Modeling for Environmental Impact Assessment of oil refineries in Iran

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Abstract: Environmental Impact Assessment (EIA) consist of large volume of quantitative and qualitative information that usual methods are not able to present them properly and because Environmental Impact Assessment (EIA) is one of the most appropriate criteria for sustainable development and environmental management are in the world, Therefore, appropriate methods must be used and to be carried out. In this paper the application of AHP (Analytical Hierarchy Process) in environmental impact assessment that can support full integration quantitative and qualitative information and the decision is to be introduced. In this project four oil refineries in Iran were selected as case studies. For construction and operation phases Tehran and Isfahan oil refineries. For construction and operation phases Expert Choice 11 was chosen as appropriate software for oil refineries environmental impact assessment and decision-making procedures. The results gives better decision-making ways, choose the correct solutions and provide a field for future recommendations for these three different phases. EIA in this method has good results based on the multidisciplinary in decision-making for environmental impacts. In conclusion with consideration of calculations, graphs, existing environment and oil refineries conditions new ways will find for Environmental Impact Assessment of oil refineries in Iran. In continue multi-criteria for EIA oil refineries have been considered.
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1. Introduction

In recent years the earth has witnessed a massive climate change that has caused many environmental events. This certify of environmental problems are clear. The problems at the local level or the result of human activities by organizations and governments are imposing on the environment. The countries that have adopted rules for its activities, the balance between environment and development occur when the activities take place in the environmental threshold (Blanco et al., 2009). Thus, binding environmental principles developed gradually led to the development of environmental law what are the dimensions of national and international levels and environmental rights and environmental laws and regulations, and today one of the most important tool environmental and management factors in solving problems of the environment. However, other factors such as notification and public enlightenment and institutionalizing the concept of culture and social behavior, but certainly very important and significant is the prevention and pollution prevention and environmental degradation and the relationship between humans and the environment without binding legal rules, and may not be possible. Human activity is larger than that of nature itself phytoremediation carry out a proper solution to minimize the effects Correction, the predicted environmental effects of implementing the activities (Duarte et al., 2007). The EIA method is very efficient in identifying environmental understand its importance, the different parts or activities of a project evaluation of the components of the environment and ultimately the results of the solution is expressed as to create more consistency (Canter., 1996). The EIA provide the conditions for identifying environmental problems and create solutions to prevent or reduce this problem to reach an acceptable level offers. EIA is environmental management will do plan that creates a monitoring program (Atiyat Mosa, 2004). One way to do the environmental assessment for projects acceptable for achieving sustainable development and can be as a planning tool for managers, planners and decision is Easy, so it could be based on potential impacts the environmental effects of construction and industrial projects appears with various options to detect and It can be solved, preparing for this reason that the evaluation report environmental effects of plans and projects should be considered as a necessity. The main problem of EIA is that there is the usual method is able to support a large volume of qualitative and quantitative environmental information is not, therefore, to solve this problem, qualitative information can be converted to a numerical scale. The important point here is that the data are expressed numerically, in principle, this represents a form of status and quality was stated. As a result,

cannot be for a set of values, which are only slightly in appearance, relationships and actions to apply the mathematical algebra. Therefore, a method is needed that can change this value without factoring in their nature. Decision-making is the best method for this purpose. Thus, this study has tried new ways to express qualitative and quantitative information in the form decision-making variables, and calculate this variable using fuzzy technique is presented for solving these problems.

