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ANALYZING THE INFLUENCE OF INTERNAL AND EXTERNAL RISK FACTORS ON PORTFOLIO RATE OF RETURNS IN CASE OF INVESTMENT PROJECTS IN THE IRANIAN PETROCHEMICAL INDUSTRY

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Abstract

Objective: *Due to the importance of risk and its impact on the return on investment projects in the petrochemical industry, in this study, in order to select the best investment portfolio, after identification, risk factors affecting project returns are divided into two internal and external parts, And the weight of each risk was determined based on the technique of group fuzzy failure analysis by a 10-member team of 5 prominent Iranian petrochemical companies in the first half of 2021 has been done.*
Method: *The relative effect of each risk on the return of 3 selected projects based on the rate of return and the amount of economic added value of one of Iran's petrochemicals calculated by COMFARIII software and through ANP for both internal and external sectors has been achieved.*
Results: *According to the weight of each project, the weight of each risk and the relative impact of each risk on return and using the proposed method, the overall impact of risks on the return on investment portfolio in three completely positive correlation states between project returns Negative and non-correlation was calculated in cases where the weight of internal factors is considered to be at least 20% and maximum 40%.*
Conclusion: *The results obtained in three cases show that the identified risks, will reduce the*

rate of return on investment portfolio capital in the worst case by 5.1139%. Therefore, according to the expected return rate of the company (22.5%), the reviewed portfolio is evaluated as appropriate, if the rate of return on capital is less than the expected return rate and also the existing risks, especially external risks, cannot be controlled, They will not have cost-effective investments and the project that has the highest rate of return on investment and these steps will continue until you choose the most optimal portfolio.
Keywords: Risk; Rate of Return; Group Fuzzy Failure Analysis; ANP; Investment Projects; Petrochemical Industry.

I. INTRODUCTION

Risk or danger is any factor that could cause damage. Before an accident occurs, many issues and problems are hidden in the day-to-day operations of the plant, organization, or company. In other words, risk is hidden. In a situation where we are facing a series of new and complex pressures that are constantly changing, being adapting to strategic thinking is not only necessary but also an opportunity. Managers will be able to produce better designs when they can save time and design costs by optimizing methods, and have the best energy efficiency that is less than using energy to produce a certain amount of goods or services than before [1]. Oil and gas are the world's main sources of fuel consumption, providing more than 33% and 24% of the world's energy, respectively [2]. In recent years, there have been fundamental changes in the production capacity of the Middle East, indicating the rapid growth of the petrochemical industry in the region. In the last few decades, risk assessment in the industry has become particularly important due to the great damage done to the world's petrochemical industry, including the destruction of facilities and machinery. Strategic planning in oil projects and with systematic thinking and dynamic perception of external and internal driving forces and the implementation of relevant programs will be able to manage risks. The task of risk managers is to find solutions to the harmful effects of risk, which we call decision-making in risk management.

The choice of petrochemicals is due to the fact that this industry is currently the third largest industry in the world after the food and automotive industries, and also Iran, as the world's fourth largest oil producer and the world's second largest gas reserves, has 80% of its export earnings. On the other hand, given that the selection and implementation of oil projects is one of the main nuclei of the country's energy supply sector, the importance of risk management in the energy sector and oil projects will be doubled.

Identifying risk factors is one of the steps that can be taken in the implementation of oil projects, showing the dangers of doing so and offering several solutions to solve it. By identifying these factors, the risk of each factor can be assessed using different models and the necessary reactions to these factors can be performed during implementation, which can be referred to the table research (1):

Table 1. Researches on the subject of this research

Row	Research title	Researcher	Year of publication	Source of publication	Summary of research
1	Determining risk response strategy in risk management by ANP technique	Dori and Hamzaei [3]	2010	Journal of Industrial Management	Determining the main project risk and choosing the best strategy through nominal group technique and paired comparisons.
2	Covering the risk of oil revenue fluctuations using futures contracts in Iran	Ebrahimi and Ghanbari [4]	2009	Economic Research Journal	Acquire different situations for risk coverage strategy using different econometric methods.
3	Project Evaluation of Six Sigma Project	Tka, c. M., & Lyocsa, S [5]	2009	Qualification Reliability Engineering International	Investing in optimistic and pessimistic conditions is risky for the investor, and risk-averse.
4	Risk assessment in case of failure and analysis of effects using fuzzy weighted average fuzzy geometry	Wanga [6]	2009	Symmetry-Open Access Journal	Provide a combined approach to identifying the most important failure cases and the most effective alternative strategy for dealing with potential accidents.
5	Integrated approach to risk analysis using failure analysis methods and its effects (FMEA) and network analysis process (ANP).	Dori, and Moezz, and Salami [7]	2008	Journal of Management Research in Iran	Provide a structured, systematic, and flexible structure by ANP in the realm of risk management.
6	Systematic methodology for creating a six Sigma project	Su, C. T., & Chou, C. J [8]	2008	Expert Systems with Applications	Use (AHP) to assess the benefits of each project and prioritize six Sigma projects, use (FMEA) to assess the risk of each project.
7	An MCDM approach to choosing a six Sigma project	Ching Chow [9]	2003	The Conference of Knowledge and Value Management	Use DIMATEL to determine the relationship structure between criteria and use ANP to identify the weight of each criterion according to dependency and feedback.

The results of the present study and other researches mentioned have several stakeholders, including: government, National Iranian Oil Company, oil industry contractors, oil consulting engineers, educational institutions holding oil industry courses, etc. In order to determine some of the literature used in the research, a brief description of these terms is provided below.

Risk

The risk is the same as the uncertainty (probability) and the loss (consequence) in different ways. One of the most common of these combinations is the product of the probability of the consequence that has been confirmed in many sources [10].

Risk identification and qualitative risk analysis along with risk elimination, correction, control and monitoring section is one of the most important, necessary and technical needs of consulting engineers, safety engineers and process engineers of all industries [10].

