations results history.
- The organization should evaluate the observation of the other requirements accepted by it. The organization can evaluate the observation of the other requirements performed simultaneously with the evaluation of the regulations observance or it can devise separate administrative methods. The organization should keep these periodical evaluations results history.

##### **2. Non-conformation, amendatory and preventive measures:**

The organization should create, implement and institute an administrative method(s) for dealing with the potential and possible inconsistencies and the amendatory and preventive actions should be determined to cover the following requirements:

- Identification and elimination of the non-conformations, the creation of actions for the reduction in their environmental consequences
- Inconsistencies peripheral analysis, determining the cause(s) and taking steps to prevent them from reiteration
- The assessment of the action(s) required for preventing from non-conformations and the implementation of the planned actions for avoiding their happenings
- Keeping records of the amendatory and preventive measures results
- Reviewing the amendatory and preventive measures efficiencies

The performed actions should be proportionate to the problem's dimensions and the resultant environmental consequences. The organization should insure that any required changes in the environmental management system documentations resulting from the amendatory and preventive measures are put into practical use.

##### **3. History control**

The organization should create, implement and establish the obtained history and results required for the determination of the conformation to the environmental management system requirements and the current standard requirements. The historical information should be legible, identifiable and accessible and they should be kept as such.

#### 4. Internal auditing:

The organization should insure that the environmental management system internal auditing can be administered in programmed time intervals to cover the following cases:

It should be determined that the environmental management system:

1. Conforms with the programmed arrangements for the environmental management system including the current standard requirements
2. It is implemented and established appropriately
- The information related to the auditing results are delivered to the management

The organization should create, implement and establish program(s) to survey the ecology importance in the previous related auditing operations and results.

Create, implement and establish method(s) to include the following items:

- The responsibilities and requirements for planning and administration of the audits, reporting the results and keeping the related histories.
- The determination of the criteria, scopes, frequency and methods of auditing

The methods for the selection of the auditors and the auditing office should bring about this assurance that the auditing process is objective and impartial.

#### 2-1-4-5. Management review:

The senior management should review the environmental management system in scheduled time intervals to insure its appropriateness continuation, sufficiency and efficiency. The review should include the improvement opportunity evaluations and the change need in the environmental management system such as environmental policy and the micro- and macro-objectives. The review historical data should be kept. The management review inputs should include the following cases:

- The internal auditing results and the evaluation and the observation of the regulations and the other accepted requirements by the organization
- Communication with the interest groups including dealing with the complaints
- The environmental performance
- The extent to which the micro- and the macro-objectives have been actualized
- The status of the amendatory and preventive measures
- Changing the conditions such as expansion and development of the regulations and the other requirements related to the environmental aspects
- Recommendations for improvement

The management review outputs should include any decisions and actions related to the possible changes in the environmental policy, micro- and macro-objectives and the other environmental management system elements corresponding to the continuous commitment and improvement [16].

## 2-2. Research background

Imami (2013) in a study entitled as the determination of the important criteria in the ISO 14001 environmental management system performance evaluation for the Besparan Petrochemistry in Imam Khomeini Port has taken advantage of the hierarchical method to design the organization's environmental performance evaluation model in order to improve the current standard's implementation in the organization. In the first step, the main criteria were designed based on the ISO 14001 environmental management system by making use of the survey of the articles and researches performed in this field and interviewing and consulting with the experts and specialists. In the next step, the criteria were weighted by making use of the hierarchical methods and by making use of the SuperDecision software, and in the final step it was dealt with the organization's performance score determination. This survey indicates that even though the standard has numerous advantages for the organization the ISO 14001 focus on the preservation of this standard is one of the main pillars upon which the organization's environmental performance is depended.

Mardani et al (2009) in a study dealt with the study of the environmental management system implementation factors (EMS), ISO 14001, by making use of the AHP method in small- and medium-sized enterprises in Arak. In this study the important factors and sub-factors in the successful implementation of ISO 14001 based on the environmental management system and the resultant advantages have been evaluated and there has been made use of the hierarchical analysis process.

Karbasi and his colleagues (2009) in a study dealt with the survey of the environmental management system in Darkhoyen oil field and they offered performance improvement solutions. In the first stage, this study identified the air, sound and residual pollutants in the Darkhoyen deployment unit in order to survey the environmental status in the aforementioned unit.