The current status of methods used in EIA in the world and Iran

There are many different methods for environmental impact assessment methods and models developed and described, such as checklists, Matrix, on synthesis (McHarg, 1969), system analysis (Makhdoom, 2000), simulation models and diagrams, methods of cost analysis – benefit and so on. To select and provide the appropriate method for each project should set of conditions and characteristics of such as profile methods (Simplicity, ease of understanding and method capability and so on) and consider to environmental characteristics and the nature of the project. Choosing a method appropriate for impact assessment is considered most important step in the effects intended to reduce, correct and prevent environmental impact assessment (Durate et al., 2007). So far the most common method for environmental impact assessment projects in Iran has been used, Leopold matrix method (Leopold et al., 1971), the Iranian matrix (Makhdoom, 2009) and ICOLD matrix. Leopold matrix with the value 10 + to 10 – could not worthy of a place to earn impact assessment development in Iran. The Leopold matrix when its rated to 5 + 5 - was the most common methods to evaluate the development could take place. Rate of change in the 1990 decade by Makhdoum offered, hence the matrix modified Leopold matrix by changing the nature and value today with 5 + 5 - Iran is known as the Iranian made matrix (Makhdoom, 2007). Makhdoom expressed that if the value of 10 to 5 due to the fact that the first evaluation or assessment of quality of life to think and then think about and evaluate the quality of their number or investment value. Leopold in the initial matrix for the 10 traits can be good in English, 10 traits that bad row easily for English speakers or fluent in English is understandable, the rate of 10 to 10 -is considered (Makhdoom, 2007) that in the Persian language is very difficult or practically impossible. Matrix methods for evaluating environmental effects are used in Iran, advantages and disadvantages there are multiple benefits that can be easily, and need for mental Expert specializes not too pointed. Methods For reasons such as lack of comprehensive and systematic matrix, unreal Being, do not display the spatial and temporal effects of subjective and qualitative It, do not show interactions and cumulative effects and not properly applied mathematics and studies of unrealistic performance Evaluation does not lead to the logical and defensible (Phillis,., 2001 & Wood, C. 1995). Qualitative variables that are normally evaluated with quantitative values, neglecting the uncertainty of valuation for the variables are impossible or unknown and lack of quality parameters that are involved in the evaluation of these methods have other disadvantages. This method works in two dimensions (magnitude and importance) were evaluated in the analysis is given. There is a lack of "magnitude" only the strong modifier for decision making, lack of ability on display and summarize the results and the correct sum, neglecting the coefficient or the degree of importance for the factors, based on valuation and lack of general use as an indicator of their performance is immersed in an aura of ambiguity. We found shortcomings on the fuzzy method for solving the problems that human thought processes for compliance and data quality has a high potential for environmental impact assessment can offer.

2. Materials and Methods

1-Expert Choice (EC)

AHP approach is a multi-criteria decision making method that is suitable for dealing with complex systems to choose from among several alternatives which provides a comparison of the subdivision of the problem in the hierarchical form. This tool can be used for analyzing different kinds of economic, social and technological problems. AHP (Analytical Hierarchy Process) can be applied on the choice of the best policy, the creation of a list of priorities, the prevision of results and temporal dependencies, the optimal allocation of resources, the assessment of risks and planning (Adamovic et al. 2010). Several papers have compiled the AHP success stories in very different fields and areas (Ishizaka & Labib 2009). The vast majority of the applications still uses AHP and is unaware of successive developments. This fact is probably due to the leading software supporting AHP, Expert Choice (EC), which still incorporates AHP (Ishizaka & Labib 2009). This software is a multi-criteria decision support tool based on the AHP (Adamovic et al. 2010). Expert systems have been used in areas related to the environment such as environment planning, Environmental Impact Assessment (EIA) and environmental monitoring (Say et al, 2007;

Bachiler & Glasson 2004) since the 1980s. These systems perform problem-solving based on a database of expert knowledge; they draw on heuristic reasoning and act as adviser or provide decision support. ES are promising technologies that manage data and information, diagnose the problem, and provide the required advice and expertise to solve the problem. They thus seem well suited to many of the tasks associated with environmental management plan. They provide a structured approach to environmental management and help users cope with large volumes of environmental management study (Say et al. 2007). Expert system in environmental engineering first appeared in mid-eighties, some 15 years after the emergence of expert systems technology. Many expert systems have been developed for environmental engineering application areas including water quality management, solid waste management, air pollution diagnostic, water pollution diagnostic, soil pollution diagnostic, and Environmental Impact Assessment for projects.