The risks of oil and gas projects can be categorized into external and internal. Internal risks are

the risks that occur within the project itself and its operations. Such as exploration risk, risks related to drilling and development of oil and gas fields.
External risks refer to risks that exist outside the project and its operations. Such as political, economic, and commercial risks.
The origins of some of these unexpected fluctuations in environmental factors (external factors influencing the economic activity of the firm) may not be well known. Of course, this ignorance is not fundamentally important, because it is not up to the investor to fix or control them, but in order to avoid the adverse effects of these unexpected environmental fluctuations, these risks can be covered.
Important reasons for the need for strategic thinking in the application of risk management, the emergence of new technologies, the existence of differences in performance and complexity, and the relationships of environmental variables can be mentioned [11].
Rate of Return
One of the indicators of economic evaluation of investment projects that potential and actual investors always observe it, but in practice and in reality, Rate of Return is always related to risk, and empirical evidence has confirmed this theory to some extent [12].

Group fuzzy failure analysis
Failure can be defined as the organization's deviation from the required behavior. An approach to analyzing failure factors and its effects is a systematic way to identify and prevent product problems and the process that focuses on preventing defects, increasing safety, and increasing customer satisfaction.
The main purpose of analyzing failure states and its effects is to discover and prioritize potential failure states by calculating the risk priority index, which is the product of three concepts: the probability of failure, the severity of failure and the ability to detect failure [13].

ANP
Both quantitative and qualitative variables should be considered in the evaluation process. In addition, there is a relationship between different system variables. ANP technique meets these requirements by converting qualitative judgments into quantitative values and observing the relationships between factors for decision analysis. It is a matter of complex decision making. Since human judgments about preferences are often vague and cannot be presented in exact numbers, the application of fuzzy logic is essential in solving such problems. With these capabilities, the Fuzzy ANP technique is used as the best technique to create the decision tools of this study. In recent years, this technique has been used in many studies such as: Mohanty et al [14], Tuzkaya and Onut [15], Liu and Lai [16], Lee, Wang [17], Dağdeviren, Yuksel [18], Luo et al [19], and Vinodh, Ramiya & Gautham [20] have been used.
One of the most widely used methods in the FANP method to obtain the weight of each factor in the pairwise comparison matrix is the 'Buckley method'. In this method, the triangular fuzzy number is used as D = (a, b, c), which is as follows:
(a, b, c in Equation (1), fuzzy numbers are triangles that are represented by 3 real numbers as F = (a, b, c); The upper bound with c, the lower bound with a, and b is the most probable value of a fuzzy number {mean or optimal}).

$$\tilde{A} = \begin{bmatrix} (1,1,1) & (a_{12}^1, a_{12}^m, a_{12}^n) \dots & (a_{1n}^1, a_{1n}^m, a_{1n}^n) \\ \left(\frac{1}{a_{12}^1}, \frac{1}{a_{12}^m}, \frac{1}{a_{12}^n}\right) & (1,1,1) \quad \dots & (a_{2n}^1, a_{2n}^m, a_{2n}^n) \\ \left(\frac{1}{a_{1n}^1}, \frac{1}{a_{1n}^m}, \frac{1}{a_{1n}^n}\right) & \left(\frac{1}{a_{2n}^1}, \frac{1}{a_{2n}^m}, \frac{1}{a_{2n}^n}\right) \dots & (1,1,1) \end{bmatrix} \quad (1)$$

Equation (2) is used to obtain the geometric mean of row I of the matrix A.

$$Z_i = \left\{ \prod_{j=1}^{n} a_{ij} \right\}^{\frac{1}{n}} \quad (2)$$

In relation (2), $\pi_{a_{ij}}$is the algebraic sum of the values of a_{ij}in the matrix $\tilde{A}$.

(3)

$$a_i = \left\{ \prod_{j=1}^{n} a_{ij}^{\frac{1}{n}} \right\}, b_i = \left\{ \prod_{j=1}^{n} b_{ij}^{\frac{1}{n}} \right\}, c_i = \left\{ \prod_{j=1}^{n} c_{ij}^{\frac{1}{n}} \right\}$$

Using Equation (3), we obtain the final values (a, b, c). Next, using Equation (4), we calculate the algebraic sum of each column.

$$a = \sum_{i=1}^{m} a_i, b = \sum_{i=1}^{m} b_i, c = \sum_{i=1}^{m} c_i$$

(4)

To obtain the fuzzy normal, we use equations (4) and (5).

$$CW_i = \left(\frac{a_i}{c}, \frac{b_i}{b}, \frac{c_i}{a}\right) \quad (5)$$

We normalize the normalized numbers based on Equation (5) using the center of gravity method. For this purpose, we use Equation (6).

$$W_i = \frac{\frac{a_i}{c} + \frac{b_i}{b} + \frac{c_i}{a}}{3} \quad (6)$$

Finally, using Equation (7), we calculate the normal biphasic weight.

$$GW_i = \frac{W_i}{\sum_{i=1}^{n} W_i} \quad (7)$$

The set of weights obtained, based on Equation (7), will be equal to 1.

Investment projects

Investment projects are selected based on options that address the organization's goals and do not exceed the available resources [21]. The formulation of project selection was first formulated by Lorie & Savage [22].

Petrochemical industry

In 1964, in order to focus and develop this industry, the National Petrochemical Industries Company was established and started its work. This industry has a potential impact on the environment, health, security, as well as society and the economy. This industry can produce human waste, sewage and gas effluents that contain sulfur oxide, nitrogen oxide, dust, gasoline and carbon monoxide, as well as greenhouse gases and noise pollution, which can affect human health, groundwater, soil, diversity. Biology and buildings have irreparable effects [23,24,25,26,27]. In the research background section, a review of the research conducted in relation to risk management and how to measure it will be presented, and then based on the questions raised in the research in the research methodology section, the proposed model for investment projects of Iran Petrochemical Industry will be presented. Finally, research findings, conclusions and suggestions will be provided.