Farrashi et al (2008) in a study entitled the organizations' environmental performance evaluation model in maintaining the ISO 14001 standard dealt with the case study of the district 7 of Tehran's municipality. The results indicated that this organization's performance has been weak regarding maintaining the management system.

Tayon Feng et al (2014) in article entitled the environmental management system influence on the financial performance: the limited intermediation analysis, applied the current study for the regression hierarchical analysis for discovering the environmental management systems (EMSs) effective on the financial performance through the customer satisfaction and loyalty and the effects of cost adjustment options. The experimental results obtained from this study indicate that the EMSs influence the satisfaction and loyalty of the customers and the financial performance significantly and positively.

## 3. Research Methodology

At first, after the study of the articles and the library researches and the survey of the studies performed in this field, field visit and interview with the managers and the experts and modeling the main criteria were determined. The criteria were formulated into questionnaires and the importance degree of each of the criteria and their indices were determined by the experts and specialists and then the hierarchical tree which was obtained based on the criteria and indices resulted from the final questionnaire was drawn, then the FAHP tables were tabulated and these tables were completed by a number of the pipe manufacturing experts and specialists and the criteria and indices' weights were determined. All of the criteria and the indices were transferred to the Excel. In the next stage, the current status questionnaire was prepared to determine the status quo scores of the pipe manufacturing company's environmental management system and the criteria' and indices' scores were determined through the evaluation of all of the units, observations, interview and debate with managers and the experts and next the weighted scores of the criteria and indices for the organization's performance was determined.

Then, through the indices performance scores and the total score analyses of the organization the importance/performance analysis (IPA) model was used for the standardization and the determination of the current status in respect to the company's performance status. Finally, it was dealt with providing solutions and amendatory

measures and necessary controlling actions or the creation of changes in them in order to avoid the inconsistencies to excel the system.

#### 4. Research findings

##### 4.1 The identification of the criteria:

According to the studies performed for the performance evaluations resulting from the management systems establishments such as ISO 14001 in Ahwaz pipe manufacturing company the following criteria have been confirmed by the professors, experts and specialists:

**Table 1.**Final criteria and subcriteria

Criteria	ode	Subcriteria	ode
Policy	1	Senior management commitment	11
		Motivational mechanism	12
		Policy	13
		The budget allocated to the iso 14001 standard	14
Planning	2	Environmental aspects risk management	21
		Environmental standard and requirements	22
		Environmental objectives and programs	23
Implementation and operation	3	The existence of efficient structure and experienced executive group in ems	31
		Staff awareness of ems	32
		Ems communications	33
		The existence of the up-to-date and valid documents regarding ems	34
		Operation control in ems	35
		Contractors	36
		ISO 14001 visits	

			37
		Emergency situations management	38
Survey	4	The periodical survey of the key operational keys	41
		Accidents management	42
		Inconsistency evaluation and pursuance	43
		Document and history control	44
		Performing internal audit by the internal experienced and specialist auditors	45
		Management review group aware of the organization and the environmental management system	46

#### 4-2. Criteria weight determination

According to the identified criteria and subcriteria the weights for each of the criteria and subcriteria has been identified based on the verbal variables confirmed by the experts and by using fuzzy AHP model. To survey the model in the ambiguous and fuzzy state the verbal variables should be used and then the appropriate fuzzy number for each of the verbal variables can be identified based on the model used. In the present study Chen's comparative relationships (2004) have been used. The relationships are as tabulated in table 2:

**Table 2. Fuzzy numbers for each of the verbal variables**

Importance survey of the verbal criteria	The comparative fuzzy number	Low importance survey of the verbal criteria	The inverse comparative fuzzy numbers
Equal	(1, 1, 1)	Equal	(1, 1, 1)
Equally Important	(1.2, 1, 3.2)	Equally Unimportant	(2.3, 1, 2)
Weakly Important	(1, 3.2, 2)	Weakly Unimportant	(1.2, 2.3, 1)
Important	(3.2, 2, 5.2)	Unimportant	(2.5, 1.2, 2.3)
Very Important	(2, 5.2, 3)	Very Unimportant	(1.3, 2.5, 1.2)
Absolutely Important	(5.2, 3, 7.2)	Absolutely Unimportant	(2.7, 1.3, 2.5)

After the used verbal variables and the comparative fuzzy number were identified the fuzzy hierarchical analysis method was used, at first the  $S_k$  value should be calculated for each line of the pairwise comparison matrix the formulae for its calculation is as follows [10]:

$$S_k = \sum_{j=1}^n M_{kl} \times \left[ \sum_{j=1}^m \sum_{j=1}^n M_{ij} \right]^{-1}$$

Where K denotes the line number, I and j are options and indices, respectively.