2-Reason for Selecting Expert System

Environmental engineering is multidisciplinary in nature and requires specialized expertise in diverse fields such as water quality management, waste management, air control, noise control, soil erosion and sediment control, chemistry, biology, fluid mechanics, mathematics, statistics, economics and law. Individual engineers cannot always be well versed in all of these areas. An efficient environmental management system has to include software tools for water, soil, and air pollution diagnosis (Oprea & Dunea 2009). Expert system (ES) can serve as an important support tool to supply solution, directed knowledge in unfamiliar subjects. The environmental systems are often too complex to be modeled traditionally thus engineers forcing to rely more on expertise. ES is useful in gathering expertise from multidisciplinary sources, which is logistically difficult to manage in conventional practice. Environmental engineering is also more depends on empiricism, and environmental systems are not readily described through formal mechanistic models. ES can be used in dealing with problems where uncertain and incomplete data exist or where quantitative data can be as important as qualitative data. Traditional algorithm does not have much success with these types of problems. Expert systems can help transfer these techniques into less experienced hands. Expert systems have been used in areas related to the environment such as environment planning, Environmental Impact Assessment (EIA) and environmental monitoring (Say et al, 2007; Bachiler & Glasson 2004) since the 1980s. These systems perform problem-solving based on a database of expert knowledge; they draw on heuristic reasoning and act as adviser or provide decision support. ES are promising technologies that manage data and information, diagnose the problem, and provide the required advice and expertise to solve the problem. They thus seem well suited to many of the tasks associated with environmental management plan. They provide a structured approach to environmental management and help users cope with large volumes of environmental management study (Say et al. 2007). Expert system in environmental engineering first appeared in mid-eighties, some 15 years after the emergence of expert systems technology. Many expert systems have been developed for environmental engineering application areas including water quality management, solid waste management, air pollution diagnostic, water pollution diagnostic, soil pollution diagnostic, and Environmental Impact Assessment for projects. All parts were conducted according to these steps;

Step one: Preparing the data

First choice of high-performance functions for linguistic variables defined above, and input and output data sets in each stage, the preparation is a process that input and output functions related to participation. I therefore prepared a set of diagrams that show different levels in the decision. Each value in the decision making level in a series of 100 percent 1 to 0% for 0 to join the membership will change. This means that only one of the absolute value Is true is false and all other values, a set Decision making that values it at all values of It is true that from 100% to 0% change. The logic toolbox decision-making software, input and input variable is always on the enamel a numeric value.

Step two: Applying the logical operator

After preparation of the variable input and output functions using decision rules, which can output to a number is obtained higher or lower than the input number.

Step three: Inference rules for decision-making

Control systems are inference rules of decision and rule base, which is a set of rules and decisions are relating to the collection, input and output values. Before applying the inference method, the weights for the (grade 0 to 1) are defined by any law. According to the rules of weight is specified at a minimum level. For

example, weight one, to maximum has no effect on output, to exert influence in the relationship between the rules should give the number except one.

Step Four: Merge all outputs and results summarized

Since the decision is with regard to all laws, rules must be in total output are merged, at this stage, the results were not applied for any law to be performed in parallel.

Step Five: TOPSIS (Technique for Order Preference by Similarity to the Ideal Solution)

- In this method two artificial alternatives are hypothesized.
- Ideal alternative: the one which has the best level for all attributes considered.
- Negative ideal alternative: the one which has the worst attribute values.
- TOPSIS selects the alternative that is the closest to the ideal solution and farthest from negative ideal alternative.

Input to TOPSIS

- TOPSIS assumes that we have m alternatives (option) and n attributes / criteria and we have the score of each option with respect to each criterion.
- Let x_{ij} score of option I with respect to criterion j we have a matrix $X=(x_{ij})$ m*n matrix.
- Let J be the set of benefit attributes or criteria (more is better)
- Let J' be the set of negative attributes or criteria (less is better)

Steps of TOPSIS

- **Step 1:** Construct normalized decision matrix.
- This step transforms various attribute dimension into non-dimensional attributes, which allows comparisons across criteria.
- Normalize scores or data as follows:

$$r_{ij} = x_{ij} / \sqrt{(\sum x^2_{ij})} \text{for} i = 1,...,m; j = 1,...n$$

Other steps of TOPSIS were out of the studies so they did not use.

3-Case studies

In this part Tehran and Isfahan oil refineries were selected. The decisions data due to quantitative were normalized in the part of environmental studies with TOPSIS; step-1. Other data form economical, social and land use studies due to qualitative were put in the software. All Studies were carried out with consideration of cities and villages near by these oil refineries, their environmental characteristics, environmental, economical, social and land use effects of oil refineries on the cities and villages near by them.

3. Result and discussion

The studies consists of two stages results.

-Stage one: in model view; economical, environmental, land use and social parameters have been weighted that available in Figure 1.