II. RESEARCH BACKGROUND

Markowitz [28] was the one who introduced and developed the concept of diversification in the stock portfolio. In general, he showed how diversification in the capital basket reduces its risk for the investor. Investors can earn efficient stock portfolios for a given return by minimizing the risk of the stock portfolio.

The first study of economic issues and the risk of oil exploration projects by Alice, winner of the 1988 Nobel Prize in Economics in 1956, made it possible to measure the exploration of the Algerian desert by using a model of sequence of exploration steps, which can be the first. He called the classic example of risk analysis in the oil and gas industry.

After this study, in the 1980s and 1990s, US and French state-owned companies began to conduct risk analysis in the form of periodic assessments of oil and gas resources with new methods such as normal log distribution, Pareto distribution, and normal fractal percentage. Today, risk management and analysis is used in oil exploration activities around the world and in most projects using the principles of risk analysis in combination with new technology.

Amiri and Mahboub Ghodsi [29] developed the issue of portfolio selection with the least undesirable risk and using a linear planning model in a fuzzy environment.

Pakdin Amiri [30] In his research, proposed a new method for evaluating and helping to decide on the best projects in the National Iranian Oil Company using AHP and fuzzy method of preference Technique(TOPSIS) based on similarity to the ideal solution. The AHP used to analysis the project selection structure and determine the weight of the selection criteria and the TOPSIS fuzzy method has helped to obtain the final ranking as well as to solve the project selection problems. Finally the decision maker can implement his decision according to the combination of different weights in the process.

A review of studies shows that different strategies have been adopted for risk management that none of which have comprehensively addressed the internal and external risk factors and the relationship between these factors as well as their effect on investment portfolio returns. In most studies only some risk factors have been considered. Overall risk factors are considered in projects and focus less on specific industries. Fewer group decisions have been made in this study. Therefore, in this article, an attempt has been made to answer the following questions in the Iranian petrochemical industry based on a group agreement and the formation of an expert team.

1. What are the risks that may affect the return on investment projects in the industry?
2. What is the weight of each risk (internal and external)?
3. What is the impact of the identified risks on the portfolio rate of return on investment projects?

III. RESEARCH METHOD

Organizations and companies have a set of investment projects on their agenda. In order to implement these projects, each organization and company prioritizes these projects based on its priorities and criteria. So he chooses a portfolio of these projects as his investment portfolio.

On the other hand, one of the most important and basic criteria in selecting projects is the rate of return on investment compared to the rate of return expected by investors. The rate of return on investment is higher than the rate of return expected in a period of return on investment for investors, companies and organizations. The purpose of examining internal and external risk factors on the return on investors' portfolio is to determine whether the return on the portfolio is still higher than the expected rate of return?

The objectives of the research will be determined by creating an expert team to identify potential risk factors and the relative weight of each factor using failure analysis. Due to the fact that the values are verbal and uncertain, fuzzy numbers will be used to weigh the risk factors. Then, due to the fact that some of these factors affect the internal processes of the organization and others outside the organization affect the projects, the identified factors are divided into two parts, internal and external. After separating the internal and external risk factors, the decision tree is examined to determine the relative impact of each risk on the return on investment portfolio and also the relationship between risk factors based on the group agreement of the expert team. Due to the fact that the considered criteria are uncertain and based on group agreement, at this stage of the group fuzzy network analysis method (ANP), the impact of each factor on the return on investment portfolio is calculated and calculated according to the weight of each project. The proposed model portfolio is offered for Iranian petrochemical companies. Figure (1) shows the steps of conducting research.

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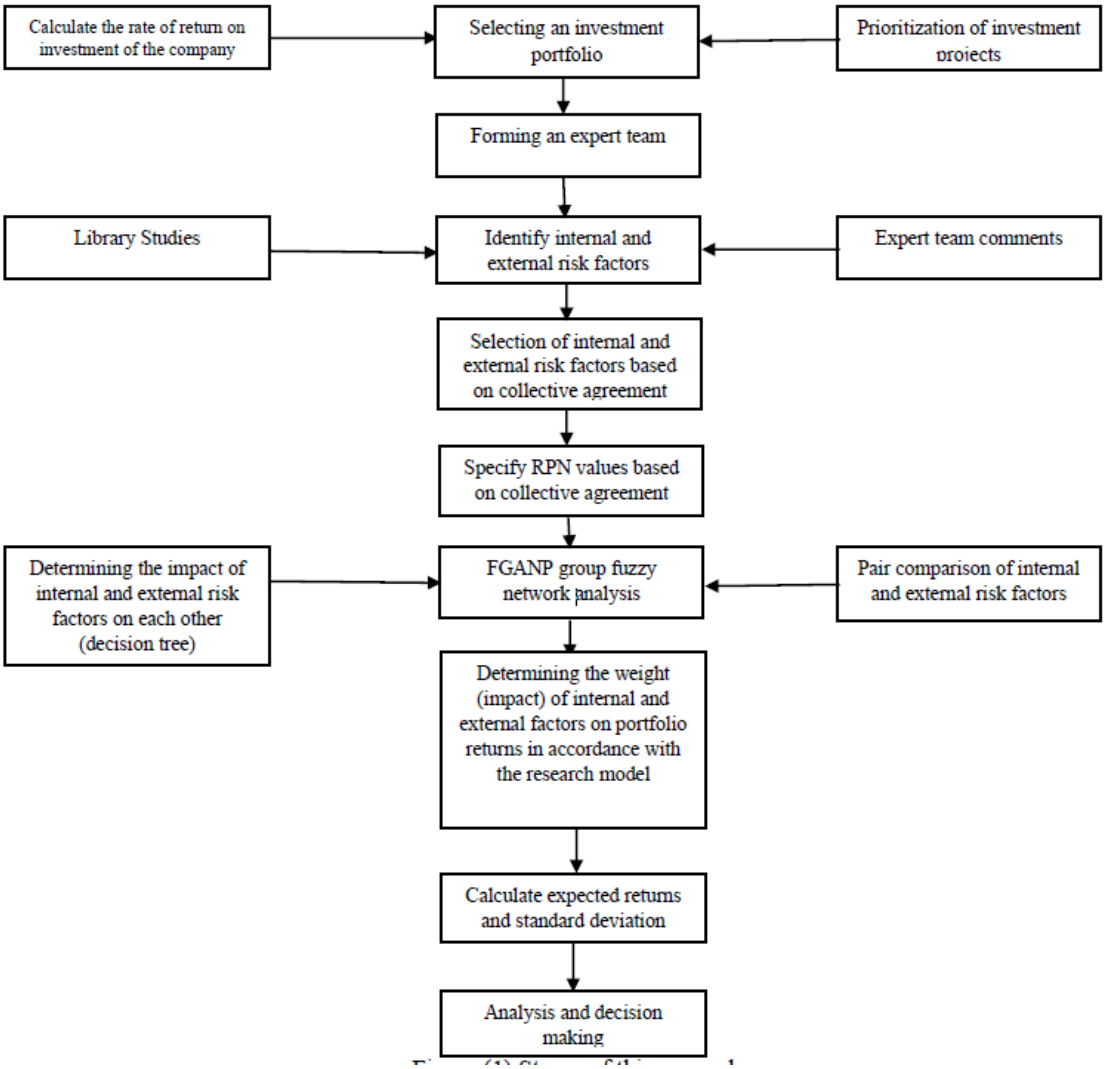