In this method, after the calculation of  $S_k$  their orders should be calculated in relation to one another. Generally, if  $M_1$  and  $M_2$  are two triangular fuzzy numbers, the magnitude degree of  $M_1$  over  $M_2$  can be denoted by  $V(M_1 \geq M_2)$  and it is identified as follows [11]:

$$\begin{cases} V(M_1 \geq M_2) = 1 & \text{if } m_1 \geq m_2 \\ V(M_1 \geq M_2) = \text{hgt}(M_1 \cap M_2) & \end{cases}$$

Also we have:

$$\text{hgt}(M_1 \cap M_2) = \frac{u_1 - l_2}{(u_1 - l_2) + (m_2 - m_1)}$$

The order for a triangular fuzzy number from the k other triangular fuzzy number can be calculated from the following relation:

$$V(M_1 \geq M_2 \dots M_k) = \text{Min}[V(M_1 \geq M_2) \dots V(M_1 \geq M_k)]$$

In this method for the calculation of the indices weights, in the pairwise comparison matrix it can be done as follows [12]:

$$W'(x_i) = \text{Min}\{V(S_i \geq S_k)\}, k=1, 2, \dots, n \quad k \neq i$$

Therefore, the vector and the indices weights are formed as follows:

$$W' = [W'(c_1), W'(c_2), \dots, W'(c_n)]$$

According to the above explanations in the following section the criteria and subcriteria ranking results are offered.

At first, the sum and the inverse sum of the first and the second and the third entries of the triangular fuzzy numbers can be calculated in the entire matrix:

**Table 3.** Sum and the inverse sum of the matrix entries pairwise comparison for the main criteria

	low	medium	high
Elemental sum	8.112	8.092	0.871
The elemental sum inverse	.047	.055	.055

Next, the sum of the matrix line elements is calculated:

**Table 4.** Sum of the line elements of the main criteria matrix

	Low	Medium	High
Sum of the first line elements	.1	.7	.5
Sum of the second line elements		.7	.7
Sum of the third line elements	.812	.2	.268
Sum of the fourth line elements		.992	.038

Each line's average entries calculation in relation to the sum has been introduced in the below table:

**Table 5.** Each line's average entries calculation in respect to the sum of the main criteria matrix entries

	Low	Medium	High
1	.340	.315	.358
2	.287	.315	.425
3	.182	.453	.290
4	.143	.110	.167

In the next stage, the Ss comparisons for the identification of M order has been done:

**Table 6.** Comparison between the Ss in the main criteria matrix

	1	2	3	4
1	-----	.870	.077	.585
2	.1056	-----	.364	.484
3	.611	.945	-----	.718
4	.011	.276	.364	-----

After determining the comparison amount between each of the criteria, according to the introduced rule, the biggest value is calculated:

**Table 7.** Lowest calculated value

$v(s1 > s2,3,4)$	.612
$v(s2 > s1,3,4)$	.948
$v(s3 > s1,2,4)$	.365
$v(S4 > S1,2,3)$	.485

Identifying the lowest comparison value, averaging is performed and then the weight for each of the main criteria can be determined.

In the following table the weight and the rank for each of the criteria has been determined:

**Table 8.** Final weight and rank of each of the main criteria

riteria	Final Weights	ank
1	0.41 2	
2	0.94 8	
3	1.36 5	
4	0.68 5	

In this way based on the fuzzy AHP model it is determined that the third criterion which is related to the implementation and operation, is of the highest importance from the experts' point of view. In the following the final weights and ranks for each of the subcriteria can be determined:

**Table 9.** Subcriteria' weights and the ranks

Subcriteria	ode	Final Weights	ank
Senior management commitment	11	0.334	
Motivational mechanism	12	0.063	