-Stage two: for construction and operation priorities with respect to: Economical parameters (Per percent) in case of Tehran oil refinery the results are in Figure No-2.

-Stage three: For construction and operation priorities with respect to: Economical Parameters (Per percent) in case of Isfahan oil refinery the results are in Figure No-3.

-Stage four: For compare of EIA in construction and operation priorities with respect to: Economical Parameters (Per percent) in case of Tehran and Isfahan oil refinery the results are in Figure No-4.

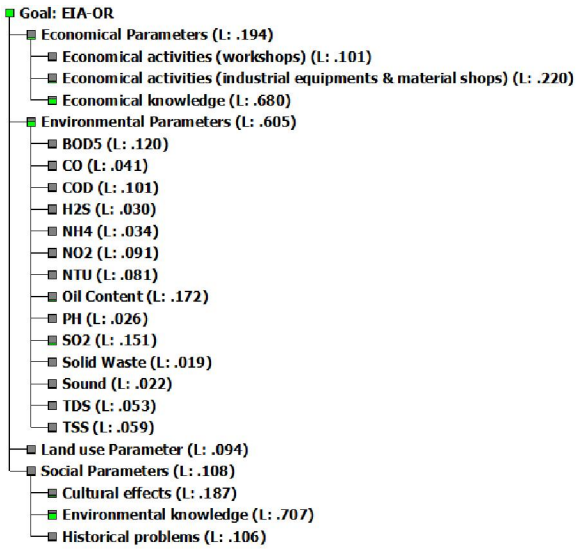

Figure 1: Model view for EIA of oil refineries

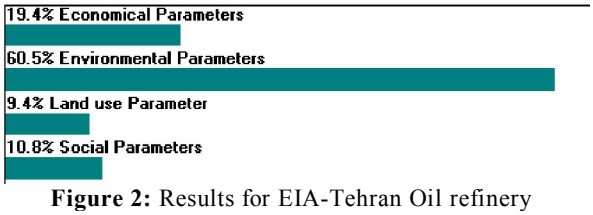

Figure 2: Results for EIA-Tehran Oil refinery

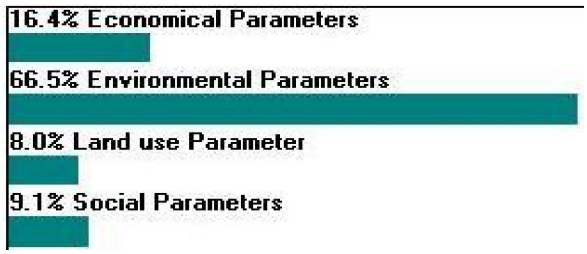

Figure 3: Results for EIA-Isfahan Oil refinery

Figure 4: Compare of EIA of Tehran and Isfahan oil refineries

The results of these four stages give the view of EIA of two oil refineries in Iran. As in the figures 2, 3 shows in the part of environmental parameters the effects Isfahan oil refinery is more than Tehran oil refinery. It means the effects on environmental indexes such as biological ambiance (fauna, flora), physical ambiance (water and air quality, solid waste, sound) are more than Tehran oil refinery. In the part of economical parameters the effects of Isfahan oil refinery is more than Teheran oil refinery. In the parts of economical, land use and social parameters the effects of Tehran oil refinery is more than Isfahan oil refinery. It means effects on these parameters either positive or negative totally considered in this study. So the effects of oil refineries on studied parameters and EIA studies of oil refineries can measure by this method.

4. Conclusion

With consideration of these results for two oil refineries the EIA study provide special information.

Base on the table no 1 and results from the EIA of oil refineries in conclusion these analysis will obtain for final data of EIA refineries in Iran.