Figure (1) Stages of this research

The proposed model is defined based on the Markowitz model [28, 31] and according to Equation (8). In this regard, the return on investment portfolio is obtained from the total weight of return on each project minus the risk of factors affecting it.

$$X_p^{\sim} = \sum_{i=1}^{n} W_i X_i - f(R^{\sim}) \quad (8)$$

In relation (8), $X_p^{\sim}$ Investment portfolio return, W_i project i weight, X_i project return i and $f(R^{\sim})$ the total weight of the impact of all potentially identified risk factors on project portfolio return is as follows Relationship (9) is defined.

$$f(R^{\sim}) = \sum_{i=1}^{n} \sum_{j=1}^{m} W_i W_{R_{ij}} R_{ij}^{\sim} X_i \quad (9)$$

In relation (9), $W_{R_{ij}}$ is the relative effect of risk j on the efficiency of i project, which is obtained

through the pair wise comparison of group fuzzy network analysis. Risk is calculated based on the FMEA failure analysis method in accordance with Equation (10). Due to the fact that these values are fuzzy, they are first normalized and then de-fuzzy for other calculations. (The total weight of all factors is equal to one).

$$R_{ij}^{\sim} = D_{ij}^{\sim} P_{ij}^{\sim} S_{ij}^{\sim} \quad (10)$$

By placing relation (9) and (10) in relation (8), relation (11) is defined as follows.

$$X_{p}^{\sim} = \sum_{i=1}^{n} W_i X_i - \sum_{i=1}^{n} \sum_{j=1}^{m} W_i W_{R_{ij}} D_{ij}^{\sim} P_{ij}^{\sim} S_{ij}^{\sim} X_i \quad (11)$$

According to the approach of this research, the identified potential risk factors are divided into two parts: internal and external. According to the weight of each section, the above model is developed in accordance with Equation (12). They are more in control of the organization, so they have a different weight effect than more influential external factors, which are determined by the group agreement of the team of experts.

$$X_{p}^{\sim} = \sum_{i=1}^{n} W_i X_i - \left(\sum_{i=1}^{n} \sum_{j=1}^{m} W_{INF} W_i W_{R_{ij}} D_{ij}^{\sim} P_{ij}^{\sim} S_{ij}^{\sim} X_i + \sum_{i=1}^{n} \sum_{j=1}^{m} W_{EXF} W_i W_{R_{ij}} D_{ij}^{\sim} P_{ij}^{\sim} S_{ij}^{\sim} X_i\right) \quad (12)$$

In relation (12), W_{INF} is the weight of potential internal risk factors and W_{EXF} is the weight of external factors that is obtained by the team of experts and based on group agreement. In this regard, in order to prevent the error of the weight effect of the factors as a point, the values in an agreed domain are calculated and analysis.

Since the return is expected to be in accordance with Equation (12), it is necessary to examine the distribution of returns. On the other hand, the efficiency of projects in the investment portfolio may be positive, negative or non-correlation, which in three cases of positive correlation (+1), completely Negative (-1) and zero and based on the famous Markowitz model in this approach. It is examined as a relation (13).

$$\delta^2 X_{p}^{\sim} = \sum_{i=1}^{n} W_i^2 \left(\sum_{j=1}^{m} \sum_{i=1}^{n} \sum_{i\hat{}=1}^{n} W_{INF} \; W_{R_{ij}} D_{ij}^{\sim} P_{ij}^{\sim} S_{ij}^{\sim} + \sum_{j=1}^{m} \sum_{i=1}^{n} \sum_{i\hat{}=1}^{n} W_{EXF} \; W_{R_{ij}} D_{ij}^{\sim} P_{ij}^{\sim} S_{ij}^{\sim}\right) \quad (13)$$

$$+ 2\left(W_i W_{i\hat{}} \left(\sum_{j=1}^{m} \sum_{i=1}^{n} \sum_{i\hat{}=1}^{n} W_{INF} \; W_{R_{ij}} D_{ij}^{\sim} P_{ij}^{\sim} S_{ij}^{\sim} + \sum_{j=1}^{m} \sum_{i=1}^{n} \sum_{i\hat{}=1}^{n} W_{EXF} \; W_{R_{ij}} D_{ij}^{\sim} P_{ij}^{\sim} S_{ij}^{\sim}\right) \rho_{i,i\hat{}}\right)$$

In the following, the relation (13) is derived from the square and the scattering rate is obtained. The table of research symbols and variables is shown in Table (2).