Policy	13	0.447	
The budget allocated to the ISO 14001 standard	14	0.157	
Environmental aspects risk management	21	0.501	
Environmental standard and requirements	22	0.2	
Environmental objectives and programs	23	0.297	
The existence of efficient structure and experienced executive group in ems	31	0.215	
Staff awareness of ems	32	0.307	
Ems communications	33	0.049	
The existence of the up-to-date and valid documents regarding EMS	34	0.087	
Operation control in EMS	35	0.135	
Contractors	36	0.057	
ISO 14001 visits	37	0.127	
Emergency situations management	38	0.018	
The periodical survey of the key operational keys	41	0.04	
Accidents management	42	0.041	
Inconsistency evaluation and pursuance	43	0.216	
Document and history control	44	0.293	
Performing internal audit by the internal experienced and specialist auditors	45	0.27	
Management review group aware of the organization and the		0.138	

environmental management system	46		
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#### 4-3. Criteria performance determination

After the criteria weights were determined, the performance for each of the criteria was determined by taking advantage of the experts' notions and the calculated performance amount for each of the criteria has been given:

**Table 10. Criteria performance**

Criteria	ode	Per formance
Senior management commitment	1	5
Motivational mechanism	2	4
Policy	3	4
The budget allocated to the ISO 14001 standard	4	3
Environmental aspects risk management	5	3.7 8
Environmental standard and requirements	6	3.6 7
Environmental objectives and programs	7	3.2 5
The existence of efficient structure and experienced executive group in ems	8	4.6 7
Staff awareness of ems	9	2.8
Ems communications	10	3.3
The existence of the up-to-date and valid documents regarding EMS	11	4.1 7
ISO 14001 visits	12	5
Operation control in EMS	13	3.1 7
Emergency situations management	14	3.1 8
Accidents management		2

	15	
Contractors	16	3.4 4
The periodical survey of the key operational keys	17	3.8 6
Inconsistency evaluation and pursuance	18	3.2 8
Document and history control	19	5
Performing internal audit by the internal experienced and specialist auditors	20	5

#### 4.4. Importance-performance analysis (IPA):

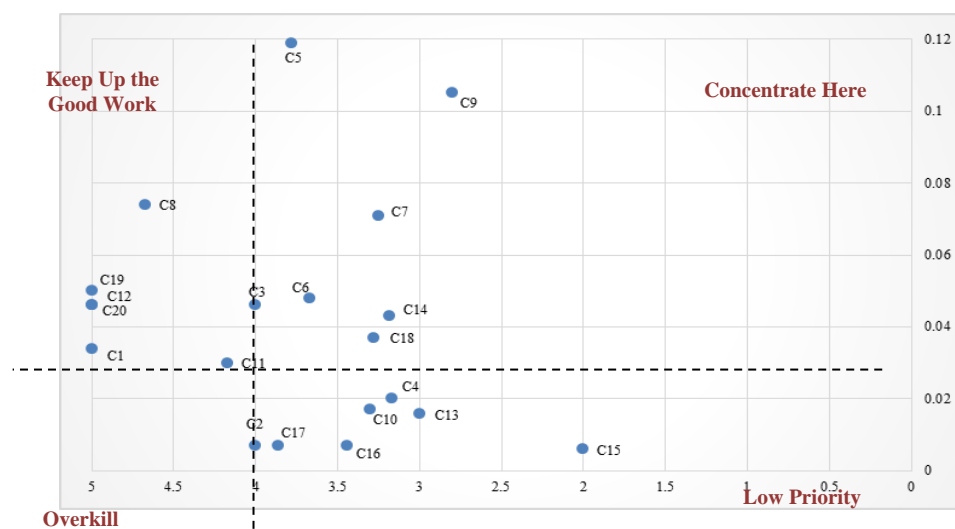
After determining the criteria importance and the company's performance in each of the criteria, it was dealt with the importance and performance analysis by making use of the IPA method:

**Table 11. Importance and the performance of each of the criteria and also the threshold value for each of them**

Criteria	ode	I mportance	Per formance
Senior management commitment	1	0. 034	5
Motivational mechanism	2	0. 007	4
Policy	3	0. 046	4
The budget allocated to the ISO 14001 standard	4	0. 016	3
Environmental aspects risk management	5	0. 119	3.7 8
Environmental standard and requirements	6	0. 048	3.6 7
Environmental objectives and programs	7	0. 071	3.2 5
The existence of efficient structure and experienced executive group in ems	8	0. 074	4.6 7
Staff awareness of ems	9	0. 105	2.8