Table no 1: Compare the relative importance with respect to: Goal: EIA-OR

Parameters	Economical Parameters	Environmental Parameters	Land use Parameter	Social Parameters
Economical Parameters		0.214	1.9	2.8
Environmental Parameters			4.7	5.2
Land use Parameter				0.610
Social Parameters	Incon: 0.06			

Pair wise comparison main criteria of these numbers shows 1.9 means the preferred priority. These numbers have special meaning base on decision-makers preferred for these parameters to each other. The number 0.214 means environmental parameters are strongly preferred to economical parameters. The number 1.9 means economical parameters moderately preferred to land use parameter. For 2.8 means economical parameters moderately preferred to social parameters. For number 4.7 means environmental parameters preferred to land use parameter. For number 5.2 means environmental parameters strongly preferred to social parameters. For number 0.610 means social parameters moderately preferred to land use parameter. Inconsistency is 0.06 and it means the concentration of this study is extremely high. Compare of these EIA studies give new information about two these refineries. For Tehran oil refinery these results consist of some items. Tehran oil refinery, in effects on environmental parameters has better conditions compare to Isfahan oil refinery. But for other parameters such as economical, land use and social parameters Isfahan oil refinery has better conditions compare to Tehran oil refinery.

5. Acknowledgment

All these studies were done with cooperating of specialists and direct managers of National Iranian Oil Company. So base on this research and obtained data, these results are using in the National Iranian oil Company. These results were useful for the Integrated Management System (IMS) for oil refineries and they will capable to use in other oil

refineries in Iran. In this research considered too many parameters such as showed in Figure No.1 that gives the list of sub-items of each parameter. With this method the Iranian oil refineries have a special model for EIA. The EIA of oil refineries also can develop to other parts of oil industry such as gas refineries and petrochemical industry in Iran in future researches.

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References

1. Adamovic, P., Caslav Dunovic, C. & Nahod, M.M.2010. Expert choice model for choosing appropriate trenchless method for pipe laying. http://www.crosbi.znanstvenici.hr/…/348146.Adamovic_Dunovic_Nahod_Prag_09_2007.pdf [20 jun 2010].
2. Atiyat, N. M. Mosa. 2004. Environmental Impact Assessment fir Domestic Solid waste Landfill Project. Environmental Research center. Royal Science Society. Amman- Jordan (website: http://www.EPA.gov).
3. Bachiler, A. & Glasson, J.2004.Expert systems and geographic information systems for impact assessment.London.Taylor & Fransic.
4. Blanco, A.; Fajardo, W.; Martin, J. M. and Requena, I. 2003. Costructing Linguistic Versions for the Multicriteria Decision Support systems promethee I and II. Inter. J. Int. Syst., 18, 711- 731.
5. Canter, L. W. 1996. Environmental Impact Assessment. McGraw Hill Book Co.Baltimore.
6. Duarte, O. G.; I. and Requena; Y. Rosario. 2007. Fuzzy Techniques for Environmental-Impact Assessment in the Mineral Deposit of Punta Gorda (Moa, Cuba). Environmental Technology, Vol. 28. pp 659-669.
7. Ghodsipoor H.2000. Analytical Hierarchy Process-AHP science, Tehran polytechnic university, Iran.
8. Ishizaka,A. & Labib,A.2009.Analytic Hierarchy Process and expert: benefit and limitations. Journal of ORInsight 22 (4):201-220.
9. Leopold, L. B.; Clarke, F. E.; Hanshaw, B. B. and Bashley, J. R. 1971. A procedure for evaluating environmental impacts. US Geological Survey Circular 645/1971. Washington, D. C.
10. Makhdoom, M. 2000. Environmental Impact Assessment for industries in Iran, university of Tehran, Iran.
11. Makhdoom, M. 2007. Environmental Impact Assessment science for heavy industries in Iran, university of Tehran, Iran.
12. Makhdoom, M. 2009. Environmental Impact Assessment science, university of Tehran, Iran.
13. Mc Harg Ian, L. 1969. Design with Nature, American Museum of Natural History.
14. Oprea,M. & Dunea,D.2009. An environmental diagnosis expert system. Proceedings of the workshops of the 5th IFIP conference on artificial intelligence applications innovations (AIAI-2009):April 23-25,Thessaloniki,Greece.
15. Phillis, Y. A. and Andriantiatsaholiniaina, L. A. 2001. Sustainability: an ill-defined concept and its assessment using fuzzy logic, Ecological Economics, 37(3): 435- 456.
16. Say,N.P.,Yucela, M. &Yilmazerb, M. 2007. A computer-based system for Environmental Impact Assessment (EIA) applications to energy power stationsin Turkey:C-EDIFO. Journal of Energy Policy 35:6395-6401.
17. Wood, C. 1995. Environmental impact assessment-a comparative review. Harlow, Essex: Longman Scientific and Technical.

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