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Table (2). Symbol and variables of research

Definition	Symbol	Definition	Symbol
The weight and importance of risk j factors on project i	$R_{ij}^{\sim}$	Portfolio returns	$X_p^{\sim}$
The impact of risk j factors on project i	$W_{R_{ij}}$	i Project efficiency	$\mathbf{X_i}$
The overall weight of internal risk factors on portfolio returns	W_{INF}	i project weight	$\mathbf{W_i}$
The overall weight of external risk factors on portfolio returns	W_{EXF}	investment risk	$\mathbf{f(R^{\sim})}$
Number of projects	n	Detection-control of risk j factors on project i	$D_{ij}^{\sim}$
The number of risks in each internal and external sector	m	Probability of risk factors on project i	$P_{ij}^{\sim}$
The correlation coefficient between project i and $\hat{\imath}$	$\rho_{i,i^{\wedge}}$	The intensity of the impact of risk j factors on project i	$S_{ij}^{\sim}$

After the effect of the potential factors, we collect the internal and external risk with the highest calculated distribution and reduce the return of the portfolio in risk-free conditions. If the value obtained is higher than the expected return rate of the investor, The layout will be executable.
To convert verbal comments, the fuzzy spectrum of Table (3) is used:

Table 3. Research fuzzy spectrum

Verbal word	Corresponding fuzzy scale	Conversely, values
Equal preference	(1,1,1)	(1,1,1)
Low preference	(1,3,5)	$(\frac{1}{5},\frac{1}{3},1)$
High preference	(3,5,7)	$(\frac{1}{7},\frac{1}{5},\frac{1}{3})$
Too much preference	(5,7,9)	$(\frac{1}{9},\frac{1}{7},\frac{1}{5})$
Absolute preference	(7,9,9)	$(\frac{1}{9},\frac{1}{9},\frac{1}{7})$
Amounts between	$(\tilde{2},\ldots,\tilde{8})$	

Identify risk factors

In order to identify risk factors based on library studies and expert team opinions, first all factors are listed and after discussion and exchange of views, based on the group agreement reached, the most important factors are selected and divided into internal and external parts.

Risk factor failure analysis

To obtain a failure analysis, three segments of probability, control and intensity are evaluated.
Probability: Determining the probability of occurrence of each of the risk factors in investment projects.
Control-Diagnosis: What factors need to be implemented before risk factors occur that make their negative impact less and more controllable.
Intensity: Understanding the intensity of the impact of factors on selected projects.
According to the above definitions, a questionnaire is prepared and provided to the team of

experts to express their opinions in accordance with Table (4) and to determine the scores of each factor.

Table 4: Definition of probability, intensity and Control-Diagnosis in oil projects

Score	Possibility	Intensity	Control-Diagnosis
(0.2،0.1،0.1)	Unlikely to happen	Almost low	Almost certain
(0.3،0.2،0.1)	It happens very, very rarely	Very, very little	Very lucky
(0.4،0.3،0.2)	It happens very rarely	very little	Good luck
(0.5،0.4،0.3)	It rarely happens	low	Chances are very balanced
(0.6،0.5،0.4)	Occasionally occurs	Less than average	Balanced chance
(0.7،0.6،0.5)	It usually happens	More than average	Low luck
(0.8،0.7،0.6)	It happens a lot	Much	Very little chance
(0.9،0.8،0.7)	It happens very often	very much	Unlikely
(1،0.9،0.8)	It happens very, very often	very very much	Very unlikely
(1،1،0.9)	The event occurs	Almost infinite	No luck

In the following, the relationships between internal and external risks are plotted in two separate networks. The connection of the components in the networks shows the effect of the elements on each other, which is obtained through group agreement.
In this study:
Internal risks include: insufficient of a comprehensive information system, managerial change, resistance to change, Weakness in documentation, Shareholders' decisions, high cost (old technology), Prolonged supply cycle of materials and parts.
And external risks include: Instability of economic conditions (change in macro-government policies),changes in rules and regulations (environmental laws), sanctions, Currency price fluctuations, oil price fluctuations, Inflation and inflationary recession, Interest rate changes (high bank facility rates), high cost of energy supply, insufficient of desire for foreign investment, Product price fluctuations, insufficient of communication with major manufacturers.
The final result of the failure analysis of group risk factors is presented in two sections of internal risk and external risk in Tables 5 and 6.

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Table 5: Results of Internal Risk Failure Analysis

No.	Risk factors	Intensity			Control-Diagnosis			Possibility			RPN		
1	insufficient of comprehensive information system	0.9	1	1	0.8	0.9	1	0.7	0.8	0.9	0.504	0.72	0.9
2	Managerial changes	0.6	0.7	0.8	0.5	0.6	0.7	0.3	0.4	0.5	0.09	0.168	0.28
3	Resistance to change	0.7	0.8	0.9	0.3	0.4	0.5	0.4	0.5	0.6	0.084	0.16	0.27
4	Weakness in documentation	0.4	0.5	0.6	0.4	0.5	0.6	0.4	0.5	0.6	0.064	0.125	0.216
5	Shareholders' decisions	0.4	0.5	0.6	0.3	0.4	0.5	0.3	0.4	0.5	0.036	0.08	0.15
6	High cost (old technology)	0.7	0.8	0.9	0.4	0.5	0.6	0.3	0.4	0.5	0.084	0.16	0.27
7	Prolonged supply cycle of materials and parts	0.6	0.7	0.8	0.6	0.7	0.8	0.7	0.8	0.9	0.252	0.392	0.576