Ems communications	10	0.017	3.3
The existence of the up-to-date and valid documents regarding EMS	11	0.030	4.1
ISO 14001 visits	12	0.046	5
Operation control in EMS	13	0.020	3.1
Emergency situations management	14	0.043	3.1
Accidents management	15	0.006	2
Contractors	16	0.007	3.4
The periodical survey of the key operational keys	17	0.007	3.8
Inconsistency evaluation and pursuance	18	0.037	3.2
Document and history control	19	0.050	5
Performing internal audit by the internal experienced and specialist auditors	20	0.046	5
Threshold Value		0.041	3.5

The importance-performance matrix can be plotted as follows:



**Figure 1.** Criteria' placements in the importance-performance analysis quarter model

1. First quarter (Concentrate here): this part of the model has the most important criteria for the company. Since the criteria with high importance in which the company performance is low are placed in this section. The company should concentrate more attention on this section. From among the studied criteria, three criteria are located in this section which include 7 criteria (the environmental programs and objectives), criterion 9 (staff members knowledge of EMS) and criterion 14 (the emergency situations management).

2. Second quarter (Keep up the Good Work): the criteria of this section are of a great importance and of course the company's performance in these criteria is good. Therefore, there is no need to worry about the company's performance in this section. The same trend should be pursued for the criteria. The criteria existing in this section are: criterion 3(policy), criterion 5 (environmental aspects risk management), criterion 6 (environmental legal requirements and standards), criterion 8 (the existence of efficient executive group and structure and specialized in EMS), criterion 12 (ISO 14001 reviews and visits), criterion 19 (documents and history check) and criterion 20 (performing internal audit by the experienced and specialized internal audits).

3. Third quarter (Low Priority): the comprehended indicators in this quarter are valued low from the importance and performance points of view. Even though the performance level is low in here, but the managers should not focus more attention on this section, since the comprehended indicators in this quarter are not of high value and importance. The criteria of this quarter include criterion 4 (the allocated budget to ISO 14001 standard), criterion 10 (EMS communication), criterion 13 (operation control in EMS), criterion 15 (incidents management), criterion 16 (contractors) and criterion 18 (the evaluation and pursuance of non-conformation).

4. The fourth quarter (Overkill): this quarter includes criteria which are of low importance, but the company's performance is relatively high in them. Spending endeavors in these criteria by the pipe manufacturing company is practically wasting the resources since the resources are allocated to the criteria which are not ranked high in value by the customers. The criteria of this section are criterion 1 (senior management commitment), criterion 2 (the motivational mechanisms). Criterion 11 (the existence of the up-to-date and valid documentation).

## 5. Discussions and Conclusions

After some years from the environmental standard system establishment in our country we are constantly witnessing the inefficiency of such systems, even though these systems establishment bring about many advantages for the organizations their maintenance is one of the fundamental bases upon which the organization's environmental performance is depended. Along this course, Ahwaz pipe manufacturing company which is active in the field of manufacturing and the supply of the pipes needed in the oil, gas, petro chemistry and water industries with the customer identified standards, supplying the financial resources and the implementation of the pipe line projects, the creation and the deployment of the oil, gas, petroleum products and water in Iran and the world implemented the ISO 14001 system for the environmental conservation. Since the appropriate environmental management of an organization pertains to the environmental performance evaluation in order for the elemental management results for the activities, products and organizational services which is interacting with the peripheral environment to be comprehended and improved the company is determined to evaluate its performance by making use of the various criteria. In the current study the evaluation criteria and the importance and the company's performance in each of the criteria have been investigated. Then, based on the IPA analysis it became clear that on which of the criteria the company should focus its attention. In the following section according to the obtained results there are suggestions made for the officials in Ahwaz pipe manufacturing company and we are hopeful that the company's problems will be resolved through the implementation of these suggestions.

### 5-1. Suggested solutions for the implementation and operation criteria

Because the most important subcriteria for the awareness and increase in the worker's knowledge is the ISO 1400, therefore the organization's managers can increase the their staff members' knowledge via holding in-service or outer organization educational courses and with the titles related to the environment and by hiring the experienced and skilful professors regarding the environmental problems. Also, the use of the journals, books, brochures and posters inside the factory, in resting suits, uniform changing suits, staff members dining rooms, company's corridors and so forth can continuously and gradually increase the organization's awareness. Moreover, the management