Table 6: Results of External Risk Failure Analysis

No.	Risk factors	Intensity			Detection control			Possibility			RPN		
1	Instability of economic conditions (change in macro-government policies)	0.8	0.9	1	0.8	0.9	1	0.7	0.8	0.9	0.448	0.648	0.9
2	Changes in rules and regulations (environmental laws)	0.5	0.6	0.7	0.3	0.4	0.5	0.7	0.8	0.9	0.105	0.192	0.315
3	Sanctions	0.8	0.9	1	0.8	0.9	1	0.8	0.9	1	0.512	0.729	1
4	Currency price fluctuations	0.6	0.7	0.8	0.5	0.6	0.7	0.8	0.9	1	0.24	0.378	0.56
5	Oil price fluctuations	0.4	0.5	0.6	0.3	0.4	0.5	0.8	0.9	1	0.096	0.18	0.3
6	Inflation and inflationary recession	0.6	0.7	0.8	0.6	0.7	0.8	0.7	0.8	0.9	0.252	0.392	0.576
7	Interest rate changes (high bank facility rates)	0.6	0.7	0.8	0.5	0.6	0.7	0.3	0.4	0.5	0.09	0.168	0.28
8	High cost of energy supply	0.6	0.7	0.8	0.5	0.6	0.7	0.4	0.5	0.6	0.12	0.21	0.336
9	insufficient of desire for foreign investment	0.8	0.9	1	0.5	0.6	0.7	0.8	0.9	1	0.32	0.486	0.7
10	Product price fluctuations	0.5	0.6	0.7	0.3	0.4	0.5	0.3	0.4	0.5	0.045	0.096	0.175
11	insufficient of communication with major manufacturers	0.7	0.8	0.9	0.6	0.7	0.8	0.7	0.8	0.9	0.294	0.448	0.648

Fuzzy network analysis

After determining the risk factors, we shown them on a network, which indicates the effect of the elements on each other. Figures 1 and 2, respectively, show the internal and external risks of Iran's petrochemical industry.

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Figure 1. Network communication is an internal risk section

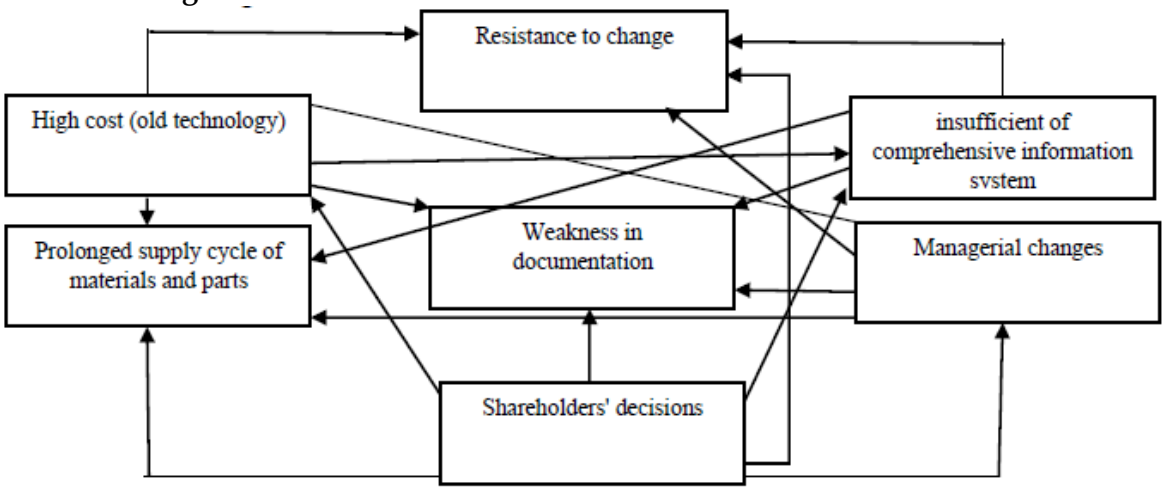
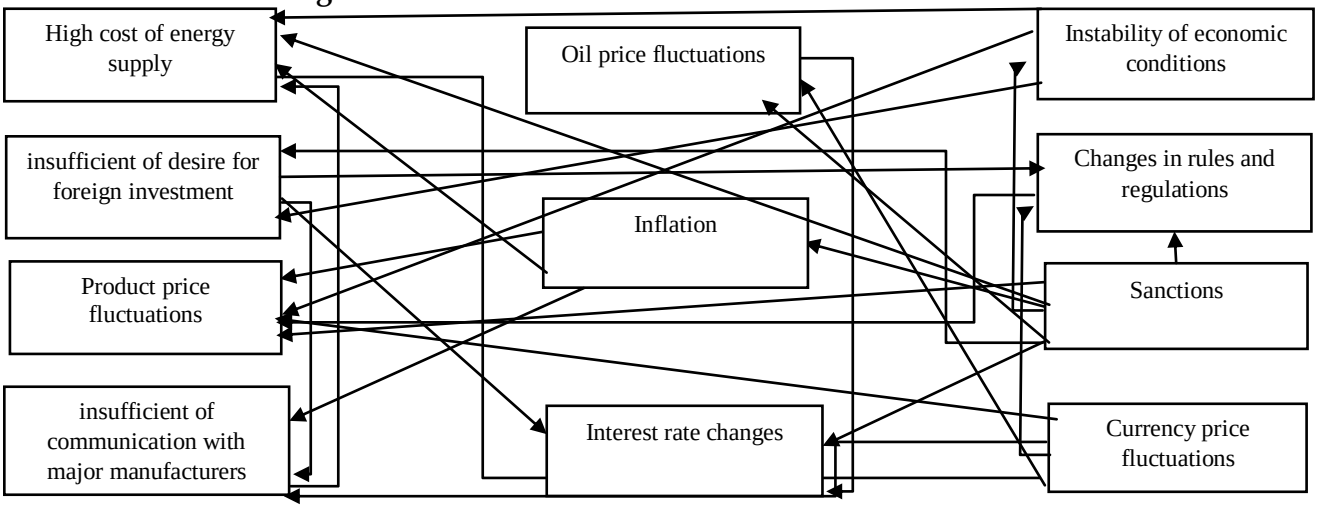


Figure 2. Network communication is an external risk section



After determining the network relationship between internal and external risk, the effective weights of potential risk factors on the final return in both internal and external sectors are calculated through the fuzzy group pair wise comparison matrix [32,33], and the results obtained in Tables 7 and 8 are visible.

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Table 7. Final weights affecting the return on internal risk

No.	Risk	The final weight			Fuzzy normal			Primary de-fuzzy	Normal de-fuzzy
1	insufficient of comprehensive information system	1.07	1.18	1.3	0.11	0.13	0.16	0.13399069	0.101
2	Managerial changes	1.04	1.11	1.2	0.11	0.12	0.15	0.12616732	0.075
3	Resistance to change	0.44	0.47	0.5	0.05	0.05	0.06	0.05328338	0.064
4	Weakness in documentation	0.45	0.47	0.51	0.05	0.05	0.06	0.05369755	0.076
5	Shareholders' decisions	2.57	2.91	3.18	0.26	0.33	0.39	0.32675115	0.334
6	High cost (old technology)	2.04	2.28	2.56	0.21	0.26	0.32	0.25969415	0.265
7	Prolonged supply cycle of materials and parts	0.48	0.52	0.55	0.05	0.06	0.07	0.05873371	0.084
	Summation of column	8.09	8.94	9.8				1.01231796	1.000

Table 8. Final weights affecting the return on external risk

No.	Risk	The final weight			Fuzzy normal			Primary de-fuzzy	Normal de-fuzzy
1	Instability of economic conditions (change in macro-government policies)	1.51	1.61	1.72	0.083	0.097	0.115	0.098	0.097
2	Changes in rules and regulations (environmental laws)	0.56	0.6	0.66	0.030	0.036	0.044	0.037	0.036
3	Sanctions	5.14	5.93	6.46	0.282	0.356	0.435	0.358	0.353
4	Currency price fluctuations	1.89	2.17	2.43	0.104	0.130	0.164	0.132	0.131
5	Oil price fluctuations	0.65	0.7	0.75	0.036	0.042	0.050	0.043	0.042
6	Inflation and inflationary recession	1.71	1.89	2.04	0.094	0.113	0.137	0.115	0.113
7	Interest rate changes (high bank facility rates)	0.4	0.43	0.47	0.022	0.026	0.032	0.027	0.026
8	High cost of energy supply	0.32	0.33	0.36	0.017	0.020	0.024	0.020	0.020
9	insufficient of desire for foreign investment	1.67	1.87	2.06	0.091	0.112	0.139	0.114	0.112
10	Product price fluctuations	0.29	0.32	0.36	0.016	0.019	0.024	0.020	0.019
11	insufficient of communication with major manufacturers	0.72	0.82	0.95	0.039	0.049	0.064	0.051	0.050
	Summation of column	14.9	16.7	18.3				1.014	1.000

The fuzzy values of the final weight of the internal and external factors of Tables 7 and 8 are first fuzzy normal and then the initial de-fuzzy, and considering that the total weight of all factors must be equal to 1, the final values are normalized. In this way, the weight of each

internal and external risk factor is obtained.

Research findings

By identifying the internal and external risk factors as well as the weight of each factor according to Tables 7 and 8, the impact of the risk of these factors on the proposed investment portfolio of one of Iran's petrochemicals based on analysis performed by COMFARIII software has a capital Rate of Return(ROR) according to Table (9) Also, according to the weight of each project in terms of the amount of investment, based on the amount of economic added value created, prioritization and the first 3 projects were selected. The order of the projects is given in the table below. In fact, the first project, because it had more added value for the industry, has a priority of 1. The 'weight' column in Table 9 shows the project's investment from the entire portfolio.

Table 9. Weight and rate of return on investment portfolio projects of the organization

No.	Rate of Return(ROR)	Weight
Project 1	28.6	0.45
Project 2	29.4	0.32
Project 3	28.2	0.23

According to Table 9, if the company does not take into account the internal and external risk factors affecting the return on projects, the return on investment portfolio will be equal to 28.764%. However, the results obtained from the proposed research model (Relationships 12 and 13) with regard to internal and external risk factors, the relationships between these factors and also the weight of risk factors that are considered based on group agreement for internal factors in the range of 0.2-0.4.The return on investment portfolio proposed in accordance with Table 10 has been reduced to the range of 24.470-24.728%. In addition, due to the fact that the efficiency of the projects may be correlated with each other, according to the calculations made, this value has a standard deviation in the range of 0.7972-0.8199%.Therefore, the results show that the efficiency of this portfolio will be 23.650% under the influence of risk factors in the worst case. This means that 5.1139% less than risk-free conditions that will reduce the attractiveness of the investment, and depending on the expected rate of return on investment of each company, the portfolio may be rejected or accepted. Considering that the expected rate of return of this petrochemical company is 22.5%, the proposed portfolio is approved and can be implemented.

If the return is less than the expected rate of return, the project that has the highest rate of return on capital is removed from the portfolio and replaced by another project, and these steps will continue until the optimal portfolio is selected.

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Table 10. Expected return rate and standard deviation

Weight of external factors	Weight of internal factors	Standard deviation (complete negative correlation)	Standard deviation (zero correlation)	Standard deviation (complete positive correlation)	Returns
0.80	0.20	0.8087	0.8143	0.8199	24.728
0.79	0.21	0.8081	0.8138	0.8194	24.715
0.78	0.22	0.8075	0.8132	0.8189	24.702
0.77	0.23	0.8069	0.8127	0.8184	24.690
0.76	0.24	0.8064	0.8122	0.8179	24.677
0.75	0.25	0.8058	0.8116	0.8174	24.664
0.74	0.26	0.8052	0.8111	0.8169	24.651
0.73	0.27	0.8046	0.8106	0.8165	24.638
0.72	0.28	0.8041	0.8100	0.8160	24.625
0.71	0.29	0.8035	0.8095	0.8155	24.612
0.70	0.30	0.8029	0.8090	0.8150	24.599
0.69	0.31	0.8024	0.8085	0.8145	24.586
0.68	0.32	0.8018	0.8079	0.8140	24.573
0.67	0.33	0.8012	0.8074	0.8135	24.560
0.66	0.34	0.8006	0.8069	0.8130	24.547
0.65	0.35	0.8001	0.8063	0.8126	24.534
0.64	0.36	0.7995	0.8058	0.8121	24.521
0.63	0.37	0.7989	0.8053	0.8116	24.509
0.62	0.38	0.7984	0.8048	0.8111	24.496
0.61	0.39	0.7978	0.8042	0.8106	24.483
0.60	0.40	0.7972	0.8037	0.8101	24.470

Investigating the relationship between standard project portfolio deviation in three modes of positive, negative correlation and insufficient of correlation and return on investment portfolio shows the direct relationship between risk and return. In fact, as the risk increases, so will the return, and vice versa.