should invite the ISO system planning experts in definite time intervals to upgrade the workers' and the staff members' knowledge via reviewing the necessary cases. Besides, holding up maneuvers in relation to the environmental accidents and getting the staff members familiar with the importance of such subjects can be effective. On the other hand, performing the exact educational efficiency and encouraging the individuals who observe and practically use their learning from the instructional courses can increase their motivation for learning the instructional material. Also, programming a learning and knowledge evaluation system for the workers and rewarding the individuals who have learnt the material and put them into practical use can level up the workers' enthusiasms to learn and put the material into practical use. Also, the adoption of a reward system for those workers suggesting practical applications for the improvement of the environmental system can entangle the workers' minds in the constant system improvement. Getting the staff members familiar with the potential disobedience results and consequences and the operational procedures via showing films, visiting the polluted areas, introducing materials regarding the pollution symptoms and signs in the format of pictures and written material in the form of journals can be effective. Managers can elect individuals from among the groups as the heads of the groups and they can get the material related to ISO 14001 and the enacted organizational guidelines reminded and implemented via the groups' heads. Also, the tasks, responsibilities and options and the methods of counteracting the emergency situations regarding the environmental problems should be identified and the workers should be informed of them. Managers should not manifest the ISO implementation as unimportant and they themselves and the foremen should oblige themselves to the implementation of the enacted ISO paragraphs. Also, through giving value and importance to the environmental problems in the surveys and the reports during the happening of events and accidents and the preparation of a separate form and committing to completing the form in all of the accidents and the pursuance survey for the elimination of the environmental pollution they should show that the environmental problems are really organizational challenges. Managers can invite the environment practitioners and officials for exhibiting the system implementation during doing the job and by doing so they can increase the workers' motivation and challenge for completing the task. Also, the old and inappropriate instructions should be up-to-dated. The company should define guidelines and standards for its contractors and by doing so the company can require them to the implementation of and performing the ISO 14001 standards. Also, in the contractors evaluation process the contractor's qualification option should be considered from the environmental point of view. Contractors having the ISO 14001 standard or the contractors who use clean and green equipment and tools should be preferred and they should be given higher scores.

### **5-2. Planning criterion suggested solutions**

An ISO 14001 system and the environmental problems management can be successful when it is constantly improving the system design. Any system is not devoid of imperfection at the time of its implementation and these deficiencies usually happen because the official specialists in charge of the ISO system planning enter within a short time span. When the system is designed, the planning process should not be discarded. The programmed system may come up with problems or it may have low output due to its incongruence with the company. Also, the company's activities may increase, decrease or they may change and each of these cases may need changes in the system. Organization managers should assign the planning task to a specialist group in the organization in order to prevent the system from downturns or inconsistencies. The environmental objectives and plans should be continuously up-to-dated and they should be adjusted according to the organization's objectives. Also, the environmental standards and requirements should be constantly asked from the environment offices and in case there is a deficiency they should be embedded in the organization's system.

### **5-3. Evaluation criterion suggested solutions**

The survey and the evaluation of the ISO 14001 system can prevent it from drifting away and in case there is a need for adjustment the problems can be swiftly identified. Management should survey the organization's operational methods and the enacted methods by the continuous controlling of the historical data and the past documents and histories so that in case a deviation takes place it can be instantly adjusted. Also, performing the internal audit by the experienced and specialist internal auditors can improve the evaluation process. When the managers are really determined to implement the system the auditing task should be performed by the experienced auditors and the more strictly and meticulously this task is performed the better the system's problems can be illuminated. By doing so, the

organization management can easily identify and evaluate the extant issues and the inconsistencies. When the system survey is not performed by a special unit or department and all of the staff members are supposed to be responsible for the evaluations and recommendations a better performance can be expected. As an specimen, the respective manager can acquaint several members of the staff with the environment department tasks regarding the measurement and the survey of air and aerosols, water and the related pollutions, noise and so on and by making the needed equipment available for this survey this task is not limited to the sanitation and preparing separate reports with the environmental perspective.

#### 5-4. Policy criterion suggested solutions

The organization policy is the task identified for the higher levels of the organization. The compatibility of the activities with the organizational continuous policies and requiring the practicality of the guidelines and environmental standard paragraphs in the organization policy can pave the way for requiring the workmen to do so. As it was mentioned earlier, the best pattern for the workmen to be followed in the organization is the manager and when the manager is not committed to ISO 14001 considerable system improvements cannot be expected. The organization should consider maneuvers, creation of motivational programs, internal audits, books, journals, posters etc. and sufficient budget allocation for the implementation of the programs otherwise the operational strength of the ISO system can be extremely reduced.

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