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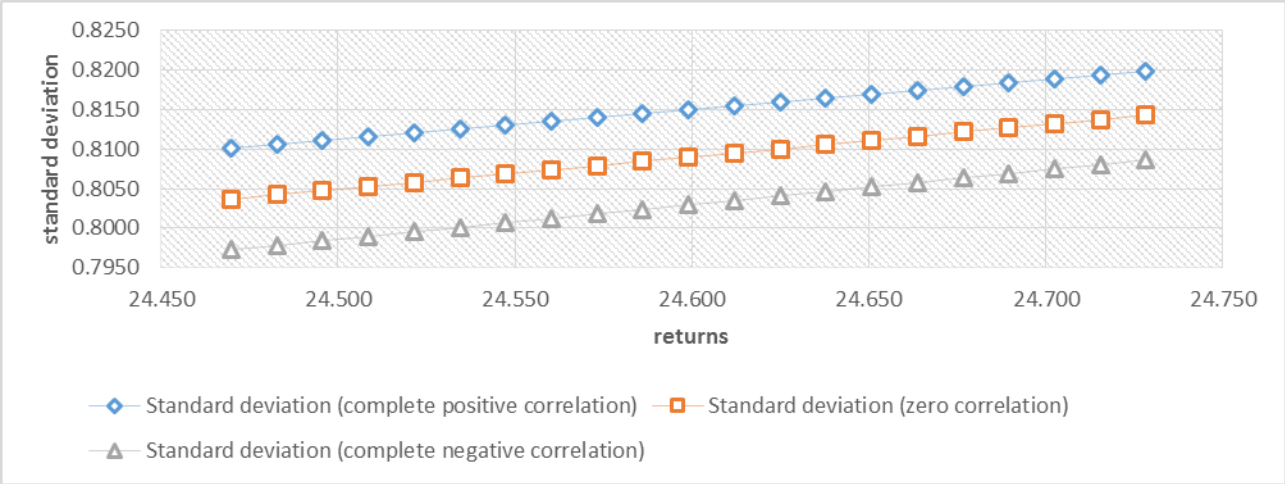

Figure 3. Return / risk in fuzzy network

IV. DISCUSSION

Risk is an event that results in negative results. However, from a scientific point of view, risk covers all events that have a chance of having negative or positive results, common or separate. Considering the explanations provided, we find that recognizing more and more risk in any industry will have a significant impact on the peace of mind of the owners of that industry, and for this recognition, there is no other way but to connect more and more experts in that industry. The rate of return on investment is one of the key indicators in the selection of investment projects. If only this factor is considered in the economic analysis of the project and the impact of project risks is not considered, The analysis performed is not valid. Failure to pay attention to the risks involved in carrying out a project or a portfolio of projects will result in wasting the organization's resource. Organizations and companies usually set an expected rate of return based on their chosen models and methods. This is the expected building rate of return for project selection. If the return on investment of a project is higher than this amount (in an expected return period), the project is selected and implemented. If the impact of existing risks on this project or projects is ignored, in practice the existing risks of return on investment may be lower than the rate of return expected by the investor and the project becomes virtually uneconomic. In this study, using the proposed model, the impact of internal and external risks on the return on investment portfolio in Iran's petrochemical industry was evaluated. For this purpose, first, through library studies and group agreement of the team of experts, risk factors were identified and then, using the method fuzzy ANP failure analysis, the risks of Iran's petrochemical industry were weighed. 18 risks were identified, 7 factors were related to internal risk and others 11 factor were related to external risk.

Based on the weights obtained, according to Tables (7 and 8) in the section of internal risk factors, respectively risk of shareholders' decisions (33.4%), high cost risk (26.5%) and risk of insufficient of information system (10.1%), They have the highest percentage of impact (risk).

Also in the section of external risk factors, respectively: the risk of sanctions (35.3%), the risk of currency price fluctuations (13.1%), the risk of inflation and stagflation conditions (11.3%), and

the risk of reluctance of foreign investors (11.2%), Respectively, have the highest percentage of impact (risk). The results obtained in this section are the main focus of investors to prioritize risk management.

After separating the internal and external risk factors, the decision tree was determined to determine the relative effect of each risk on the return on investment portfolio and also the relationship between risk factors based on the group agreement of the expert team. Findings show that if the impact of internal and external risk factors is not calculated, based on the information in Table(9), the return of the selected portfolio will be (28.764%), which compared to the expected rate of return of the company (22.5%), this portfolio It is evaluated for proper investment. The impact of internal and external risk factors in accordance with the approach of this study shows that existing risks reduce project returns in the worst case by (5.1139%) and from (28.764%) to (23.650%).

Of course, this amount of (23.650%) is still higher than the expected rate of return of (22.5%) of the company, The rate of return of the portfolio, taking into account internal and external risk factors, is more than (22.5%).

The results of this study are consistent with the results of [3, 30, 34]. In the field of identifying risks of large projects such as oil projects, sanctions risks and exchange rate fluctuations and prices in [3] and risks of transportation, maintenance and repairs and capacity in Pakdin production research [30] And [34].

It is suggested that the model presented in this study be used in other organizations and companies in order to manage the risk of industrial projects.

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